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A Conceptual Framework for Regulatory Practice in **Mobile Telecommunications Systems**

Jolien Ubacht



A Conceptual Framework for Regulatory Practice in Mobile Telecommunications Systems

Dissertation

for the purpose of obtaining the degree of doctor
at Delft University of Technology
by the authority of the Rector Magnificus Prof.dr.ir. T.H.J.J. van der Hagen
chair of the Board for Doctorates
to be defended publicly on

Friday 27 November 2020 at 12.30 o'clock

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List of Abbreviations

1G	First generation mobile network
2G	Second generation mobile network
3G	Third generation mobile network
4G	Fourth generation mobile network
5G	Fifth generation mobile network
ACT	Advisory Committee on Telecommunications
ANFR	Agence Nationale des Fréquences
ART	Autorité de Régulation des Télécommunications
ARCEP	Autorité de Régulation des Communications Electroniques et des Postes
ACM	Autoriteit Consument en Market (the Netherlands Authority for Consumers and Markets)
BABT	British Approvals Board for Telecommunications
BEREC	Body of European Regulators for Electronic Communications
BT	British Telecom
BTG	Nederlandse Vereniging van Bedrijfstelecommunicatie Grootgebruikers
BSC	Broadcasting Standards Commission
BSI	British Standards Institution
CA	Consumer Association
CC	Competition Commission
CCR	Commission Consultative des Radiocommunications
CCRST	Commission Consultative des Réseaux et Services de communications électroniques
CEN	Comité Européen de Normalisation/European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CDA	Critical Discourse Analysis
CGT	Classic Grounded Theory
CGGT	Classic Glaserian Grounded Theory
CMA	Communications Managers Association
COIN	COmmon INfrastructure
CPE	Customer Premises Equipment
CPS	Carrier Pre Selection
CST	Conseil Supérieure de la Télématique
CSTS	Complex Socio-Technical System(s)
CTA	Comité de la Télématique Anonyme
DCMS	Department for Culture, Media and Sport
DGFT	Director General of the Office of Fair Trading
DIGITIP	Direction Générale de l'Industrie, des Technologies de l'Information et des Postes
DGTP	Direction Générale des Postes et Télécommunications
DGT	Director General of Telecommunications, Head of OFTEL
DMSU	Digital Main Switching Unit

DTI	Department of Trade and Industry
EDGE	Enhanced Data for GSM Evolution
EC	European Commission
ERG	European Regulators Group (for electronic communications networks and services)
ETSI	European Telecommunications Standards Institute
EU	European Union
FCC	Federal Communications Commission (USA)
FCS	Federation of Communication Services
FIST	Forum voor Interconnectie en Speciale Toegang/Forum for Interconnection and Special Access
FR	France
FGT	Formal Grounded Theory
GSM	Groupe Spéciale Mobile/Global System for Mobile Telecommunications
GPRS	General Packet Radio Service
HDTF	Hoofddirectie Dienst Telecommunicatie en Post (Dutch General Directorate on Telecommunication and Postal Services)
ICT4D	Information and Communication Technology for Development
IEC	International Electrotechnical Commission
IPF	Interconnect Policy Forum
IRG	Independent Regulators Group
ISO	International Organization for Standardization
ITC	Independent Television Commission
ITU	International Telecommunication Union
LTE	Long Term Evolution
MI	Market Influence
MISP	Mobile Independent Service Providers
MMC	Monopolies and Mergers Commission
MNO	Mobile Network Operator
MVNO	Mobile Virtual Network Operator
MRTS	Mobile Radio Telecommunications Services
MTT	Mobile Termination Tariff(s)
NCA	National Competition Authority
NMA	Nederlandse Mededingings Autoriteit
NCC	National Consumer Council
NCCPR	National Consumer Call Preference Registry
NFG	Network Futures Group
NGO	Non-Governmental Organisation
NICC	Network Interoperability Consultative Committee
NL	the Netherlands
NMT	Nordic Mobile Telephone
NR	5G New Radio
NRA	National Regulatory Authority
NRF	New Regulatory Framework
NTP	Network Terminating Point
OCCN	Operator Charge Change Notice
OFT	Office of Fair Trading
OFTEL	Office of Telecommunications
OFCOM	Office of Communications
OLO	Other Licensed Operators Group
ONP	Open Network Provision
OPTA	Onafhankelijke Post en Telecommunicatie Autoriteit

OTELO	Office of the Telecommunications Ombudsman
PABX	Private Automatic Branch eXchange
PAC	Public Accounts Committee
PD	Primary Doc
PTO	Public Telecommunication Operator
PTT	Post, Telegraphy and Telephony
QDA	Qualitative Data Analysis
RA	Radiocommunications Agency
RAU	Radio Authority
RDR	Rijksdienst voor het Radioverkeer (Dutch Radiocommunications Agency)
Roi	Return on Investment
RPI	Retail Price Index
SGT	Substantive Grounded Theory
SIM	Subscriber Identity Module
SMP	Significant Market Power
SMS	Short Message Services
SMSC	Short Message Service Centre
SP	Service Provider
SSUR	Sous-Système Utilisateur pour le RNIS
sTN	Stichting Telecomgebruikers Nederland (Dutch Telecommunications User Council)
STS	Socio-Technical System(s)
TAC	Telecommunications Advisory Committee
TACS	Total Access Cellular System
TMA	Telecommunications Managers Association
TND	Directie Toezicht Netwerken en Diensten
TTE	Telecommunications Terminal Equipment
UK	United Kingdom
UMTS	Universal Mobile Telecommunications System
WEO	Well Established Operator

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Glossary

Glossary Table 1 Generations of mobile networks and their services in the EU

Generations of mobile networks	Transmission/frequency band	Standard	Services	Operational from:
1st (1G)	Analogue , 450 MHz	No European Standard: NMT, C-NET or TACS	Voice only	1980
2nd (2G)	Digital, 900 MHz and 1800 MHz	GSM, GPRS, EDGE	Voice & data transmission	1990
3rd (3G)	Digital, 1885-2200 MHz	IMT-2000/UMTS	Voice, Internet access, video calls	2000
4th (4G)	Digital, 800-900 MHz and 1800-2600 MHz	LTE (based in Internet Protocol)	Broadband mobile services	2009
5th (5G)	Digital, 700-1400 MHz, 2100 MHz and 3.5 GHz.	5G New Radio (NR)	Real time data exchange, Internet of Things applications	2019

Table 1 and the descriptions of the network generations are based on (Bekkers & Smits, 1995; De Reuver, 2009; Marsden, 2010; Tehrani, Vahid, Triantafyllopoulou, Lee & Moessner, 2016; Van de Kaa & Greeven, 2017; Suryanegara, Mirfananda, Asvial & Hayati, 2018)

1G network

First Generation (1G) mobile network, operating on analogue transmission, from the 1980s onwards. There was no European standard; each country chose their own standard, e.g. Nordic Mobile Telephone (NMT), C-Net, Total Access Cellular System (TACS). Only voice telephony was supported and the network lacked interoperability which did not allow for (international) roaming. Frequency band: 450 MHz.

2G network

Second Generation (2G) cellular network, first generation with digital transmission, from the 1990s onwards. In EU Member States the Global System for Mobile Communications (GSM) standard was chosen, which enabled (international and national) roaming. At the start mainly focused on voice telephony, later evolutions are General Packet Radio Service (GPRS) (indicated as 2.5G and EDGE (Enhanced Data for GSM Evolution) indicated as 2.75G, allowing for data transmission too. Frequency bands: around 900 and 1800 MHz.

3G network

Third Generation (3G) cellular network. Based on the IMT-2000 standard for higher bandwidth, suitable for e.g. internet access and video calls in addition to voice, from 2000 onwards. Evolutions are 3.5 and 3.75. In Europe also known as Universal Mobile Telecommunications System (UMTS). Frequency bands: 1885-2200 MHz.

4G network

Fourth Generation (4G) cellular network. Based on Internet Protocol: Long Term Evolution (LTE) standard, from 2009 onwards. Provides for full broadband mobile services. Frequency bands: 800-900 MHz and 1800-2600 MHz.

5G network

Fifth Generation (5G) cellular network. High bandwidth for real time data exchange and Internet of Things applications, from 2019 onwards. Frequency bands: 700-1400 MHz, 2100 MHz and 3.5 GHz.

Asymmetric regulation

Asymmetric regulation is basically “requirements imposed on incumbent producers [that] differ from those imposed on new entrants” (Sappington and Weisman, 1996, p. 10). In a more general sense asymmetric regulation is the regulator’s choice to impose requirements on specific market parties within a regulated market with the aim to annul (potential) negative consequences from an imbalance in market power.

Carrier (Pre) Selection (CPS)

Carrier (pre)selection refers to the possibility of callers to determine the operator for each separate call by means of dialing a prefix or by setting a preferred operator for all of their calls.

Category

In a GT approach, the properties linked to the empirical data are merged into conceptual (sub) categories in the selective coding phase. Once the conceptual categories emerge, they represent a set of dimensions (Urquhart, 2001).

Competition engineering

Competition engineering refers to regulatory activities to stimulate market competition. It is in contrast with monitoring a market with effective competition which is usually under the jurisdiction of an NCA.

Dimension

In a GT approach, the properties linked to the empirical data are merged into conceptual (sub) categories in the selective coding phase. Subsequently, towards a higher level of coding these categories represent a dimension (Urquhart, 2001). A dimension thus represents a set of interrelated categories.

Dossier

A (regulatory) dossier is a series of documents that pertain to a specific market issue and represent the sequence of regulatory activities to develop a regulatory arrangement.

End user campaign

An end user campaign includes all activities to raise consumer awareness on choice and prices, such as the publication of information leaflets, websites to inform end users, and information packages.

End user survey

An end user survey means that the NRA makes an analysis of end user behavior in using mobile telephony.

Enforcement activities

Enforcement activities represent the interventions that an NRA takes to solve a market issue. Examples are behavioral directions such as a designation of SMP, penalties or a licence adaptation (Ubacht, 2016).

Ex ante regulation

A form of market intervention that is applied before a market issue arises, e.g. obligations for network operators to provide for wholesale access to SPs.

Ex post regulation

A form of regulation that is applied after a market issue occurs, e.g. when anti-competitive behavior takes place, or a market party or end user lodges a complaint with the regulatory authority.

Fine-tuning

In developing a regulatory arrangement, an NRA can formulate details such as to which selection of market parties the arrangement applies or for which specific period of time that the arrangement is applicable.

Indirect access

Indirect access is the term that refers to the technological option in an access network for an end user to choose an alternative operator for routing the call via another network, by dialing an access code before each call. An indirect access provider can control the traffic of a call as soon as it leaves the mobile network and thus becomes more independent of the MNO. Without indirect access, the SP is dependent on the MNO for packaging and tariffing of the total call (Ofitel, 1999c).

Interconnection

In the *Directive 97/33/EC of the European Parliament and of the Council of 30 June 1997 on interconnection in Telecommunications with regard to ensuring universal service and interoperability through application of the principles of Open Network Provision (ONP)* interconnection is defined as:

“the physical and logical linking of telecommunications networks used by the same or a different organization in order to allow the users of one organization to communicate with users of the same or another organization, or to access services provided by another organization. Services may be

provided by the parties involved or other parties who have access to the network” (European Parliament and the Council of the European Union, 1997b).

Interoperability

Interoperability refers to the ability of services to operate over a diversity of infrastructural components owned by several operators. A definition of interoperability is as follows: “Interoperability means the technical features of a group of interconnected systems (‘systems’ includes equipment owned and operated by the customer which is attached to the public telecommunication network) which ensure end-to-end provision of a given service in a consistent and predictable way” (Ofitel, 1997c, art. 1.6).

Market Influence (MI)

The term Market Influence is used to label a market player that is deemed to have significant market power (SMP) in a specific market segment. This term is used in the United Kingdom. MNOs that are deemed to have SMP or MI fall under a separate regime with detailed rules that aim at leveling its dominant market position in order to protect the position of the operators without SMP or MI and (independent) SPs.

Market issue

In this study a market issue is any reason for an NRA to perform activities in order to develop a regulatory arrangement.

Market power

Market power is defined by Intven, Oliver & Sepúlveda as “the power to unilaterally set and maintain prices or other key terms and conditions of sales; that is without reference to the market or to the actions of competitors” (Intven, Oliver & Sepúlveda, 2000a, p. 5.1).

Market review

A market review refers to an in-depth analysis into the structure, conduct and performance of a (relevant) market.

Market survey

A market survey means that the NRA sets up performance criteria and investigates how the market players perform on them (e.g. end user tariffs).

Mobile coverage

Mobile coverage refers to the geographical area in which an end user has access to a mobile network in order to establish a connection by means of mobile end user equipment.

Mobile number portability

Mobile number portability allows end users to switch from one MNO or SP to another, while retaining their mobile number.

Mobile Termination Tariffs (MTTs)

Mobile operators charge other (mobile and fixed) operators for terminating receiving calls on their network. These are the MTTs.

Mobile Telecommunications System

In this study we consider the mobile telecommunications system as the constellation of the institutional, multi-actor and technical subsystems that in interaction provide for the functioning of the delivery of mobile telecommunications services to society. The interactions between the subsystems create uncertainties for the functioning of the system as a whole. As such, the mobile telecommunications system can be regarded as a complex socio-technical system (see section 1.3).

National Regulatory Authority (NRA)

In this study a national regulatory authority is regarded as a public organization with the legal task to perform activities to provide for fair competition and to safeguard public values in a network-based market in which the services are provided by commercial actors, and for which public interests are legally formulated.

New Regulatory Framework

Five years after the official liberalization date for the European telecommunications sector in 1997, a New Regulatory Framework [NRF] was implemented in the EU Member States. The NRF is based on the perception that competition in the telecommunications markets has increased and that sector-specific regulation can move into the direction of regulation based on concepts of market dominance in general competition law. After the transposition of the NRF into national law and jurisdiction, thorough economic market analyses became the base of all regulation by NRAs. This new approach is not part of our empirical data that is limited to the five year period before the implementation of the NRF in 2002.

Network-based market

A network-based market is a market in which the provision of services to the general public is based on a technical infrastructure that requires high upfront investments, with long terms for return on investment (RoI) and stranded assets.

Networking activities

The networking activities are those activities that either another national or international regulatory authority performs within an NRA dossier, or the other way around: the activities that an NRA performs for other regulatory organizations (Ubacht, 2016).

OFTEL Formula

The OFTEL Formula is a formula used for price cap regulation that is based on the retail price index (RPI). This RPI-X formula is defined as “[t]he system of price control where average annual price changes for the price-controlled services are limited to the increase in inflation (as measured by the Retail Price Index) less a specified number (X)” (OfTel, 2000a, Annex F).

Policy making

In this study we reserve the term ‘policy making’ for the national level of governance, which is the realm of national Ministries that are responsible for developing the policy framework consisting of laws and regulations for the telecommunications market.

Personal number/personal numbering service

A personal number is “[A] number, allocated by a [Personal Numbering SP] to a person (or organization), which is not itself linked to a network. A Personal Number is independent of a terminating network operator, and it is that independence which enables end users to control the delivery of incoming calls so that they can be reached anywhere, irrespective of location” (OfTel, 2001d, glossary). For example, In the United Kingdom these PNS were recognizable by the 070 numbering range.

Premium Rate Service

Premium Rate Services are “special services commonly containing information or entertainment accessed by dialing a special telephone number. Customers pay for both the service and the call through their normal telephone bill” (OfTel, 2001d, point 3.7). For example, the 09-numbering range in the United Kingdom is reserved for Premium Rate services.

Privatization

Privatization entails a change in the owner structure of a firm from state into private hands. Moran and Prosser state that “Privatisation,...is not so much a retreat of the State, as a shift in the modes of intervention from ownership to regulation” (Moran and Prosser, 1994b, p. 7).

Procedural activities

The procedural activities are the activities of (mainly but not exclusively) the regulatory authority to support the process of dealing with a market issue (Ubacht, 2016).

Property

In a GT approach, a property is the lowest code that is linked to empirical data in the open coding phase. During the selective coding phase the properties are merged into conceptual (sub) categories. Once the conceptual categories emerge, they represent a set of dimensions (Urquhart, 2001).

Public reports/publication of reports

A public report or publication of reports is the means by which the NRA reports publicly on its decisions or e.g. on its survey on performance criteria on the basis of market surveys or on analyses of end user complaints.

Public value

The term ‘public values’ is used to indicate that there are specific interests that come into a danger zone when economic reasons reign in sectors that are regarded as serving public interests. A common set of public values can be discerned for the telecommunications networks as they offer essential services to users who rely on the network for social and economic reasons. Social reasons are for example access to information and being able to reach emergency services. Economic

reasons are that the telecommunications networks provide not only access to information and communication but also perform as an essential infrastructure for trading and financial transactions.

Regulation

The definition of 'regulation' is by no means straightforward. Prosser discusses that various meanings are attributed to the concept of regulation (Prosser, 1997, p. 4-6). Meanings that are distinctive regarding the level at which the concept is defined, but also dependent on the cultural setting in which the act of regulation is defined.

The level of definition can range from an abstract approach to regulation as "the act of controlling, directing, or governing according to a rule, principle or system" (Prosser, 1997, p. 4) to a very specific level as "the legal rules and other measures which express such command and control arrangements, contrasted with other forms of law such as criminal and contract law" (Prosser, 1997, p. 4). Prosser notes that the choice of a definition also depends on the cultural setting in which regulation is based or in which the person who defines the concept of regulation is working. For example, in countries such as the United Kingdom, in which laws are not extensively used, the latter definition does not match with the regulator's practice.

Prosser offers an alternative to the definition of regulation by looking at the common concepts of the various definitions and formulates the following definition: "public interventions which affect the operation of markets through command and control" (Prosser, 1997, p. 4). In a comment to this definition Prosser adds that command and control should not be considered too strictly, but can also be filled in by means of alternative arrangements such as self-regulation. What we miss in this definition is the level of the intervention, more specifically: the actor that acts by means of the intervention. Therefore, based on Prosser's definition and discussion, we will use the following definition of regulation in this thesis:

Regulation is public intervention by sector-specific regulatory authorities that affects the operation of markets.

This definition means that we focus on interventions by National Regulatory Authorities (NRAs) for the telecommunications market and not on legislative intervention by Ministries or on the activities of Competition Authorities who apply generic competition law to the market. Neither do we look into private regulation by means of mutual agreements such as private contracts.

Regulatory activity

A regulatory activity is an action that an NRA undertakes in order to solve a market issue. In this thesis we specify these as either a procedural, enforcement, networking or strategic activity (see the definitions of these activities in this glossary).

Regulatory arrangement

The regulatory arrangement is the result of the regulatory process to deal with a market issue. It can take a variety of forms, e.g. an enforcement or on the contrary a forbearance of intervention.

Regulatory instrument

The instrument that a regulatory authority uses in order to solve a market issue. In extant literature often also used for policy making instruments of Ministries.

Regulatory reform

The removal of barriers to competition in a sector/market that is previously characterized by a non-competitive structure [based on (Moran and Prosser, 1994, p. 2)].

Regulatory practice

In this study we define regulatory practice as the activities of a sector-specific NRA in the process of regulating the mobile telecommunications system.

Regulatory strategy

In the process of solving a market issue, an NRA has several strategic options. It can choose to formally regulate the issue, but it can also look for alternative forms of regulation such as enforced co-regulation or self-regulation.

Relevant market

The term 'relevant market' is based on competition law and refers to "the smallest group of products and geographic area in which a firm with market power can profitably impose a sustainable price increase" (Intven, Oliver & Sepúlveda, 2000a, p. 5.7).

Roaming (national and international)

OFTEL describes the concept of roaming as follows: "Roaming is the use by a customer of one mobile operator of another mobile operator's network to make or receive a call, usually because the customer is out of reach of his own operator's base stations" (Oftel, 1999a, point 1.2). Roaming can play an important role in the aim to have full coverage within the national boundaries or when a customer travels abroad.

In order to allow their own end users to roam on the networks of other operators, MNOs have to enter into a Roaming Agreement in which the technical and commercial terms are included. If the home and the visited network are in the same country, we speak of national roaming. If the two networks are located in different countries, then it is a case of international roaming. Roaming requires similar standards on the home and visited network. If the standard of the radio interface (between the Mobile Station and the antennas) is not similar on both networks, a roaming end user might have to use a different Mobile Station, unless the Mobile Station can handle both (Bekkers and Smits, 1995, p. 88).

For this study we specifically looked into the case of national roaming, for which we discern three types of agreements:

Type 1: 2G/2G or 2G/3G roaming during network roll out phase. This allows a new market entrant to attain full coverage during network roll out. In those parts where roll out has not yet been reached, its users will have access via a visited network that is exploited by an established network operator. This situation occurs in the case of sequential standards, for example when GSM1800 operators rolled out their networks where GSM900 networks were already available. It also plays a

role in the roll out phase of next generation mobile networks with e.g. 3G users roaming on 2G networks in those areas where the 3G network is not rolled out yet. If the home and visited networks use different standards, then the handset must be able to deal with this. For example GSM900/1800 and 2G/3G national roaming required dual band handsets.

Type 2: 3G/3G roaming during network roll out phase. This type of roaming enables operators to attain faster coverage during network roll out in the case that the existing networks do not support the new services. This situation could occur during the 3G network roll out. Existing MNOs and new market entrants alike can establish a geographical division of the territory amongst them and can start rolling out their networks in different geographical areas. By allowing mutual national roaming to their customers, they can reach a faster spread of 3G services throughout the country (note that 2G networks cannot support 3G multimedia services). Thus, they will not only save on their investments in infrastructure by spreading the efforts in roll out over a longer period of time, but they will also reach an earlier exploration date through wider coverage via national roaming.

Type 3: 2G/2G or 2G/3G roaming in network saturation phase: in later stages of a network lifecycle (the network saturation stage) national roaming agreements prevent inefficient duplication of networks (e.g. in less populated areas) without loss of customer access. Like in the type 2 national roaming, this type also requires a division of specific geographical areas amongst operators. National governments can support this type of national roaming agreements when non-coverage of areas becomes a political and/or economic issue.

From an operator's point of view type 1 and 2 national roaming agreements are not exclusive. For example new entrant 3G network operators can have a national roaming agreement with an existent 2G network operator for basic services and another agreement based on a geographical division with a competing 3G operator for 3G services. However, the use of type 1 and 2 agreements is limited by licence conditions on the required percentages of national territory or population to be covered by proprietary networks at a specific date. As soon as the licence conditions on roll out are met, type 3 agreements can be sustained in those areas where no roll out conditions per operator apply.

RPI-X% (Retail Price Index (RPI))

RPI is a financial regulatory measure and defined as “[t]he system of price control where average annual price changes for the price-controlled services are limited to the increase in inflation (as measured by the Retail Price Index) less a specified number (X)” (Ofcom, 2000a, Annex F).

Self-regulation

Self-regulation refers to initiatives of the market parties themselves to *pro-actively* offer a solution and take their responsibility to develop the solution to the market issue, without a regulatory authority taking part in the initiative.

Significant Market Power (SMP)

The designation of SMP is an intervention to put extra obligations on a telecommunications operator. It is defined as follows: “Article 4(3) of the Directive states that an organization shall be presumed to have SMP when it has a share of more than 25% of a particular telecommunications market in the geographical area in a Member State within which it is authorized to operate. NRAs

may nevertheless determine that an organization with a market share of less than 25% in the relevant market has SMP. They may also determine that an organization with a market share of more than 25% in the relevant market does not have SMP" (OfTel, 1998c).

SIM lock

SIM stands for Subscriber Identity Module and a SIM lock is a technical mechanism that is used by MNOs or SPs to prevent end users to use their mobile phone on a competitive network. The mechanism locked the phone and thus its user to an MNO or SP for a specific period of time after taking a subscription. More specifically, in the case of offering a free mobile phone upon subscription, the MNO or SP will only annul the SIM lock after a Return of Investment is reached.

Strategic activities

The strategic activities represent the options that a regulatory authority has to refrain from a top-down regulatory approach in solving a market issue. Instead, a solution is found by relying on market forces or on communal actions with or by the market parties: the market parties are expected to take their own responsibility to develop a solution to a market issue. The NRA thus chooses not to intervene by means of enforcement (Ubacht, 2016).

Sub category

In a GT approach, the properties linked to the empirical data are merged into conceptual (sub) categories in the selective coding phase. Once the conceptual categories emerge, they represent a set of dimensions (Urquhart, 2001).

Telecommunications Market

The telecommunications market is the physical or virtual area where transactions between suppliers and buyers of telecommunication services and end user equipment take place. The market can be distinguished into a wholesale and a retail market segment.

Well Established Operator (WEO) (UK)

Well Established Operator (WEO) was a term used in the United Kingdom. It refers to an operator with a market power of 25% or more in a relevant market, who has the ability to raise prices above the competitive level for a non-transitory period without losing sales to such a degree as to make this unprofitable. The status of a WEO had to be determined by the DGT after discussion with the operator and a public consultation (OfTel, 1998c).

Preface

Looking back on the research project that has now materialized in this PhD thesis, I realize that I have met so many people along the way who provided for inspiration, intellectual challenges, and support. I am thankful for all the opportunities in life that I get: for being able to gain an academic degree, to have a supportive husband, to raise two children and to combine that with a full time career, for the space to develop myself as an academic researcher, for having inspiring colleagues and for the daily interactions with students full of ambitions in an important stage of their life. I want to thank a lot of persons personally in this preface, on the risk of forgetting somebody who also earns a special mention.....

At the very beginning my interest into the domain of mobile telecommunications was triggered by prof.dr. Jens Arnbak who sadly passed away a couple of years ago. He opened the door to academic challenges in spectrum allocation, mobile licences and governance issues. He was also the first head of the ICT section that I consider as my academic homebase.

Along the way, I became interested in the institutional challenges that are raised in the domain of liberalized infrastructure-based markets, by the work of prof.dr. John Groenewegen and his research group on institutional economics. His sharp observations and open mindedness towards a grounded theory approach supported me to push forward into the direction of regulatory practice in mobile telecommunications systems.

I am grateful to prof.dr.ir. Marijn Janssen for his willingness to be my promotor. He had the confidence that I did the right thing, despite stepping in towards the end of my journey. He gave me the confidence that it could be done, and look what it led to! I enjoy working with you in the ICT section in research, managerial as well as educational activities, Marijn. I learn a lot from your perspectives that turns our collaboration into a truly interdisciplinary experience.

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A huge thank you to the ESS Head of Department Caspar Chorus for the sabbatical that gave me the opportunity to work on the manuscript without distractions. I am very happy Bonnie van Huik replaced me as department manager during my sabbatical, you did very well!

I am so happy with the never failing support from the ESS department secretaries, Laura, Jo-Ann, Diones, Priscilla, Ellen and Betty. You always have an answer to my questions and I love to hear your laughter down the hall. Your accuracy and friendliness are important pillars of our department and your social skills are the concrete for our academic community.

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Summary

Complex socio-technical systems

Many of today's essential services depend on infrastructure-based systems such as the energy, the telecommunications and the public transport system. These systems consist of interdependent subsystems that coevolve over time. The governance of these systems is performed by many different types of public and private actors. In addition these systems are subject to technological innovation. End users of their services rely on the quality and provision of these infrastructure-based systems. In order to mitigate unwanted societal outcomes such as outages, high consumer prices and underperformance of service quality, these systems are regulated. These infrastructure-based systems are defined as complex socio-technical systems (CSTS); a concept that denotes that the system's functioning is dependent on the interactions between the technical, the social and the institutional components of the system. Due to their large scale size and the required upfront investments in infrastructural elements, these CSTS are not easily changed. However, changes in the institutional context, technological innovation or changes in the actor system do occur. The consequences of these changes are hard to predict and lead to uncertainties for authorities that regulate these systems. In this research we study a major change in the mobile telecommunications system to explain the way in which regulators address the (unwanted) consequences and uncertainties due to the ensuing changes within the system.

Mobile telecommunications market

This major change is the liberalization of the telecommunications market in the European Union (EU) which led to a new institutional context from 1997 onwards. The telecommunications market is the physical or virtual area where transactions between suppliers and buyers of telecommunication services and end user equipment take place. The market can be distinguished into a wholesale and a retail market segment. The liberalization transformed the telecommunications market from a monopoly to a competitive market. New telecommunications providers entered the market, new networks were rolled out and new services were offered to end users.

Regulation of the mobile telecommunications market is complicated because of the interaction between multiple market players with diverging interests, the technological and economic market characteristics and the safeguarding of public values. We therefore consider the mobile telecommunications market as part of a complex socio-technical system (CSTS) in which not only transactions between buyers and sellers take place, but which is also expected to contribute to social values for which laws and regulations are formulated and which involves authorities that perform activities to provide for fair competition and to safeguard public values.

This system operates on a technical infrastructure that consists of many interdependent parts that interact and coevolve. The societal aspect is rooted in the essential services provided by the system to society. And multiple actors are involved in the operation of the mobile telecommunications system. Entry to the mobile telecommunications market is regulated by means of licences that allow for the use of scarce frequencies. For the provision of mobile services, network operators need to make high upfront investments in infrastructural components, such as antennas for the transmission of mobile signals and the construction of ducts for transmission cables. Enabled by the market liberalization and technological innovations, service providers entered the mobile market to provide services to end users in competition with the network operators. As a consequence the tensions between the market players in the mobile telecommunications system increased as they need to compete for market shares to attain a return on their investments and to satisfy their stakeholder interests.

These business-oriented objectives can be at odds with the public values that governments formulate for the telecommunications system. Examples of such public values are conditions for security of supply, universal access and fair customer tariffs. The commercial interests versus the public values is another source of tensions in the system. In addition, changes in a subsystem (e.g. a technological innovation) can lead to uncertainties in the overall functioning of the system.

This diversity of tensions can lead to market issues which are addressed by national sector-specific regulatory authorities (NRAs). We define market issues as any reason for an NRA to perform activities in order to develop a regulatory arrangement. Regulatory practice by NRAs in the mobile telecommunications system is about dealing with market issues that enter their regulatory agenda and with uncertainties in the system. Their main regulatory objectives are to contribute to fair competition in the market and to safeguard public values.

Systematic literature review

We conducted a systematic literature review into academic literature on the regulation of the mobile telecommunications market (1989-2019). The literature review shows that academic research on the regulatory process that takes place after the licence allocations to the network operators is fragmented. The academic literature is characterized by studies into single regulatory interventions (such as obligations for mobile number portability; or a price cap regime on mobile termination tariffs) or into the effect(s) of regulatory instruments. As such the way in which these interventions are developed by regulatory authorities in a context of uncertainties and complexities is lacking. A study into regulatory practice of NRAs who deal with many market issues simultaneously in a changing context needs to go beyond specific, single regulatory arrangements.

The literature review also shows that the majority of the research is aimed at analysis and evaluation but does not aim for conceptualization. In addition, in the majority of the studies an economic or legal perspective to analyze regulatory practice is adopted. These studies do not show the interactions between the technical, multi-actor and institutional subsystems that need to be aligned within a CSTS.

Research objective

To fill these knowledge gaps, our research objective is to explain how the NRAs deal with the tensions and uncertainties in the mobile telecommunications system to support or further market

competition and to safeguard public values at the same time. In this study we define regulatory practice as the activities of a sector-specific NRA in the process of regulating the mobile telecommunications system. Our research deliverable is a conceptual framework of regulatory practice that explains how regulatory authorities deal with the tensions and uncertainties in the mobile telecommunications system.

Conceptualization of regulatory practice can support regulatory authorities and market players in understanding the interactions between the institutional context, the multi-actor subsystem and the technical system in the mobile telecommunications market. Next generations of mobile standards will potentially lead to new networks or system components, new market entry and new services. Conceptualization can explain how regulatory authorities deal with the tensions and uncertainties in the system after a change in the CSTS of the mobile telecommunications market takes place.

Research philosophy

For developing our research strategy we present our research philosophy based on a discussion of the four main inquiry paradigms in social sciences: positivism, post positivism, critical theory and constructivism.

For our ontological belief we adhere to constructivism with its ontology of relativism as we believe that the interactions between multiple actors create the social context in which they live. We believe that there is no such thing as one reality, the actors all have their own perception of reality and create their common world based on the meaning they give to it.

Our epistemological belief is in interpretivism as we consider ourselves as an interpreter of processes between human actors, institutions and the technical system within CSTS. We do not believe in discovering an objective truth, but are foremost interested in the interactions that take place and how these are formed in the context of a CSTS.

Our axiological belief is rooted in a constructivist view because we value the interpretation of the processes in society and want to understand the interactions between actors involved when a change occurs in their context. We therefore want to interpret the processes in which meaning is developed.

Our methodological belief is in interpretivism, because we value the interpretation of processes in society (our axiological belief) and to understand the dynamic interactions within a CSTS. We believe that these processes and interactions in a particular context are best studied by means of qualitative research methods. We value an open research approach to do justice to the interactions in the system without preselecting an analytical framework that restricts the researcher to focus on specific factors.

Research approach

Based on our research philosophy we chose for an open, inductive research approach for this study. The Grounded Theory (GT) approach offers a systematic research strategy to study a situation by means of empirical data to develop a substantive concept that explains the main concerns of the actors in the domain of research. Over the years several variants of the GT approach have been presented, we reviewed and compared the Classic Glaserian, the Straussian and the Constructivist GT approaches. We chose to follow the Classic Glaserian GT (CGT) approach. For explanatory theory

development, the classic GT variant is suitable as it allows for emergence of concepts from the empirical data without the more rigid procedures of coding paradigms that are commonly used in the Strauss & Corbin variant. CGT is also more tolerant in its coding process by not requiring sensitizing concepts, which allows us to conceptualise actual regulatory practice without the restrictions of prior formulated concepts. The Constructivist approach is more oriented towards the researcher who interacts in the research community, which is less suitable for our objective to look into the activities of regulatory authorities in an era of major institutional change in the past.

Research strategy

The CGT approach consists of the phases of open, selective and theoretical coding, conceptual comparison and evaluation. We retrieved the empirical data for the coding phases from the formal documents on the regulatory practice of the NRAs for the mobile telecommunications market in the United Kingdom, the Netherlands and France between 1997 and 2002. We reconstructed 61 regulatory dossiers in their respective national mobile telecommunications markets.

Open and selective coding phase

For the open and selective coding phases we formulated the following two exploratory sub questions:

1. How to conceptualize the market issues that a national regulatory authority in the mobile telecommunications market deals with?

2. How to conceptualize the activities that a national regulatory authority in the mobile telecommunications market performs to deal with market issues?

These two sub questions were answered by coding the empirical data from the 61 regulatory dossiers. We reconstructed the dossiers by means of the formal publications on the market issues that required regulatory intervention. For the coding process we used software for qualitative data analysis: Atlas.ti. We performed line by line coding for the market issues as well as the activities that the regulators performed during the development of a regulatory arrangement to address the market issue. By means of open and selective coding we derived the dimensions *Market Issues* and *Regulatory Activities* as answer to the first two sub questions. In the theoretical coding phase these two dimensions were combined to create the core category of our conceptual framework.

Theoretical coding phase

For the theoretical coding phase we formulated the sub question:

3. Which are the dimensions and their relationships for the conceptual framework for regulatory practice in the mobile telecommunications system?

In the theoretical coding phase we established the relationship between the dimensions *Market Issues* and *Regulatory Activities* to formulate the core category of regulatory practice: the *Process of Matching and Mixing*. This core category explains the main concern of the regulatory authorities and conceptualizes the pattern(s) by which they deal with the issues in the complex market of mobile telecommunications. Regulatory practice is foremost a procedural approach in which a mix of regulatory activities are performed to match with the type of market issue, along the way. Market

issues are either addressed with the social rationale to safeguard public or consumer interests. Or they are addressed with the economic rationale to create competitive market conditions and to support service innovation. In both rationales ex post and ex ante regulation is conducted. By constant comparison between the market issues we discerned patterns that show that the rationale and ex post/ex ante character influence the intensity and duration of the regulatory process.

In addition to the core category, the theoretical coding phase yielded three additional dimensions for the conceptual framework that influence regulatory practice in the mobile telecommunications market:

Dimension uncertainties: the uncertainties are rooted in unpredictability of (especially new) services demand, dynamics in technological innovations and doubts on the authority of the regulator to deal with market issues. But also new policy rules and regulations, and lacking insight into the effects of regulatory arrangements on the competitiveness of the market are a source of uncertainty;

Dimension fine-tuning of the regulatory arrangement: towards the end of the development of a regulatory arrangement a regulator settles the details of the arrangement. These details state to which relevant actor(s) the arrangement will be applicable, whether regular evaluations will be performed and how long the arrangement will be applied. Also the lead time of implementation of the arrangement is assessed: occasionally the implementation takes too long to be effective due to expected changing market developments;

Dimension phases: in the empirical data on regulatory practice we discerned five phases in regulatory practice that are characterized by their nature of initiation, analysis, exploration, formulation and closure. After closure of the case the phases can be repeated.

We used the core category and the additional dimensions to develop the initial version of our conceptual framework of regulatory practice. In the framework the relationship between the core category and the other dimensions are established.

Conceptual comparison

In the phase of conceptual comparison we compared our conceptualization of regulatory practice with concepts of regulatory practice from extant literature. This answers the sub question:

4. How does the conceptual framework of regulatory practice in the mobile telecommunications system compare and relate to extant theoretical concepts of regulatory practice?

In a CGT approach the conceptual comparison is meant to continue the development of our conceptual framework as well as to assess our contribution to extant literature. The selection of the extant literature was based on a literature search for conceptual studies on regulatory practice as a process in general. The following concepts are presented in extant literature:

a. ***regulatory practice as conversation:*** concepts that relate to regulatory practice as conversation address three functions of communicative processes. These relate to knowledge exchange between actors involved; for building trust between regulators and regulatees; and for rule interpretation to choose the correct type of approach to come to an understanding of how the formal rules must be interpreted in the regulatory process.

b. **regulatory practice as a process of adaptivity**: adaptivity to the behavior of the regulatees, e.g. if the regulatee cooperates than a less stringent intervention can be applied and adaptivity to the coevolution of regulation, technology and markets. This last form of adaptivity relates to the long term view on regulation, when institutionalization and technical innovation in network industries will change future regulatory structures.

The conceptual comparison showed that our core category *Process of Matching and Mixing* focuses on matching regulatory activities with the market issues, whereas the extant concepts show that other types of matching are also relevant. Based on the conceptual comparison we extended our conceptualization to take these additional forms of matching into account: matching with the behaviour of market parties, and with longer term evolution in the system. We also added business activities as an additional source of uncertainty. We kept the core category of *Process of Matching and Mixing* as the main core concern of the NRAs and formulated the substantive concept of *Exploratory Regulatory Practice* for the entire conceptual framework. This substantive concept explains the exploratory way in which regulatory authorities deal with market issues and uncertainties in the complex mobile telecommunications system.

The conceptual comparison also showed that our substantive concept of *Exploratory Regulatory Practice* complements other studies that do not take the integral regulatory process as object of study. Neither do other concepts of regulatory practice conceptualize the uncertainties within a complex socio-technical system such as the mobile telecommunications system. We therefore conclude that our conceptualization of regulatory practice contributes to the existing literature by the way in which NRAs deal with the tensions that arise from the interactions between the institutional, multi-actor and technical subsystems.

Evaluation of the conceptual framework

Our last sub question aims at the evaluation of the conceptual framework:

5. To which extent does the conceptual framework explain how regulatory authorities deal with the tensions and uncertainties in the mobile telecommunications system?

We evaluated our conceptual framework of *Exploratory Regulatory Practice* by using the criteria for a CGT approach: fit, relevance, workability and modifiability. We claim that our framework matches these criteria, based on the following arguments:

The coding of the empirical data was performed without predefined codes or theoretical concepts. Therefore, our concepts are firmly based in emergence from the empirical data (*fit*). Our conceptual framework demonstrates “what’s really going on that is important to the people in the substantive area” (Glaser, 1998, p. 237) and as such can be considered to comply with the criterion of *relevance*. We developed an integrated conceptual framework with concepts of regulatory practice that explains “*how the main concern of the participants is continually resolved*” (Glaser, 1998, p. 236). The relationships between the dimensions are established (*workability*). Our conceptual framework can be extended towards a more generalized theory of regulatory practice. Data from other substantive domains or extant theoretical concepts can be used to extend, add or modify dimensions of the conceptual framework, potentially towards the development of a formal grounded theory of regulatory practice (*modifiability*).

Scientific and societal contribution

Regulation of complex socio-technical systems requires conceptual frameworks to understand the tensions between the institutional, multi-actor and technological subsystems and how this influences regulatory practice. We contribute to academic studies that so far did not consider regulatory practice as an exploratory process to deal with tensions and uncertainties in the mobile telecommunications system. For researchers in regulatory studies the conceptual framework provides for a socio-technical perspective that transcends the economic, legal or political science perspective. The conceptual framework opens the black box of regulatory practice to explain how NRAs deal with tensions and uncertainties in the mobile telecommunications system by means of an exploratory process.

The societal relevance of our study is to practitioners who are involved in the regulation of mobile telecommunications systems. The full overview of market issues that we present can be used to evaluate and design the requirements for new generations of mobile telecommunication networks. In our conceptual framework we include the uncertainties that are based in a diversity of sources. For the new generation of e.g. 5G networks uncertainties will be present too. The concept of *Exploratory Regulatory Practice* represents an exploratory way of working to deal with these uncertainties. The more variance in regulatory activities is available to regulatory authorities, the better they can explore how to mix their activities to develop a regulatory arrangement that matches with the market issues at hand. For an increasing number of actors from municipalities, mobile application domains, NGO's and citizens who will be involved in discussions on next generations of mobile networks and services, our study offers an overview of potential tensions and uncertainties they can be confronted with. Concepts from our study can be used to be aware of these tensions and how they can be addressed by means of regulation or other forms of governance.

Limitations & future research topics

We developed our conceptual framework from the perspective of the regulatory authorities. This limited taking into account the range of activities of the regulated market parties. In our conceptual comparison we concluded that regulatory concepts such as (*Really*) *Responsive Regulation* and *Smart Regulation* address the role of the behaviour of regulated firms in a regulatory setting. Future research is required to conceptualize the business activities and market party behaviour and how this fits into the conceptual framework.

We used formal documents as sources for the empirical data. This choice enabled indepth analysis, but also limited gaining insight into informal regulatory activities. In addition, formal documents may be biased due to political considerations or the socio-cultural context in which they were published. In future research practitioners can be asked for their assessment of the workability of the framework based on their perceptions and experiences.

Our framework is grounded in empirical data in a specific context and in a specific period. In future research our conceptual framework of *Exploratory Regulatory Practice* can be scaled up by means of empirical data from other CSTS. In addition empirical data from tensions raised by future mobile networks (e.g. 5G) can be used to test the conceptual framework on its applicability in another time period in which new actors will enter the system, new rules may be applicable and other types of uncertainties may arise. A continued GT approach can be used to perform this future research to

discover whether this influences the concept of *Exploratory Regulatory Practice* or can contribute to the formulation of a higher level of conceptualisation towards e.g. a formal theory.

A GT approach provides for a structured research strategy for developing conceptualizations or theoretical models that can shed a new perspective on substantive domains of research. Foregoing the use of existing theories or theoretical models enables the researcher to look at the domain without preconceptions. We consider a substantive theory developed by means of a GT approach to be particularly suited to analyze and explain interactions in CSTS. Its inductive nature and the rigorous procedures combined with a constructivist ontology and an interpretive epistemology are well suited to understand processes and the interactions between the institutional, actor and technical subsystems in CSTS. For the current transitions that are needed in complex systems innovation (e.g. transitions in the energy and transport sectors, smart cities, as well as digital transitions), comprehensive frameworks and theories can provide an integral overview of what is needed to further these transitions in society. Future research into the use of the GT approach in studies in the domain of CSTS is needed to show its strengths and weaknesses in contributing to the understanding and explaining of the tensions that are rooted in the interactions between the institutional, multi-actor and technical subsystems.

As for this study, our conceptualization of regulatory practice yields a process-oriented perspective on the regulation of CSTS. This contributes to researchers and practitioners to look beyond the formal analysis of the legal institutional framework and the formal regulatory instruments that ignore the process of regulation. A look into the regulatory process “means looking behind the institutional façade to grasp the ‘real world’ of public action” (Minoque, 2001, p. 12). We claim to have developed a conceptual framework to explain such public action in the real world.

Samenvatting

Complexe socio-technische systemen

Veel maatschappelijk essentiële diensten zijn afhankelijk van infrastructuur gebaseerde systemen, zoals energievoorzieningen, telecommunicatiediensten en het openbaar vervoer. Deze systemen bestaan uit subsystemen die zich in onderlinge samenhang ontwikkelen. Het management van deze systemen wordt uitgevoerd door verschillende typen publieke en private actoren. Daarnaast zijn deze systemen onderhevig aan technologische innovatie. Eindgebruikers vertrouwen op de kwaliteit en levering van diensten die via deze infrastructuur gebaseerde systemen worden aangeboden. Om ongewenste maatschappelijke gevolgen zoals uitval, hoge consumentenprijzen en ondermaatse kwaliteit van dienstverlening te voorkomen, worden deze systemen van overheidswege gereguleerd. Deze infrastructuur gebaseerde systemen worden gedefinieerd als complexe socio-technische systemen (CSTS); een concept dat aangeeft dat het functioneren van het systeem afhankelijk is van de interacties tussen de technische, de sociale en de institutionele componenten van het systeem. Door hun omvangrijke schaalgrootte en de benodigde voorinvesteringen in infrastructurele elementen, zijn deze CSTS niet eenvoudig te veranderen. Toch treden er veranderingen op in de institutionele context, door technologische innovatie of door veranderingen in de samenstelling van betrokken actoren. De gevolgen van deze veranderingen zijn moeilijk te voorspellen en leiden tot onzekerheden voor autoriteiten die deze systemen reguleren. In dit onderzoek bestuderen we een grote verandering in het mobiele telecommunicatiesysteem om te verklaren op welke wijze toezichthouders omgaan met de (ongewenste) gevolgen en onzekerheden door veranderingen binnen het systeem.

Markt voor mobiele telecommunicatie

Deze grote verandering is de liberalisering van de telecommunicatiemarkt in de Europese Unie (EU), die vanaf 1997 leidde toe een nieuwe institutionele context. De telecommunicatiemarkt is het fysieke of virtuele plaats waar transacties plaatsvinden tussen leveranciers en afnemers van telecommunicatiediensten en eindgebruikersapparatuur. De markt bestaat groothandel en detailhandel. Door de liberalisering is de telecommunicatiemarkt getransformeerd van een monopolistische naar een concurrerende markt. Nieuwe telecomaانبieders traden toe tot de markt, nieuwe netwerken werden uitgerold en nieuwe diensten werden aangeboden aan eindgebruikers.

De regulering van de mobiele telecommunicatiemarkt is gecompliceerd door de interactie tussen meerdere marktpartijen met uiteenlopende belangen, de technologische en economische kenmerken van de markt en de borging van publieke waarden. We beschouwen de mobiele

telecommunicatiemarkt daarom als onderdeel van een complex socio-technisch systeem (CSTS). In dit CSTS vinden niet alleen transacties tussen verkopers en kopers plaats, maar wordt ook een bijdrage aan maatschappelijke waarden verwacht waarvoor wet- en regelgeving wordt geformuleerd. In dit CSTS voeren publieke organisaties activiteiten uit voor het bevorderen en waarborgen van eerlijke concurrentie en publieke waarden.

Dit CSTS bestaat uit een technische infrastructuur met onderling afhankelijke componenten. Het sociaal-maatschappelijke aspect is geworteld in de essentiële diensten die het systeem aan de samenleving levert. En veel (typen) actoren zijn betrokken bij de werking van het mobiele telecommunicatiesysteem. De toegang tot de markt voor mobiele telecommunicatie wordt gereguleerd door middel van licenties die het gebruik van schaarse frequenties mogelijk maken. Voor het aanbieden van mobiele diensten moeten netwerkexploitanten vooraf hoge investeringen doen in infrastructurele componenten, zoals antennes voor de transmissie van mobiele signalen en de aanleg van transmissiekabels. Mede dankzij de liberalisering van de markt en door technologische innovaties betraden nieuwe netwerkexploitanten en dienstverleners de mobiele markt om diensten te leveren aan eindgebruikers in concurrentie met de bestaande netwerkexploitanten. Als gevolg hiervan nam de spanning tussen de marktspelers op de markt voor mobiele telecommunicatie toe in hun streven naar marktaandeel om een rendement op hun investeringen te behalen en in het belang van hun aandeelhouders.

Deze commerciële belangen van de marktspelers kunnen op gespannen voet staan met de publieke waarden die overheden formuleren voor het telecommunicatiesysteem. Voorbeelden van dergelijke publieke waarden zijn voorzieningszekerheid, universele toegang en eerlijke tarieven voor eindgebruikers. Hierdoor vormen de commerciële belangen versus de publieke waarden een andere bron van spanningen in het systeem. Bovendien kunnen wijzigingen in een subsysteem (bijvoorbeeld een technologische innovatie) spanningen veroorzaken met een ander subsysteem en leiden tot onzekerheden in het functioneren van het gehele systeem.

Deze diversiteit aan spanningen kan leiden tot kwesties in de markt die worden aangepakt door nationale sectorspecifieke regelgevende instanties (NRA's). We definiëren marktkwesties als elke reden voor een NRA om activiteiten te verrichten om tot een sturingsarrangement te komen. De praktijk van regulering door NRA's op de markt voor mobiele telecommunicatie hebben betrekking op het omgaan met marktkwesties die om regulering vragen en het omgaan met onzekerheden in het systeem. Hun belangrijkste doelstellingen zijn bij te dragen aan eerlijke concurrentie op de markt en aan het waarborgen van publieke waarden.

Systematisch literatuuronderzoek

We hebben een systematisch literatuuronderzoek uitgevoerd naar academische literatuur over de regulering van de markt voor mobiele telecommunicatie (1989-2019). Uit dit literatuuronderzoek blijkt dat het wetenschappelijk onderzoek naar regulering dat plaatsvindt nadat de vergunningen aan mobiele netwerkkoperators zijn verleend, versnipperd is. De academische literatuur wordt gekenmerkt door studies naar afzonderlijke interventies (zoals verplichtingen voor de overdraagbaarheid van mobiele nummers of het instellen van een prijsplafond voor tarieven voor gespreksafwikkeling) of naar de effecten van de inzet van instrumenten voor regulering. Als zodanig ontbreekt de manier waarop deze interventies door regelgevende instanties worden ontwikkeld in een context van onzekerheden en complexiteit. Een onderzoek naar de regelgevingspraktijk van

NRA's die in een veranderende context veel marktkwesties tegelijkertijd aanpakken moet verder gaan dan afzonderlijke interventies.

Uit het literatuuronderzoek blijkt ook dat het merendeel van het onderzoek gericht is op analyse en evaluatie maar niet op conceptualisering. Bovendien wordt veelal een economisch of juridisch perspectief gebruikt om regulering te analyseren. Deze studies tonen niet de interacties aan tussen de technische, multi-actor en institutionele subsystemen die op elkaar aan moeten sluiten binnen een CSTS.

Onderzoeksdoel

Om een bijdrage te leveren aan deze kennislacunes is ons onderzoeksdoel te verklaren hoe de NRAs omgaan met de spanningen in onzekerheden in het mobiele telecommunicatiesysteem ter ondersteuning of bevordering van concurrentie in de markt en tegelijkertijd het beschermen van de publieke waarden. In deze studie definiëren we de praktijk van regulering als de activiteiten van een sectorspecifieke NRA in het proces van regulering van het mobiele telecommunicatiesysteem. Ons onderzoeksdoel is het ontwikkelen van een conceptueel kader van regulering dat verklaart hoe regelgevende autoriteiten omgaan met de spanningen en onzekerheden in het mobiele telecommunicatiesysteem.

Conceptualisering van de praktijk van regulering kan sectorspecifieke toezichthouders en marktspelers ondersteunen bij het begrijpen van de interacties tussen de institutionele context, het subsysteem met meerdere actoren en het technische systeem op de markt voor mobiele telecommunicatie. Toekomstige generaties mobiele standaarden zullen mogelijk leiden tot nieuwe netwerken of systeemcomponenten, nieuwe markttoegang en nieuwe diensten. Conceptualisering kan verklaren hoe sectorspecifieke toezichthouders omgaan met de spanningen in de markt na een wijziging in dit CSTS.

Onderzoeksfilosofie

Voor het ontwikkelen van onze onderzoeksstrategie presenteren we onze onderzoek filosofie gebaseerd op een bespreking van de vier belangrijkste onderzoeksparadigma's in de sociale wetenschappen: positivisme, postpositivisme, kritische theorie en constructivisme.

Onze ontologische overtuiging is gebaseerd op constructivisme met de ontologie van relativisme, omdat wij als uitgangspunt hebben dat de interacties tussen meerdere actoren de sociale context creëren waarin ze leven. We geloven niet in één realiteit, de betrokken actoren hebben allemaal hun eigen perceptie van de realiteit en creëren hun gemeenschappelijke wereld op basis van de betekenis die ze eraan geven.

Onze epistemologische overtuiging is gebaseerd in interpretivisme, aangezien we de processen tussen menselijke actoren, instellingen en het technische systeem binnen CSTS interpreteren. We geloven niet in het ontdekken van een objectieve waarheid, maar zijn vooral geïnteresseerd in de interacties die plaatsvinden en hoe deze worden gevormd in de context van een CSTS.

Onze axiologische overtuiging is geworteld in een constructivistische visie omdat we de interpretatie van de processen in de samenleving belangrijk vinden en de interacties tussen de betrokken actoren willen begrijpen wanneer er een verandering plaatsvindt in hun context. We willen daarom de processen waarin betekenis wordt ontwikkeld analyseren en interpreteren.

Onze methodologische overtuiging is in interpretivisme, omdat we de interpretatie van processen in de samenleving (onze axiologische overtuiging) belangrijk vinden en de dynamische interacties binnen een CSTS willen begrijpen. Deze processen en interacties in een bepaalde context kunnen het best bestudeerd worden door middel van kwalitatieve onderzoeksmethoden. We hechten aan een open onderzoeksbenadering om recht te doen aan de interacties in het systeem zonder vooraf een analytisch raamwerk te selecteren dat de onderzoeker beperkt tot het focussen op specifieke factoren.

Onderzoeksbenadering

In lijn met onze onderzoeksfilosofie kozen we voor een open, inductieve onderzoeksstrategie. De Grounded Theory (GT)-benadering biedt een systematische onderzoeksstrategie om een situatie te bestuderen door middel van empirische gegevens met als doel een concept te ontwikkelen dat representatief is voor het handelen van actoren in het domein van onderzoek. In de loop der jaren zijn verschillende varianten van de GT-benadering ontstaan, in deze studie vergelijken we de klassieke Glaserian-, de Straussian- en de Constructivist GT-benadering. We kozen voor de klassieke GT benadering omdat deze het mogelijk maakt om concepten uit de empirische gegevens te laten ontstaan zonder de meer rigide procedures voor coderen die gewoonlijk worden gebruikt in de Straussian-variant. Ook vereist de klassieke GT benadering geen *sensitizing concepts* bij aanvang van het coderen zoals de Straussian benadering, waardoor we de feitelijke regelgevingspraktijk kunnen conceptualiseren zonder de beperkingen van vooraf geformuleerde concepten. De constructivistische benadering is meer gericht op de interactie van de onderzoeker met de betrokken personen, wat minder geschikt is voor ons doel om de activiteiten van sectorspecifieke toezichthouders te onderzoeken in een tijdperk van grote institutionele veranderingen in het verleden.

Onderzoeksstrategie

De klassieke GT-benadering bestaat uit de fasen van open, selectieve en theoretische codering, conceptuele vergelijking en evaluatie. Voor de empirische data om te coderen gebruiken we de formele documenten over regulering van de mobiele telecommunicatiemarkt die gepubliceerd zijn door de NRAs in het Verenigd Koninkrijk, Nederland en Frankrijk tussen 1997 en 2002. We hebben 61 dossiers in de respectievelijke nationale markten voor mobiele telecommunicatie gereconstrueerd.

Open en selectieve coderingsfase

Voor de open en selectieve fasen van codering hebben we twee exploratieve deelvragen geformuleerd:

1. Hoe kunnen de spanningen in de mobiele telecommunicatiemarkt die op de agenda van sectorspecifieke toezichthouders komen, worden geconceptualiseerd?

2. Hoe kunnen de activiteiten die een sectorspecifieke toezichthouder verricht om de spanningen in de mobiele telecommunicatiemarkt op te lossen, worden geconceptualiseerd?

Deze twee deelvragen werden beantwoord door het coderen van de empirische gegevens uit de 61 dossiers. We reconstrueerden de dossiers door middel van de formele publicaties over de spanningen in de markt die tot regulering leidden. Voor het coderen hebben we software voor

kwalitatieve data-analyse gebruikt: Atlas.ti. We pasten codering op zinsniveau toe voor de spanningen en voor de activiteiten die de toezichthouders hebben uitgevoerd tijdens de ontwikkeling van een arrangement om de spanningen aan te pakken. Via open en selectieve codering vormden we de dimensies Spanningen (*Market Issues*) en Activiteiten (*Regulatory Activities*) als antwoord op de eerste twee deelvragen. In de theoretische coderingsfase werden deze twee dimensies gecombineerd om het kernbegrip van ons conceptuele raamwerk te creëren.

Theoretische coderingsfase

Voor de theoretische coderingsfase hebben we de volgende deelvraag geformuleerd:

3. Welke dimensies en hun relaties vormen het conceptuele raamwerk voor de praktijk van regulering in de mobiele telecommunicatiemarkt?

In de theoretische coderingsfase hebben we de relatie tussen de dimensies *Spanningen* en *Activiteiten* gebruikt om het kernbegrip voor de praktijk van regulering te formuleren: het *proces van Matching en Mixing*. Dit kernbegrip beslaat de belangrijkste zorg van de sectorspecifieke toezichthouders en vertoont de patronen waarmee zij de spanningen op de complexe markt van mobiele telecommunicatie aanpakken. De praktijk van regulering is in de eerste plaats een procedurele benadering waarbij een mix van regelgevende activiteiten wordt uitgevoerd om aan te sluiten bij het type marktvragestuk. Marktkwesties worden ofwel gereguleerd vanuit een sociale rationale om publieke of consumentenbelangen te beschermen. Of ze worden gereguleerd vanuit een economische rationale om concurrerende marktvoorwaarden te creëren en diensteninnovatie te ondersteunen. In beide rationales wordt ex post en ex ante regulering uitgevoerd. Door constante vergelijking tussen de marktkwesties hebben we patronen ontdekt die aantonen dat de rationale en het ex post/ex ante karakter van invloed zijn op de intensiteit en de duur van het proces van regulering.

Naast het kernbegrip leverde de theoretische coderingsfase drie extra dimensies op voor het conceptuele raamwerk. Deze dimensies beïnvloeden de praktijk van regulering op de mobiele-telecommunicatiemarkt:

Dimensie Onzekerheden: de onzekerheden zijn geworteld in de onvoorspelbaarheid van de vraag naar (vooral nieuwe) diensten, dynamiek in technologische innovaties, twijfels over de bevoegdheid van de toezichthouder om marktvragestukken aan te pakken. Maar ook nieuwe beleidsregels en regelgeving en een gebrek aan inzicht in de effecten van regelgeving op de concurrentie in de markt zijn een bron van onzekerheid;

Dimensie Fine-tuning van het arrangement: tegen het einde van de ontwikkeling van een arrangement legt de NRA de details van het arrangement vast. Hierbij wordt bepaald op welke relevante marktpartijen het van toepassing zal zijn, of er regelmatige evaluaties zullen plaatsvinden en hoelang het arrangement van toepassing zal zijn. Tevens wordt in deze fase de doorlooptijd van implementatie van het arrangement beoordeeld: het kan zijn dat de implementatie te lang duurt om nog effectief te zijn door veranderende marktontwikkelingen;

Dimensie Fasen: in de empirische gegevens herkennen we vijf fasen in de ontwikkeling van een arrangement. Deze fasen worden gekenmerkt door hun aard van initiatie, analyse, exploratie, formulering en afsluiting. Na sluiting van het dossier kunnen de fasen worden herhaald.

We hebben het kernbegrip en de aanvullende dimensies gebruikt om de eerste versie van ons conceptuele raamwerk van de praktijk van regulering te ontwikkelen. In het raamwerk wordt de relatie tussen het kernbegrip en de andere dimensies vastgelegd.

Conceptuele vergelijking

In de fase van conceptuele vergelijking vergeleken we onze conceptualisering van de praktijk van regulering met concepten uit bestaande literatuur. Dit beantwoordt de deelvraag:

4. Hoe verhoudt het conceptuele raamwerk van de praktijk van regulering van het mobiele telecommunicatiesysteem zich tot bestaande theoretische concepten van regulering?

In een klassieke GT-benadering is de conceptuele vergelijking bedoeld om de ontwikkeling van het conceptuele raamwerk voort te zetten en om de bijdrage aan de bestaande literatuur te bepalen. De selectie van de bestaande literatuur was gebaseerd op literatuuronderzoek naar conceptuele bijdragen aan de praktijk van regulering als een proces in het algemeen. De volgende concepten worden in bestaande literatuur gepresenteerd:

a. **regulering als conversatie**: concepten die regulering als conversatie beschouwen hebben betrekking op drie functies van processen. Dit betreft de kennisuitwisseling tussen betrokken actoren, het opbouwen van vertrouwen tussen toezichthouders en marktpartijen, en het interpreteren van de formele regels om het juiste type benadering te kiezen;

b. **regulering als een adaptief proces**: dit concept betreft het aanpassen van regulering aan het gedrag van de marktpartijen (bijvoorbeeld als de gereguleerde marktpartij samenwerkt dan kan een minder stringent ingreep worden toegepast) en de co-evolutie van regulering, technologie en markten. Deze laatste vorm van adaptatie heeft betrekking op een lange termijn visie op regulering waarbij veranderingen in instituties en technische innovatie in infrastructuur de marktstructuur (en dus de praktijk van regulering) zullen veranderen.

Uit de conceptuele vergelijking bleek dat ons kernbegrip *Proces van Matching and Mixing* zich beperkte tot het omgaan met de marktkwesties, terwijl de bestaande concepten aantonen dat ook andere soorten *matching* relevant zijn. De conceptuele vergelijking leidde ertoe dat we extra vormen van *matching* in ons conceptuele raamwerken opnamen: het *matchen* met het gedrag van marktpartijen en met de evolutie van het systeem op langere termijn. Ook hebben we bedrijfsactiviteiten toegevoegd als extra bron van onzekerheid. We behielden het kernbegrip van het *Proces van Matching and Mixing* om de kernactiviteiten van de NRAs te verklaren. Daarnaast formuleerden we het concept van *Exploratory Regulatory Practice* dat betrekking heeft op het gehele conceptuele raamwerk, inclusief de extra dimensies. Dit concept verklaart de exploratieve manier waarop sectorspecifieke toezichthouders omgaan met vraagstukken in de markt en met de onzekerheden in het complexe mobile telecommunicatiesysteem.

De conceptuele vergelijking toonde ook aan dat ons concept van *Exploratory Regulatory Practice* een aanvulling vormt op bestaande studies op het gebied van regulering die de praktijk van regulering niet als een integraal proces zien. Ook ontbreekt in deze studies een conceptualisering van de onzekerheden binnen een complex socio-technisch systeem zoals die mobiele telecommunicatie. We concluderen daarom dat onze conceptualisering bijdraagt aan de bestaande literatuur door de

manier waarop de NRAs omgaan met de spanningen die voortvloeien uit de interacties tussen de institutionele, multi-actor en technische subsystemen in de mobiele telecommunicatiemarkt.

Evaluatie van het conceptuele raamwerk

Onze laatste deelvraag betrof de evaluatie van het conceptuele raamwerk:

5. In hoeverre verklaart het conceptuele raamwerk hoe sectorspecifieke toezichthouders omgaan met de spanningen en onzekerheden in het mobiele telecommunicatiesysteem?

We hebben ons conceptuele raamwerk van *Exploratory Regulatory Practice* geëvalueerd met behulp van de criteria voor een klassieke GT-benadering: representatief, relevant, verklarend en aanpasbaarheid. Het conceptuele raamwerk voldoet aan deze criteria op basis van de volgende argumenten:

De codering van de empirische gegevens werd uitgevoerd zonder vooraf gedefinieerde codes of theoretische concepten. Daarom zijn onze concepten stevig gebaseerd in de empirische data (representatief). Ons conceptueel kader laat zien "what's really going on that is important to the people in the substantive area " (Glaser, 1998, p. 237) en voldoet daarmee aan het criterium van relevantie. We ontwikkelden een geïntegreerd conceptueel raamwerk met dimensie die verklaren "how the main concern of the participants is continually resolved" (Glaser, 1998, p. 236). De relaties tussen de dimensies worden gelegd (verklarend). Ons conceptuele raamwerk kan worden uitgebreid naar een meer algemene theorie voor de praktijk van regulering. Gegevens uit andere CSTS of bestaande theoretische concepten kunnen worden gebruikt om dimensies van het conceptuele kader uit te breiden, toe te voegen of te wijzigen, mogelijk in de richting van de ontwikkeling van een formeel gefundeerde theorie van de praktijk van regulering (aanpasbaarheid).

Wetenschappelijke en maatschappelijke bijdrage

Regulering van CSTS vereist conceptuele raamwerken om de spanningen tussen de institutionele, multi-actor en technologische subsystemen te begrijpen en om te verklaren hoe dit de praktijk van regulering beïnvloedt.

We dragen bij aan academische studies die tot dusverre de praktijk van regulering niet beschouwden als een verkennend proces om met spanningen en onzekerheden in het mobiele telecommunicatiesysteem om te gaan. Voor onderzoekers op het gebied van regulering voorziet het conceptuele kader in een socio-technisch perspectief dat het economische, juridische of politicologische perspectief overstijgt. Het conceptuele kader opent de zwarte doos van de praktijk van regulering om uit te verklaren hoe NRA's omgaan met spanningen en onzekerheden in het mobiele telecommunicatiesysteem door middel van een verkennend proces.

De maatschappelijk bijdrage zit in de relevantie van ons onderzoek voor betrokkenen bij de regulering van mobiele telecommunicatiesystemen. In de eerste plaats voor beleidsmakers en sectorspecifieke toezichthouders, maar ook voor een groeiend aantal actoren uit gemeenten, mobiele applicatiedomeinen, NGO's en burgers bij toekomstige generaties mobiele netwerken en diensten. Wij bieden een volledig overzicht van marktwesties dat kan worden gebruikt om de eisen voor nieuwe generaties mobiele telecommunicatienetwerken te evalueren en te ontwerpen. In ons conceptuele raamwerk zitten de onzekerheden die voortkomen uit diverse bronnen. Ook voor de nieuwe generatie van bijvoorbeeld 5G netwerken zullen onzekerheden aanwezig zijn. Het concept

van *Exploratory Regulatory Practice* presenteert een exploratieve manier van werken om met deze onzekerheden om te gaan. Concepten uit ons onderzoek kunnen worden gebruikt om bewust te zijn van deze spanningen en hoe deze kunnen worden aangepakt door middel van regulering of andere vormen van governance.

Beperkingen en toekomstige onderzoeksthema's

We hebben ons conceptueel raamwerk ontwikkeld vanuit het perspectief van de sectorspecifieke toezichthouders. Dit betekent dat we beperkt gekeken hebben naar het scala aan activiteiten van de gereguleerde marktpartijen. In onze vergelijking met bestaande literatuur concluderen we dat concepten zoals (*really*) *responsive regulation* en *smart regulation* meer ingaan op de rol van het gedrag van de gereguleerde marktpartijen. Vervolgonderzoek is nodig om de bedrijfsactiviteiten en het gedrag van marktpartijen te conceptualiseren en in het conceptuele raamwerk in te passen.

In deze studie gebruikten we formele documenten als bronnen voor de empirische gegevens. Deze keuze maakte een diepgaande analyse mogelijk, maar beperkt het verkrijgen van inzicht in informele reguleringsactiviteiten. Bovendien kunnen formele documenten bevooroordeeld zijn vanwege politieke overwegingen of de sociaal-culturele context waarin ze zijn gepubliceerd. In vervolgonderzoek kan aan betrokken actoren gevraagd worden naar hun oordeel over de werkbaarheid van het raamwerk op basis van hun percepties en ervaringen.

Ons raamwerk is gebaseerd op empirische gegevens in een specifieke context en in een specifieke periode. In vervolgonderzoek kan ons conceptuele raamwerk van *Exploratory Regulatory Practice* worden opgeschaald door middel van empirische gegevens uit andere CSTS. Daarnaast kunnen empirische gegevens van spanningen die spelen bij toekomstige mobiele netwerken (bijv. 5G) worden gebruikt om het conceptuele kader te testen op de toepasbaarheid ervan in een andere tijdsperiode waarin nieuwe actoren het systeem zullen betreden, nieuwe regels van toepassing kunnen zijn en andere soorten onzekerheden kunnen ontstaan. Een voortzetting van de GT-benadering kan worden gebruikt om dit vervolgonderzoek uit te voeren om te ontdekken of dit concept van *Exploratory Regulatory Practice* beïnvloedt of kan bijdragen aan het formuleren van een hoger niveau van conceptualisering richting een formele theorie.

Een GT-benadering biedt een gestructureerde onderzoeksstrategie voor het ontwikkelen van conceptualisaties of theoretische modellen die een nieuw perspectief kunnen werpen op onderzoekdomeinen. Door af te zien van het gebruik van bestaande theorieën of theoretische modellen kan de onderzoeker open naar het domein kijken. We beschouwen een theorie ontwikkeld door middel van een GT-benadering bijzonder geschikt om interacties in CSTS te analyseren en te verklaren. Het inductieve karakter en de rigoureuze procedures in combinatie met een constructivistische ontologie en een interpretatieve epistemologie zijn zeer geschikt om processen en de interacties tussen de institutionele, actor- en technische subsystemen in CSTS te bestuderen. Voor de huidige transitie die nodig zijn bij complexe systeeminnovaties (bv. transitie in de energie- en transportsector, slimme steden, evenals digitale transitie) kunnen conceptuele raamwerken en theorieën een integraal overzicht bieden van wat nodig is om deze transitie in de samenleving te bevorderen. Vervolgonderzoek naar het gebruik van de GT-benadering in het domein van CSTS is nodig om de sterkten en zwakten van deze onderzoeksbenadering te laten zien voor het bijdragen aan het begrijpen en verklaren van de spanningen die zijn geworteld in de interacties tussen de institutionele, multi-actor en technische subsystemen.

Wat deze studie betreft, biedt onze conceptualisering van de praktijk van regulering een procesgeoriënteerd perspectief op de regulering van CSTS. Dit draagt ertoe bij dat onderzoekers en actoren in het domein verder kunnen kijken dan de formele analyse van het juridische institutionele kader en de formele instrumenten voor regulering. Deze manier van kijken negeert het belang van het proces van regulering. Een kijkje in dit proces “means looking behind the institutional façade to grasp the ‘real world’ of public action” (Minoque, 2002, p. 12). We hebben een conceptueel raamwerk ontwikkeld dat de echte praktijk van regulering verklaart.

1. Mobile Telecommunications Systems

1.1. Introduction

Infrastructure-based systems are used for the provision of essential services to society, e.g. the energy system, the transport system, the sewage system and the telecommunications system (Weijnen & Bouwmans, 2006; Künneke, Groenewegen & Auger, 2009). These systems consist of a range of interdependent subsystems that coevolve over time, which identifies them as a dynamic network-based system (Herder, Bouwmans, Dijkema, Stikkelman & Weijnen, 2008). These subsystems are managed by human actors and embedded in organizations (Weijnen & Bouwmans, 2006). As multiple actors are involved in the management of the subsystems (and thus the system as a whole), diverging interests and potential conflicts can arise. The governance of these systems is performed by "many actors who optimise their management decisions and investment strategies for their own subsystem, in their own interest" (Weijnen, Herder and Bouwmans, 2008, p. 235). Because of the importance of their services to society, end users rely on the quality and provision of the services (Geels, 2004).

Therefore, in order to mitigate unwanted societal outcomes e.g. due to outages, underperformance in service quality or high consumer prices, institutions monitor the system for compliance. Rules and regulations are formulated to explicate the public values that are attributed to the system's functioning. As an example, a system's societal contributions can be formalized by policy makers via the formulation of public values that the providers need to contribute to (Beck Jørgensen & Bozeman, 2007).

These infrastructure-based systems are defined as complex socio-technical systems (CSTS), a concept that denotes that the system's functioning is dependent on the interactions between the technical, the social and the institutional components of the system (Geels, 2004).

Due to their large scale size and the required upfront investments in infrastructural elements, these CSTS are not easily changed. As Bonen mentions: "A complex STS is not created overnight or built in one piece. It evolves gradually through an intricate process involving both technological and social

change” (Bonen, 1979, p. 2). Therefore, Bonen considers these systems to be averse to large changes as “large mature systems would usually accept only incremental change often characterized by technology lag and very slow adaptation of structure” (Bonen, 1979, p. 2).

Yet, major changes in CSTS can occur. Sources of these major changes can be either in the technical, the actor or the institutional subsystem. For instance, a considerable technical change in the architecture or in technical nodes can take place. But also the actor component can lead to interventions, e.g. through a major change in the political arena of a country in which the system operates or a huge growing demand for services by end users. In addition, new laws and regulations can change the institutional context in which the system operates.

A major change can have consequences that are hard to predict due the interactions between the subcomponents of the system. This leads to uncertainties and “unpredictable behaviour of the system as a whole” (Weijnen, Herder and Bouwmans, 2008, p. 237). The uncertainties need to be addressed by the actors in the system (Bonen, 1979, p. 10). The actors will be challenged to reconsider their objectives, explore their common interests and their contribution to attaining the desirable outcomes of the system as a whole. Their choices will impact the design of the physical system on the operational level of the technical nodes and the links between them. And ultimately, the institutional context can react to the changes of the system by formulating rules for the system architecture or by solving disputes between system actors or by (re)formulating public values to ensure the system’s contribution to society.

In this research we study such a major change in the mobile telecommunications system to explain the way in which regulators address the (unwanted) consequences and uncertainties due to interactions within the system. This change is the full liberalization of the telecommunications market in the European Union (EU), which led to a new institutional context from 1997 onwards (Mansell, 1993). As a consequence of the liberalization, new market players entered the telecommunications market to compete with the former state monopolist (Hulsink, 1999). New networks were rolled out that required technical interconnection with other subsystems (European Parliament and the Council of the European Union, 1997b). Driven by technological innovations, new mobile services emerged for end users (ITU, 1999). In short: this was a dynamic period in which the telecommunications system underwent major changes. Tensions between the actors in the system became apparent that required regulation in order not to hamper the EU policy goals of fair competition and to safeguard public values (European Commission, 1996c). The new regulatory framework led to the installment of sector-specific regulatory authorities to address these tensions by developing regulatory arrangements (European Commission, 1996a). Our objective is to explain the way in which regulatory authorities in the mobile telecommunications market dealt with the tensions in the mobile telecommunications market and the uncertainties that arised.

1.2. The mobile telecommunications market

Society is increasingly dependent on mobile telecommunications services. These services range from telephone calls to mobile applications for access to content, social media, and the exchange of information in business and governmental processes. The telecommunications market is the physical or virtual area where transactions between suppliers and buyers of telecommunication services and

end user equipment take place in order to deliver mobile services to end users. The market can be distinguished into a wholesale and a retail market segment.

Penetration rates of mobile phones have shown a steep curve, from an average of 10.7 on 100 inhabitants in 1996 to an average of 120.7 on 100 inhabitants in OECD countries in 2015 (Organisation for Economic Co-operation and Development, 2017). For all countries in the world, these data are an average of 2.5 on 100 inhabitants in 1996 to an average of 97.3 on 100 inhabitants in 2015 (Organisation for Economic Co-operation and Development, 2017).

The mobile telecommunications market seems to be competitive because of the wide choice of providers in the retail market, but the wholesale market is highly regulated. First, due to inherent technological characteristics that hamper free market entry; require high upfront investments in sunk assets and due to a continuous evolution of the networks (Künneke, Groenewegen & Auger, 2009). In addition, whereas mobile network operators (MNOs) and service providers (SPs) compete for market share, they also need to cooperate to provide seamless mobile services to end users by connecting their networks. Last, national governments formulate public values that need to be warranted by the mobile market due to the importance of mobile services in society (Milne, 1998; Arnbak, 2002a). These socio-technical characteristics can lead to tensions for which regulatory intervention is required.

Mobile services run on infrastructures for which private MNOs need to make huge upfront investments. Their initial investments are aimed to obtain a licence to gain access to frequencies, which are scarce resources. Many national governments use auctions to allocate these licences to network operators, leading to high costs for market entry. The licences contain the conditions for operating a public mobile network, e.g. the required coverage of the network or quality of service requirements (Madden, Bohlin, Tran & Morey, 2014). Once the network operator has obtained a licence, huge upfront investments in infrastructural components need to be made, such as erecting antennas for the transmission of mobile signals and constructing ducts for transmission cables (UNESCAP, 2001c). The network operators need to compete for market shares to attain a return on their investments and to satisfy their stakeholder interests. These business-oriented objectives can be at odds with the public values that governments formulate to safeguard against purely commercial interests. Examples are conditions for security of supply, universal access and fair customer tariffs (European Commission, 1993a; Hudson, 1994; Arnbak & Ubacht, 1995; Xavier, 1995; Rapp, 1996; Garnham, 1997; Mueller, 1997; Prosser, 1997; Milne, 1998; Cave, Majumdar & Vogelsang, 2002). Public values can be served by fair competition in the market, e.g. competition can lead to acceptable retail prices for end users. But they can also be harmed by anti-competitive strategic behavior in the market, e.g. network operators that refuse SPs access to their proprietary network, which prevents the SPs to enter the market of service provision. Such refusal can lead to stagnation in the development of innovative services. As a consequence, mobile market regulation continues after the licence allocation.

Regulation of the mobile telecommunications market is complicated because of the interaction between multiple market players with diverging interests, the technological and economic market characteristics and the safeguarding of public values. We therefore consider the mobile telecommunications market as part of a CSTS in which not only transactions between buyers and sellers take place, but which is also expected to contribute to social values for which laws and

regulations are formulated and which involves authorities that perform activities to provide for fair competition and to safeguard public values. This broader interpretation of the mobile telecommunications market reflects that it is a network-based market that consists of interdependent subsystems that interact and coevolve to create a system that yields essential services to the functioning of society (Finger, Groenewegen & Kunneke, 2005). Longstaff in an article in which she explores whether the communications market can be regulated at all, states that “[a]ll this seems to imply that the focus for regulating a complex system should not be on trying to make each and every part of it predictable but on dealing with (or managing) the unpredictability and unintended consequences” (Longstaff, 2003, p. 9). Therefore our objective is to conceptualize how regulatory authorities deal with the tensions and the uncertainties in the mobile telecommunications system in their regulatory practice of developing regulatory arrangements.

Conceptualization of regulatory practice can support regulatory authorities and market players in understanding the interactions between the institutional context, the multi-actor subsystem and the technical subsystem of the mobile telecommunications system. Next generations of mobile standards will potentially lead to new networks or system components, new market entry and new services. Conceptualization can explain how regulatory authorities deal with market issues that are rooted in the tensions in the CSTS for mobile telecommunications. In this study a market issue is any reason for an NRA to perform activities in order to develop a regulatory arrangement.

In the following sections we elaborate on the complexities of the mobile telecommunications system (section 1.3) and the mobile telecommunications market (section 1.4) that can lead uncertainties and market issues that need to be addressed by regulatory authorities.

1.3. Complexities of the mobile telecommunications system

We consider the mobile telecommunications system as a CSTS. The complexity characteristics of the mobile telecommunications system are rooted in:

1. The dynamics in the institutional context;
2. The multi-actor system with divergent interests and
3. The technological characteristics of the mobile networks.

These complexities are strongly linked to each other; one cannot change one characteristic without consequences for the subsystems that are interdependent (Geels, 2004; Weijnen & Bouwmans, 2006). In the following sections we elaborate on the three sources of complexity.

1.3.1. Complexity in the institutional context

In recent decades, liberalization and privatization in the telecommunications market led to a major reform of the institutional frameworks for regulation and operations of networks and services in the EU (and beyond) (Mansell, 1993). Telecommunications markets are characterized by the provision of services to the general public that are based on a technical infrastructure that requires high upfront investments, with long terms for return on investment (RoI) and sunk assets (Klein, 1996). Due to these characteristics the market was formerly considered as best served by a (state) monopolist and the services were defined as public services. Technological advance and a reconsideration of the role and functioning of telecommunications markets lead towards privatization and liberalization

(Melody, 1997). The liberalization of the European telecommunications market was orchestrated by the European Commission and enacted via a series of Directives that had to be transposed into the national laws and regulation of the EU Member States (European Commission, 1990). Changes in the regulatory framework turned the telecommunications market from a monopolistic market with one network operator that manages a unified infrastructure into a complex market based on a network of subsystems that are managed by multiple private operators (Mansell, 1993; Noam, 1994; Mitchell, Neu, Neumann & Vogelsang, 1996). This institutional change augmented the complexity in the provision and regulation of telecommunications services.

1.3.2. Complexity in the multi-actor system

Due to the liberalization process of the 90s the telecommunications market became a multi-actor system that is governed by an international regulatory arena (Mansell, 1993; Weijnen & Bouwmans, 2006; Künneke, Groenewegen & Auger, 2009). Before the liberalization process the telecommunications services were provided by a state monopolist, with the Ministry for Telecommunications as regulator. After liberalization new national and international actors entered the market and new roles emerged (Troshani & Rao Hill, 2011).

The following actors and their roles within the liberalized mobile telecommunications market can be discerned:

Mobile network operators require a mobile licence to enter the telecommunications market to set up a public mobile network. The licence is a high barrier to entry and limits the number of operators due to spectrum limitations. Their networks are usually (inter)national and sometimes regional. Another barrier to entry is caused by the high upfront investments for installing the technical infrastructure (consisting of switches, servers, cables, ducts, poles etc.). These investments are mainly sunk costs as they can be labeled as 'specific assets', which means that the "value in alternative uses is substantially below their value in current use" (Spiller, 1996, p. 478). To make a profit, network operators need to attain *economies of scale*: the average costs for producing one more unit decreases when the total output increases (decreasing marginal costs). These economies of scale formerly led to the belief that a natural monopoly was the most efficient market structure for this type of industries, which resulted in the installment of statutory monopolies for the provision of telecommunications networks and services (Spiller, 1996, p. 480; Intven, Oliver and Sepúlveda, 2000, B-5). In the current competitive market, economies of scale can be attained by network coverage. Extended network coverage can contribute to *network externalities* which entails that the value of a network increases with every additional user of a network. In the telecommunications market every end user that subscribes to the services of a telecommunications firm raises its value for the other existing end users because they can reach more end users (Noam, 1992). Therefore, the larger the network, the higher its value will be for the end users. However, this can be at odds with the required high investments to cover commercially unattractive, low populated areas or areas that are difficult to cover because of geographical features such as mountainous areas. Mobile licence conditions specify the percentage of national coverage that an MNO needs to comply with, in terms of area or in % of the population. Access to mobile services is an example of public values that national governments can formulate, but can lead to tensions with the required investments in the infrastructure especially in low populated areas (Milne, 1998).

MNOs also strive for *economies of scope*, which Panzar and Willig describe as follows: “There are economies of scope where it is less costly to combine two or more product lines in one firm than to produce them separately” (Panzar and Willig, 1981, p. 268). This concept leads to the provision of multiple services that benefit from using and sharing capabilities or physical assets that are already present within the firm (Panzar & Willig, 1981). Therefore, MNOs are in general vertically integrated as they are also active in the provision of mobile services by providing not only plain telephony services, but also mobile added value services.

Network operators compete with each other for market share but are also dependent on each other for connecting their networks to provide seamless services to their mutual subscribers. They need to comply with laws and regulations and the conditions as specified in their mobile licences.

Mobile service providers offer mobile services to their subscribers. Mobile SPs require wholesale access to networks for the delivery of their services either via an MNO or via other SPs. Depending on the character of the service as competitive to the network operators’ own services or supplementary to their services package, reaching these agreements can be either hard fought or mutually beneficial.

In the case of a vertically integrated (dependent) SP, these services are offered via the proprietary network of the network operator. In contrast, an independent SP needs to gain access to the network of an MNO. The market economics for SPs deviate from those of the network operators through lower upfront investments, lower barriers of entry and exit and more competitors (UNESCAP, 2001c). Via commercial negotiations with MNOs, the tariffs for their services delivery are determined. A tension can arise when their services will directly compete with the services of the vertically integrated SP. This can lead to anti-competitive behavior by the network operator. If an SP experiences unfair practices in the negotiations on terms and conditions or tariffs for network access, a request for dispute settlement can be addressed to the regulatory authority (UNESCAP, 2001a; Riccardi, Ciriani & Quelin, 2009).

Retailers sell mobile services subscriptions and accessories to end users via physical or digital phone shops. For making a profit they depend on the wholesale prices set by the (dependent and independent) SPs. Margin squeezes by the SPs can reduce their profits, but on the other hand SPs can also profit from retailers in order to compete for subscribers (Troshani & Rao Hill, 2011).

Mobile equipment providers: end users can choose from a wide range of end user equipment. Communication of the end user equipment with any network and service is enabled through standards for interoperability. New market entrants in the mobile telecommunications market were equipment providers such as Nokia, LG, HTC, Huawei and Samsung who develop a wide range of mobile phones and accessories. End users can buy mobile telephones as part of a subscription from an SP or as a stand-alone asset and arrange a separate subscription themselves (Troshani & Rao Hill, 2011).

End users that want access to mobile telecommunications services can make a choice between MNOs, SPs and retailers for their subscription, end user equipment, and mobile applications. Their subscription is a private contract. The end user can be a large organization, a small and medium sized business or individual, private users of telecommunications services. They utilize end user equipment such as mobile telephones to make use of the services. End users can be confronted with

information asymmetry, which prevents them to make a well-informed choice based on rational arguments (Prosser, 1997, p. 12). Non-transparency of contract details and lacking information on the services and their quality are specific examples that can be caused by information asymmetry. To safeguard consumer interests, laws and regulations are drawn up for e.g. fair and transparent retail prices, fair conditions for subscriptions and for the dealing with complaints. Regulatory authorities monitor compliance with end user interests and public values as specified in laws, regulation and mobile licences and they can deal with end user complaints.

Interest groups represent user interests, such as general or sector-specific consumer organizations and interest groups for large telecommunications user groups, such as multinationals (Haucap, 2009).

Ministry/Department for Telecommunications: Every country has a national governmental organization that is responsible for policy making in the telecommunications market. They develop laws and regulations for the telecommunications market (entry) and are usually responsible for the mobile licence allocation process. Over the years, the dependability of society on the services of the mobile telecommunications market and its massive consumption in society (Nowotny, 1989) has led to increased political interference with the mobile services delivery, e.g. in the price-setting of the services (Spiller, 1996, pp. 478-480). Whereas the Ministry/Department for Telecommunications operates on the level of policy making via the formulation of laws and regulations, regulatory authorities operate on the level of policy implementation to deal with ensuing market issues.

Sector-specific regulatory authorities: the EU regulatory framework required the installment of independent sector-specific National Regulatory Authorities (NRAs) to regulate the telecommunications market¹. These authorities deal with tensions in the market that need to be solved by means of regulatory arrangements. They cooperate with other regulatory bodies, such as the Ministry for Telecommunications, the National Competition Authority (NCA) and their international counterparts. They have two major objectives:

1. to enhance fair market competition and
2. to safeguard public values.

Ad 1. Fair market competition can be compromised by *market dominance and/or strategic behavior*. In the early years of liberalization former (state) monopolist had generic market dominance. Their dominance was based on their access to resources and end users, their possession of fully operational networks, their ability to offer a full range of services and the strength of their brand name (Ubacht and Wille, 1999, p. 98). Nowadays market dominance is no longer the exclusive domain of former monopolists. Also new entrants can become dominant in a specific product/services market. For example, both former incumbent and new entrant MNOs can be monopolists in the mobile terminating market because they all dominate the termination of traffic on their proprietary mobile networks. The specific economic characteristics of network-based markets may limit the degree of competition and lead to strategic behavior. In particular the

¹ The arguments for this requirement are elaborated on in section 2.3.

relationship between MNOs, mobile SPs and retailers are subject to regulatory oversight for fair market competition.

Ad 2. Regulatory authorities monitor whether public values are complied with. Law and regulation have been formulated to safeguard public values because the mobile telecommunications market provides services that are deemed essential to society (Rapp, 1996; Xavier, 1997; Milne, 1998; Wellenius, 2000; Organisation for Economic Co-operation and Development, 2005; Künneke & Groenewegen, 2009). This is illustrated by Künneke and Groenewegen, who state that:

“..it would be naïve to assume that network industries can only be commercially driven. Public values and national interests are at the core of these industries and often demand public involvement and governmental interference. Infrastructures provide basic services that belong to the fundamental needs of modern societies” (Künneke and Groenewegen, 2009, p. 4)

A private ownership structure in the market can lead to misalignment between the provision of public values and the interests of a private company that predominantly aims at commercial interests to satisfy its stakeholders. If societal and consumers’ needs become subordinate to this strategic objective, then regulatory activities can aim to create safeguards against pure economic reasoning in network management and services delivery. Subsequently, public values that contribute to availability and affordability of (mobile) telecommunications services are not only included in the mobile licence conditions, but can also lead to regulatory interventions after the licence allocation.

The term of public values is subject to controversy on its definition and pragmatic translation and is also subject to change over time (Arnbak & Ubacht, 1995; Beck Jørgensen & Bozeman, 2007; Feintuck, 2010). As Van der Veen et al. state: “...policy-makers translate values from politics to society, within the current public context” (Van der Veen et al., 2009, p. 175). Nevertheless, a core set of public values can be discerned for the telecommunications networks as they offer essential services to users who rely on the network for social and economic reasons. Social reasons are for example access to information and being able to reach emergency services. Economic reasons are that the telecommunications SPs provide not only access to information and communication but also perform as an essential infrastructure for other economic sectors, e.g. for trading and financial transactions.

The following public values are commonly linked to telecommunications networks:

- **Universal service obligations** such as:
 - Universal geographical voice telephony service to all in a specified area;
 - General, non-discriminatory conditions for access to the service (*common carriage* or *equal access*: the obligation to deliver the service is independent of the content, the applicant and the receiver of the message);
 - Guaranteed quality and continuity/reliability of the service (e.g. minimal risk of overload of the network and guaranteed connection- and repair periods);
 - Recognizable and generally available consumer information (e.g. public telephone guides);
 - Security against harmful external influences (at calamities or at faults made by the user);
 - Servicing specific categories of users that have special needs (e.g. telephony solutions for the deaf and hearing impaired);
 - Affordability (e.g. a life line at lower prices).

- **The protection of consumers interests** such as against customer lock-in effects or non-competitive retail prices;
- **Environmental aspects** such as safety and national health issues (Arnbak and Ubacht, 1995, p. 87)².

Prosser characterizes this type of regulation as “consumer-oriented social regulation...[that is] basically a distributive one”, as opposed to economic reasons for regulation that are “justified by a desire to avoid unfair competition (Prosser, 1997, pp. 13-14). Prosser makes a distinction between these two types of regulation, although specific issues can be approached on the basis of economic as well as social regulation (Prosser, 1997, p. 15). He formulates the distinction in economic versus social rationale for regulation as follows:

“To illustrate the difference between economic and social rationales for regulation, a distinction can be made between rules prohibiting undue preference or discrimination in pricing or the provision of services, and those designed to support a universal service to all categories of users regardless of cost difference. The former are justified by a desire to avoid unfair competition and/allocative efficiency (sic)³ by preventing pricing below cost. Universal service provisions are however justified by the need to provide access to public services for all groups regardless of their place in the distribution of incomes...” (Prosser, 1997, pp. 13-14).

Although the economic and social rationales seem to be contradictory, this might not be the case.

First of all, market competition in itself can lead to lower end user tariffs and thus contribute to affordability for end users.

Second, in their study based on data from 42 firms operating in a diversity of four network-based markets across five European countries, Van der Veen et al. found evidence for a relationship between firm strategy and the level of five public values (sustainability, reliability, quality, price and access) (Van der Veen, Ederer, Fortanier, Rotileanu & De Wit, 2009). Their study shows that the effect of strategic choices within the private firms that operate in the network-based markets on the contribution to public values is not uniform. Their study also dismisses the classic perception that private operation will not contribute to public values. For example: for telecommunications providers it can be beneficial to adhere to universal service obligations as it supports the network externalities to have more clients. However, this depends on their market share which is not stable over time. At first a dominant operator can be keen on delivering universal obligations in order to maintain its large customer base and to keep a tie with the end user base. But over time when new entrants gain higher market shares, the formerly dominant operator may plead for sharing the costs of providing a universal service or will only accept to provide it against a financial compensation (either from government or through a universal service fund paid for by all market players).

² Of all common public interests, the topic of universal service or access and the ensuing obligations for providing such service in a competitive market received most attention in academic literature (European Commission, 1993a; Hudson, 1994; Xavier, 1995, 1997; Organisation for Economic Co-operation and Development, 1995; Rapp, 1996; Garnham, 1997; Mueller, 1997; Prosser, 1997; ITU, 1998; Milne, 1998; Cave, Majumdar & Vogelsang, 2002).

³ This is the literal quote which clearly contains a writing/printing mistake: the correct word is “inefficiency”.

Third, also the formulation of public values can change over time; they are not only subject to political perceptions but also to technological innovation. For example, the public service of access to a printed version of telephony registries can become obsolete with an increase of digital information sources to consult a telephone number.

Fourth, the above mentioned public values relate to the telecommunications services themselves. These services are deemed important for end users, which leads to the formulation of public values. In addition aspects of the labor market and working conditions can be considered a public value that is inherent to the fact that network-based sectors provide for extensive employment opportunities (Eckert, 2018). Due to the size of the network-based sectors these employment opportunities can be a significant percentage of the national labor market. Depending on the mandate this can be subject to regulation by a sector-specific regulatory authority or a labor authority (Eckert, 2018). Especially in the early days of liberalization in which a market becomes competitive, the loss of employment opportunities provided by the former (state) monopolist or the discrepancy in wages between the former monopolist and new market entrants can be a market issue, as Eckert presents in her article on the liberalization of the postal sector (Eckert, 2018, p. 186).

To summarize: the examples show the versatility of public values through time and how their provision is related to the network economics of the telecommunications market.

National Competition Authority: in contrast with the sector-specific regulatory authority, the NCA deals with the protection and promotion of consumer interests in general. The NCA applies generic competition law to markets that are sufficiently competitive. The NRA needs to contribute to the enhancement of competition in the telecommunications market.

Legal courts are active in dealing with appeals from market parties against regulatory decisions. Usually first appeal against a regulatory decision needs to be lodged with the regulatory authority itself. When the outcomes of this first appeal are not accepted, then a market party can turn to a legal court (Ottow, 2003; Andenas & Zleptnig, 2004) .

We are aware that other actors are involved in the mobile telecommunications market. However, we consider them as secondary actors in the CSTS as they provide components to the core market actors that we presented above. As such they are beyond the focus of our research. These secondary actors are, for instance:

- the hardware component providers who provide for the infrastructural components such as the antenna's, cables, and servers for the mobile system;
- application platform providers who develop platforms for mobile applications that are offered to the public, such as Google Play Store that offers applications, games, movies and e-books;
- mobile applications developers who play a role in new services development;
- content providers who develop (multi) media content, games, etc. for mobile applications;
- content aggregators who bundle content from different sources to present them as integrated content to subscribers (Ballon, Walravens, Spedalieri & Venezia, 2008; De Reuver, 2009; Troshani & Rao Hill, 2011; Sørensen, De Reuver & Basole, 2015).

Synthesis on multi-actor system

The multitude of actors in the telecommunications market have their own interests, but they also depend on each other to make the system function towards a “commonly accepted outcome....without necessarily forcing them to abandon their differences of viewpoint” (von Tunzelmann, 2003, p. 379). For example, although they are competitors, network operators also have the common objective to allow their clients to make calls to the clients of other network operators. This requires interconnection and interoperability to enable technical implementations that do not hamper trans-network communications. The implementation of interconnection and interoperability requires cooperation on the operational level.

Throughout the years, the actors are subject to change. A former state monopolist can have a dominant market position in a newly liberalized market, but over the years can be on a more equal footing with competing operators. Equally, a new market entrant can become a dominant market player on a specific market segment. Regulatory authorities became organized on the international level by a sequence of European regulatory bodies (Coen & Thatcher, 2008)⁴. In addition, end users became increasingly aware of their consumer power to choose amongst MNOs and SPs which enabled ‘voting with their feet’.

We conclude that the actors in the mobile telecommunications market are subject to change over the years. The institutional context sets the rules for market participation and the governance mechanisms. Both the multi-actor system and the institutional context are linked to the technological developments in the mobile system, which are presented in the next section.

1.3.3. Complexity in the technical system

The technological complexity of the mobile telecommunications market is rooted in the scarcity of spectrum and the technological innovations in the infrastructure. We elaborate on both in the following paragraphs.

The scarcity of spectrum is based on the physical characteristics of frequencies that can be used for mobile telecommunications (McMillan, 1995; Arnbak, 1997; Madden, Bohlin, Tran & Morey, 2014). Not every frequency range is suitable for wireless transmission and spectrum is also allocated to other types of communications such as satellite, radio and astronomy. This limits the range of suitable frequencies for mobile telecommunications. In general it can be stated that higher frequency bands allow for more bandwidth for mobile services, but also require a higher density of antennas to be installed. With the increase of the generations of networks, antenna planning becomes ever more complicated. Not only in a technical sense, also in the sense of public acceptance because citizens can be concerned about health issues due to radiation from the

⁴ In 1997 the NRAs formed the Independent Regulators Group (IRG) through a Memorandum of Understanding (Coen and Thatcher, 2008, p. 56). In 2002 an advisory body to the EC was installed with representatives from the NRAs: the European Regulatory Group for electronic communications networks and services (ERG), which was replaced by the Body of European Regulators for Electronic Communications (BEREC) in 2009 (European Parliament and the Council of the European Union, 2009). Coen and Thatcher characterize this trend as an “evolution of institutions for regulatory co-ordination” (Coen and Thatcher, 2008, p. 57).

antennas or they can object to horizon pollution (Arnbak & Ubacht, 1995; Suryanegara, Mirfananda, Asvial & Hayati, 2018).

The technological innovations in the infrastructure are spurred by subsequent generations of mobile networks from 1st to 2nd, 3rd, and 4th and recently the 5th generation (see Table 1). The subsequent technologies present challenges for the technical implementation of infrastructural elements in the network and for interconnection and interoperability between networks.

Table 1 Generations of mobile networks and their services in the EU

Generations of mobile networks	Transmission/frequency band	Standard	Services	Operational from:
1st (1G)	Analogue , 450 MHz	No European Standard: NMT, C-NET or TACS	Voice only	1980s
2nd (2G)	Digital, 900 MHz and 1800 MHz	GSM, GPRS, EDGE	Voice & data transmission	1990s
3rd (3G)	Digital, 1885-2200 MHz	IMT-2000/UMTS	Voice, Internet access, video calls	2000
4th (4G)	Digital, 800-900 MHz and 1800-2600 MHz	LTE (based in Internet Protocol)	Broadband mobile services	2009
5th (5G)	Digital, 700-1400 MHz, 2100 MHz and 3.5 GHz	5G New Radio (NR)	Real time data exchange, Internet of Things applications	2019

The MNOs design their networks with components from a diversity of hardware components providers. Subsequently, routers, antenna’s, cables etc. can come from different providers. Standardization is required to ensure seamless interconnection and interoperability between the mobile networks. The standardization processes are dealt with by standardization organizations such as:

- Comité Européen de Normalisation/European Committee for Standardization (CEN)
- European Committee for Electrotechnical Standardization (CENELEC)
- European Telecommunications Standards Institute (ETSI)
- International Organization for Standardization (ISO)
- International Telecommunication Union (ITU)

Every next generation of mobile networks allows for new licence allocations and can lead to new entrants in the market. Policy makers determine the number of licences and whether or not extant operators can apply for them (Madden, Bohlin, Tran & Morey, 2014). The licence will contain conditions on the way in which the infrastructure needs to be operationalized (Ministerie van Verkeer & Waterstaat DG Telecommunicatie en Post, 1994; Madden & Ahmad, 2013; Madden, Bohlin, Tran & Morey, 2014). The MNOs need to comply with these conditions, for which they will have to cooperate as well in order to provide for seamless services to end users. However, they will also strive for market share which can lead to anti-competitive strategic behavior that is at odds with the regulatory objective of a fair market.

Technical innovations also enable the development of new types of value added services and as a consequence can lead to market entry of new types of players in the mobile service ecosystem (Sørensen, De Reuver & Basole, 2015). These new players will negotiate with SPs, application platform providers or MNOs to gain access to end users. But also extant SPs may need to renegotiate their access to mobile networks when a technological innovation appears.

Access to new services based on technical innovations in the network may require end users to buy a new generation of mobile phones and new subscription to services. They can be confronted with barriers or high costs to switch their SP or with non-transparent tariffs of the new services/service packages.

Synthesis on technical complexity

The technical characteristics of the mobile telecommunications system illustrate the subsequent innovations on the infrastructure and services level and in end user equipment. The technical aspects of the mobile telecommunications system are closely related to the dynamics in the actor network. Innovation leads to new (types of) market players, but can also lead to tensions between extant and new market players alike.

The technological developments have consequences on different time scales: short term implementation issues versus hard to predict consequences on market structure and public values in the long term. For example, the implementation of a new generation of mobile networks requires an agreement on whether or not antenna sharing should be enforced by regulation or left to private negotiations between network operators. And if regulatory enforcement is deemed essential to attain timely coverage for end users, the conditions for new entrants or competitors to have access to antenna masts need to be formally formulated. On a longer timescale such a regulatory arrangement affects the market positions of the parties involved. Gaining insight into these consequences is necessary for regulatory authorities and market players alike, but it may require an incremental process. However, this can be at odds with developing regulatory arrangements to address short term issues.

The example illustrates the interactions between (dynamics in) the institutional context, the multi-actor and the technical system components. These interactions can lead to tensions in the market that we discuss in the next section.

1.4. Tensions in the mobile telecommunications market

The description of the mobile telecommunications system in the previous section illustrates that a diversity of tensions can lead to market issues for which regulatory authorities need to develop a regulatory arrangement in order to solve them. In this thesis a market issue is any reason for an NRA to perform activities in order to develop a regulatory arrangement. In Figure 1 we illustrate the tensions that can arise in the market as the physical or virtual area where transactions between suppliers and buyers of telecommunication services and end user equipment take place. The mobile telecommunications market can be divided into a retail market and a wholesale market (OfTel, 2001f, p. 3). In the retail market end users pay for mobile services to make phone calls, send short message services (SMS), have access to the Internet or value added services. In the wholesale market retailers, SPs and MNOs possess resources such as frequencies, infrastructure and service components, but also information content, a customer base and financial resources to invest. They operate on the wholesale market in a competitive or a collaborative way to create services that can be offered to end users in the retail market. Access to their mutual resources is based on wholesale tariffs (Troshani & Rao Hill, 2011). The distinction in the retail and the wholesale market segments can be linked to the layered telecommunications reference model that discerns several layers that

build upon each other: the infrastructure layer, the services layer, the retail layer and the end user layer (Arnbak & Ubacht, 1996, p. 15). We use these layers to visualize the specific tensions that can occur in both market segments (see Figure 1).

On the left hand side are the business-oriented objectives of market share and RoI. These objectives influence the way in which the network operators, SPs and retailers negotiate with the other market players in the wholesale market. Based on their business models they need to establish access to each other's resources to provide mobile services to end users. This can be access to infrastructure components, to services or to end users. The output of their activities is in the form of mobile services delivery to end users on the retail market, as indicated by the accolade in Figure 1. At the top of the figure are the end users who want to have access to mobile services against favorable conditions, e.g. against affordable retail prices. They depend on the terms and conditions for service delivery as determined by the market players, who are in their turn dependent on the conditions amongst themselves in the wholesale market.

At the right hand side of Figure 1 the regulatory objectives of public values and fair competition are visualized. Public values are formulated by policy makers to which the market as a whole needs to contribute. In principle fair competition can contribute to public values (e.g. low end user prices). However business-oriented objectives can hamper the attainment of public values. This can lead to regulatory intervention in the market. Fair competition is a regulatory objective to address anti-competitive behavior that can lead to unwanted market outcomes (e.g. market dominance which can lead to higher end user prices or predatory pricing that hampers market entry of new SPs).

We refer to the numbering in Figure 1 to systematically present the potential tensions in the market:

1. *on the infrastructure layer*: tensions between MNOs;
2. *on the services layer*: tensions between SPs and other SPs or MNOs;
3. *on the retail layer*: tensions between retailers and SPs or MNOs;
4. *on the end user layer*: tensions for end users to have access to mobile services.

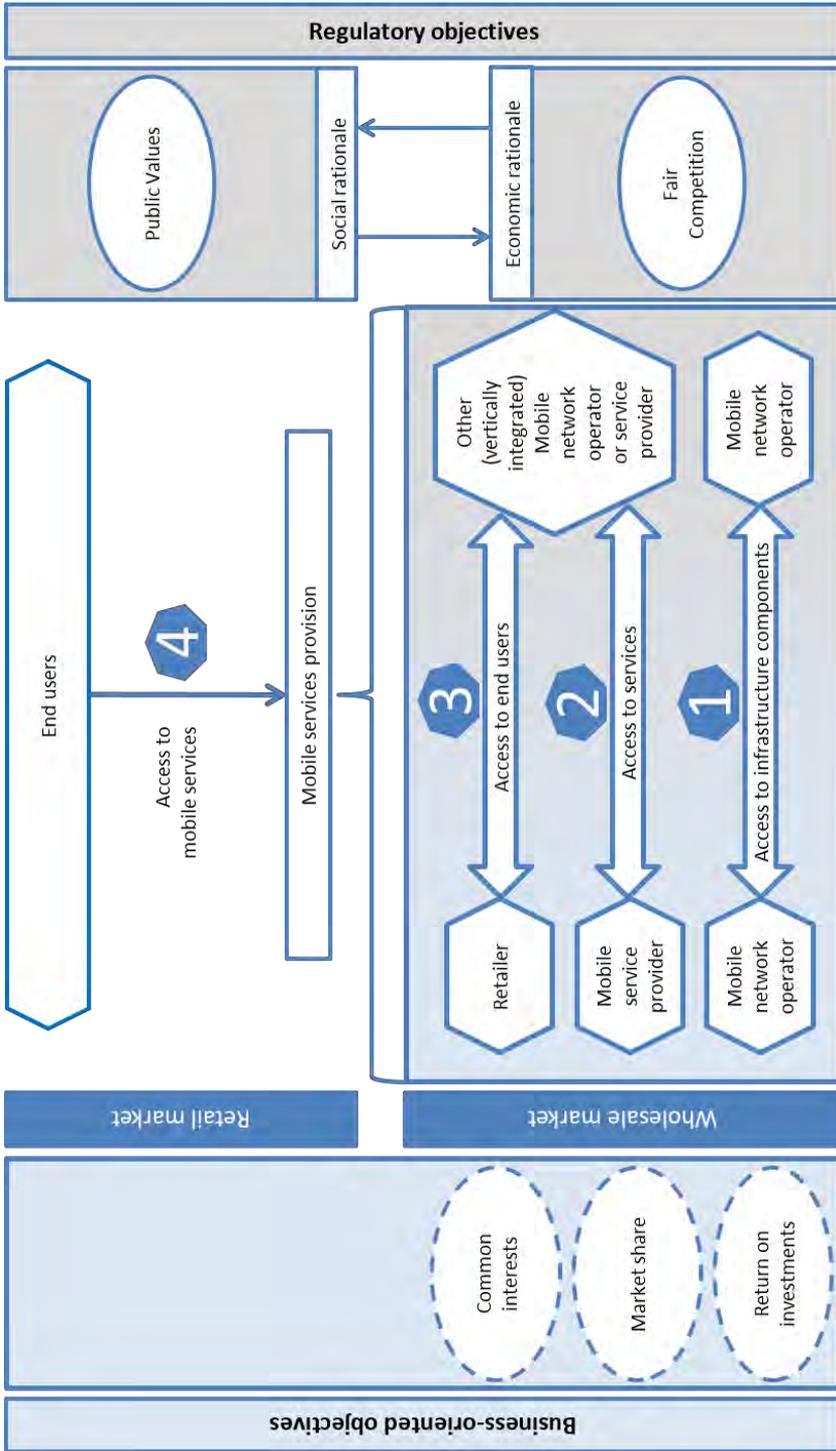


Figure 1 Overview of (potentially conflicting) objectives and tensions in the mobile telecommunications market

Legend: the numbers 1-4 in the figure are explained in the paragraphs 1.4.1-1.4.4.

1.4.1. Tensions between mobile network operators

On the infrastructure layer tensions can arise from the competition between MNOs who acquired licences to enter the market in order to roll out their mobile network (see number 1 in Figure 1). They compete for market share and RoI, but also need to negotiate access to infrastructure system components in order to interconnect their mutual networks. Without such interconnection, their end users will not be able to communicate with end users that subscribed to another network operator. In the negotiations strategic, anti-competitive behavior can occur. For example, an incumbent operator can delay the interconnection operations or can set the costs of access too high to deny a new entrant to make a profitable business case. These kinds of tensions can be dealt with by the regulatory authority in order to stimulate competition in the mobile market. A new entrant can address the regulatory authority for dispute resolution (Ottow, 2003; Atiyas, Doganoglu & Reichhuber, 2009).

1.4.2. Tensions between mobile network operators and service providers

On the services level SPs need access to mobile networks for delivery of their services to end users (see number 2 in Figure 1). Two major types of SPs can be active in the mobile telecommunications market. The first type is the vertically integrated network operator who is also an SP: a so-called dependent SP. The second type is the independent SP who needs access to a mobile network in order to provide services to end users. Services provided by these independent SPs can be in competition with the services of a dependent SP. This can lead to anti-competitive behavior from the vertically integrated network operator in negotiations for access at a reasonable price. The wholesale prices for access to the network are crucial for an SP to make a business case. Without regulation the SP can be denied access to a network or can only require access against unattractive tariffs. This will lead to less competition on the services level. When regulated access for SPs to mobile networks against reasonable prices is applied, this may facilitate new entrants in the market. New market entry can contribute to the regulatory objective of fair competition. However, regulating the prices for access at too low levels can also hamper the business case for the MNO who invested in the licence and the roll-out of the network and needs to continue investments in network maintenance and service development. Therefore a regulatory authority needs to carefully design a regulatory arrangement if such a tension arises in order to balance the interests of the market parties.

1.4.3. Tensions between retailers and service providers/mobile network operators

On the retail level retailers operate (physical or online) shops where end users can buy their subscription to mobile services either with or without the inclusion of a mobile phone (see number 3 in Figure 1). Again, a vertically integrated network operator will also operate on the retail level with such outlets, these are the dependent retailers. They sell subscriptions that are serviced solely by their own network. They compete with independent retailers on price and service packages. On the other hand, an MNO or SP that recently entered the market can route their subscriptions via independent retailers, saving on costs of a proprietary chain of outlets. These independent retailers sell subscriptions to services that are provided over multiple networks.

Tensions can occur from anti-competitive behavior between the dependent and independent retailers mutually and between the independent retailers and the MNOs (vertically integrated or not).

These first three types of tensions between strategic objectives at different levels of the mobile telecommunications system are rooted in the business models of the market players. Market share and ROI are the drivers behind their commercial strategies. However, in specific situations they also need to cooperate for interconnection, interoperability or to install technical improvements in order to maintain an integrated (inter)national telecommunications infrastructure.

1.4.4. Tensions for end users' access to services

End users who want to have access to mobile services can buy a subscription via a retailer, an SP or a network operator (see number 4 in Figure 1). These subscriptions can be a stand-alone subscription or a mobile telephone can be included. The main interests of the end users are affordable retail prices for making calls, sending short message services (SMS) and data bundles. These retail prices are the outcome of the negotiations between the market parties or the outcome of regulated wholesale or retail prices. The free choice of end users can be hampered by a lack of insight into the differences between subscriptions. In addition, the end user can be unduly linked to a contract which can hamper switching to a more attractive subscription. Beyond the contractual relationship that an end user has with an SP, regulatory objectives are in place to safeguard public values. These public values are formulated by policy makers and the regulator monitors whether the mobile telecommunications market contributes to fulfill these public values. In case of underperformance, the regulatory authority will intervene in the interest of all end users. In the next section we present the role of these regulatory authorities.

1.5. Regulatory practice in the mobile telecommunications system

In an increasingly interconnected world many uncertainties are embedded in the interdependence between system components, the multiple actors involved and the public values attributed to the system. This is the context in which a regulatory authority for a complex socio-technical system operates. The tensions in the complex mobile telecommunications system that we identified in the previous sections 1.3 and 1.4 are rooted in a diversity of sources.

In section 1.3 we presented the complexities in and interdependencies between the institutional, actor and technical subsystems and the tensions between them that can occur when a change in one of them takes place. This can lead to uncertainties for regulatory authorities that need to address these tensions when they lead to market issues. The challenge for regulatory authorities is to take the interaction between them into account, not only at a certain moment in time, but due the evolution and versatility also over time. Finger et al. denote this as the "coevolution between institutions and technology" (Finger, Groenewegen and Kunneke, 2005, p. 227). This coevolution makes it very hard to assess all interrelated factors that need to be taken into account for the development of regulatory arrangements and to ex ante predict the outcome of a regulatory arrangement on the mobile telecommunications system.

In section 1.4 we presented the tensions in the mobile telecommunications market as a the physical or virtual area where transactions between suppliers and buyers of telecommunication services and end user equipment take place. These tensions are based in the conflicting interests between market parties with their business-oriented objectives towards market shares and Rols on the one hand. On the other hand we see the regulatory objectives based on the social rationale to safeguard public values and the economic rationale for fair competition in the market.

In the EU Member States these tensions are addressed by independent sector-specific NRAs who perform regulatory activities to contribute to fair market competition and the safeguarding of public values (Kay & Vickers, 1990; Majone, 1997; Geradin, 2000). They need a proper understanding of the potential impacts of changes in the subsystems such as market changes, institutional adaptations and technical innovations to ensure beneficial outcomes for society. They also need to take the overall outcome of the market into account while not overregulating or being unpredictable in order not to harm the willingness to invest in the market. This requires mitigation of potentially adverse effects from the regulatory arrangements they develop. Theoretically full knowledge is required to assess the desirable effects, but in practice this is not feasible due to information asymmetry between actors in the system. Information asymmetry can be sustained by strategic behavior of the actors in the system. This makes it hard to assess the short and long term effects of regulatory arrangements which leads to uncertainties for the NRAs. To illustrate the dilemmas for regulatory authorities, Mansell et al. describe regulation in the transition era from the former state monopolies towards a competitive telecommunications market as the need ‘to navigate a route between the Scylla of monopoly power, network integration and political interference, and the Charybdis of competition, network fragmentation, and government indifference to social consequences’ (Mansell, Davies and Hulsink, 1995, p. 273). We aim to conceptualize the way in which regulatory authorities do so, which entails that our focus is on the regulatory perspective as visualized in Figure 1 and not on the business-oriented objectives (as indicated by the dotted lines in Figure 1).

1.5.1. Need for conceptualization

Based on a literature review that we present in full in chapter 2, we conclude that no studies have looked into how regulatory authorities deal with the tensions in the market that are rooted in strategic behavior amongst the market players and the safeguarding of public values and consumer interests in practice. Neither do these studies view the market as part of a wider CSTS in which changes in the institutional, actor and technical subsystems interact and lead to uncertainties for regulation.

Extant literature is rather focused on studying the use and effect(s) of specific, single regulatory arrangements in the market. As such they are oriented towards assessing the outcome of the regulatory process and its effect on the market, they primarily address one type of intervention and are mostly short term oriented. For example a study into the effect of the obligation to provide mobile number portability on end user switching behaviour between mobile service providers yields a single moment effect of a specific regulatory arrangement in the market. But such a study does not show how NRAs deal with the uncertainties of the effect of the regulatory arrangement in the wider context of the system in developing the regulatory arrangement. Neither does it address an extended period of regulatory practice. As such extant literature provides for indepth analysis of

specific, isolated regulatory arrangements. However these studies do not represent the mobile telecommunications system as a CSTS in which a range of tensions are dealt with over an extended period of time. A complex system that is subject to tensions from a diversity of sources, in which uncertainties need to be dealt with, and in which social and economic interests need to be weighted in the development of regulatory arrangements. To understand these complexities we need to study the regulation of such a complex market by going beyond the analysis of single regulatory arrangements and by going beyond short term regulatory periods. A study into regulatory practice of NRAs who deal with many market issues simultaneously in a changing context goes beyond specific, single regulatory arrangements.

In addition, we found in the literature review that authors tend to take an economic or legal perspective on the regulation of mobile telecommunications markets. In our study we choose for an open socio-technical perspective on regulation of complex socio-technical systems to remain as close as possible to the actual way in which regulatory authorities deal with the challenges to develop regulatory arrangements.

Showing the complexity in a CSTS is challenging for defining the boundaries of the system and for capturing and analyzing the empirical data when going beyond single regulatory arrangements. We therefore choose to develop a conceptual framework in which the relationships between concepts are presented on an abstract level. The objective of this study is to develop a conceptual framework that explains the way in which regulatory authorities deal with the tensions and uncertainties in the complex mobile telecommunications system in their aim to develop regulatory arrangements. Taking the taxonomy of theory types as presented by Gregor (see Table 2), our framework will provide for a theory type 2 'Explanation' in the taxonomy of Gregor: it will demonstrate 'what is, how, why, when and where'. We take a process-oriented perspective on regulatory practice, which we define as the activities of a sector-specific NRA in the process of regulating the mobile telecommunications market. Market issues arise from tensions in the mobile telecommunications system. In 1.4 we defined market issues as any reason for an NRA to perform activities in order to develop a regulatory arrangement.

Table 2 Taxonomy of theory types in information systems (copied from (Gregor, 2006, p. 620))

Theory type	Distinguishing Attributes
I. Analysis	Says what is. The theory does not extend beyond analysis and description. No causal relationships among phenomena are specified and no predictions are made
II. Explanation	Says what is, how, why, when, and where. The theory provides explanations but does not aim to predict with any precision. There are no testable propositions.
III. Prediction	Says what is and what will be. The theory provides predications and has testable propositions but does not have well-developed justificatory causal explanations.
IV Explanation and predication (EP)	Says what is, how, why, when, where, and what will be. Provides predictions and has both testable propositions and causal explanations.
V. Design and action	Says how to do something. The theory gives explicit prescriptions (e.g. methods, techniques, principles of form and function) for constructing an artifact.

1.6. Scientific relevance

The scientific relevance of this study is in the contribution to regulatory studies that so far lack a socio-technical perspective of the regulatory process in CSTS. With our study we want to contribute to these regulatory studies by developing a conceptual framework that explains the way in which

regulatory practice in CSTS is performed. Due to the complexities of regulatory practice in CSTS, the conceptual framework will be a process-oriented framework as complexities make it hard to predict tensions and uncertainties in the system and as such causality is hard to establish.

By developing this conceptual framework we aim to complement the outcome (effect) oriented studies into regulation of mobile telecommunications markets by taking a process-oriented approach to regulatory practice. Such a process-oriented approach fits with the complexities in the mobile telecommunications system that lead to tensions and uncertainties that are hard to predict, not only at a certain moment in time, but also over an extended period of regulation.

Our conceptual framework will show the relations between concepts to explain the complexity of regulatory practice. Our aim is not to explain causal relationships between the concepts. By means of a conceptual framework we can show how the interactions between the institutional, multi-actor and technological subsystems lead to tensions in the mobile telecommunications system and to market issues that need to be addressed by the NRAs.

1.7. Societal relevance

The conceptualization of regulatory practice that we aim to develop in our study will give regulators, policy makers, market parties and the public a means to understand the market tensions and the uncertainties that influence regulatory practice in the complex mobile telecommunications system. This conceptualization can support the assessment of tensions in the market when next generations of mobile networks will yield changes in the institutional, multi-actor and technical subsystems. We aim to develop concepts that can be used to assess the relationship between these changes and to discuss them with other actors in the market to explore how the market issues can be addressed by means of regulation or other types of governance.

1.8. Structure of this thesis

In this chapter we introduced the complexities of the mobile telecommunication system. Complexity has its roots in the interaction between the institutional context and the multi-actor and technical (sub)systems. We showed how this leads to tensions in the market between the main market players and the end users. The business oriented objectives of the market players and strategic behavior can lead to tensions with the policy objectives of fair market competition and public values. The sector-specific regulatory authorities need to develop arrangements to deal with unwanted outcomes, in the short and the long term. Our objective is to develop a conceptualization of regulatory practice that explains how regulatory authorities deal with regulating the complex mobile telecommunication system.

In chapter 2 we present a description of the institutional context of the mobile telecommunications market in the EU by means of a historical overview of the regulatory framework over the past decades. Part of this framework was the installment of sector-specific regulatory authorities. They have been subject to many academic studies over the years. By means of a literature review on regulatory practice in the mobile telecommunications market over the period 1989 to 2019 we substantiate the academic knowledge gap to which we want to contribute. The literature review shows that a process-oriented perspective on regulatory practice is lacking. Such a process-oriented

perspective will not only contribute to knowledge on the sources of complexity over an extended period of time. By taking a socio-technical perspective, we also illustrate the way in which regulators deal with tensions that are based in the interactions between the technical, actor and institutional subsystems on an operational level.

In chapter 3 we present our research design that is based on a Grounded Theory (GT) approach. As we want to do justice to the context of CSTS unrestricted by previous theories, we decide to choose an inductive research approach that provides a structured research process for the use of empirical data. The empirical data allows us to remain close to actual regulatory practice. We use the data to develop a core category that explains the way in which regulatory authorities deal with tensions and uncertainties in the mobile telecommunications system. The research process consists of the phases of open, selective and theoretical coding towards conceptualization as well as a conceptual comparison with extant concepts of regulatory practice in general domains of regulation.

In chapter 4 we first present an overview of market issues in the mobile telecommunications market. This overview is based on the empirical data of 61 regulatory dossiers in three countries (the United Kingdom, the Netherlands and France) over the period 1997-2002. A (regulatory) dossier is a series of documents that pertain to a specific market issue and represent the sequence of regulatory activities to develop a regulatory arrangement. They represent the tensions between the actors in the system as illustrated in Figure 1. Based on these dossiers we construct the dimension *Market Issues*.

In chapter 5 we analyze how the regulatory authorities addressed the market issues in the development of a regulatory arrangement. To this end we reconstructed the 61 dossiers and applied line by line (open) coding to the regulatory activities. In the selective coding phase we grouped these activities in order to reach for a higher level of conceptualization. The dimension *Regulatory Activities* is the deliverable of this chapter.

In Chapter 6 we present the initial conceptualization of regulatory practice. By combining the dimension *Market Issues* from chapter 4 with the dimension *Regulatory Activities* from chapter 5, we present the core category of regulatory practice. This core category explains the main concern of the regulatory authorities in dealing with market issues. In this chapter we also present the additional dimensions based on our coding of the empirical data. We integrate the core category and the additional dimensions to create the first version of our conceptual framework.

In chapter 7 we compare our initial conceptualization with concepts of regulatory practice from extant literature. On the one hand this comparison leads to our final conceptualization of regulatory practice in the mobile telecommunications system. On the other hand we show how our conceptualization contributes to concept from extant literature.

In chapter 8 we evaluate our conceptualization to assess the extent in which it explains the way in which regulatory authorities deal with the tensions and uncertainties in the mobile telecommunications system.

In the final chapter 9 we present the outcomes of our study by presenting and discussing the conceptual framework of regulatory practice. Our conceptualization contributes to understanding the tensions and uncertainties in the mobile telecommunications system and our process-oriented

perspective shows how these are addressed by the NRAs. In addition, we discuss the scientific and societal relevance of our research. In this chapter we also reflect on our research process and limitations and we formulate future research topics.

An overview of the structure of this thesis is visualized in Figure 2.

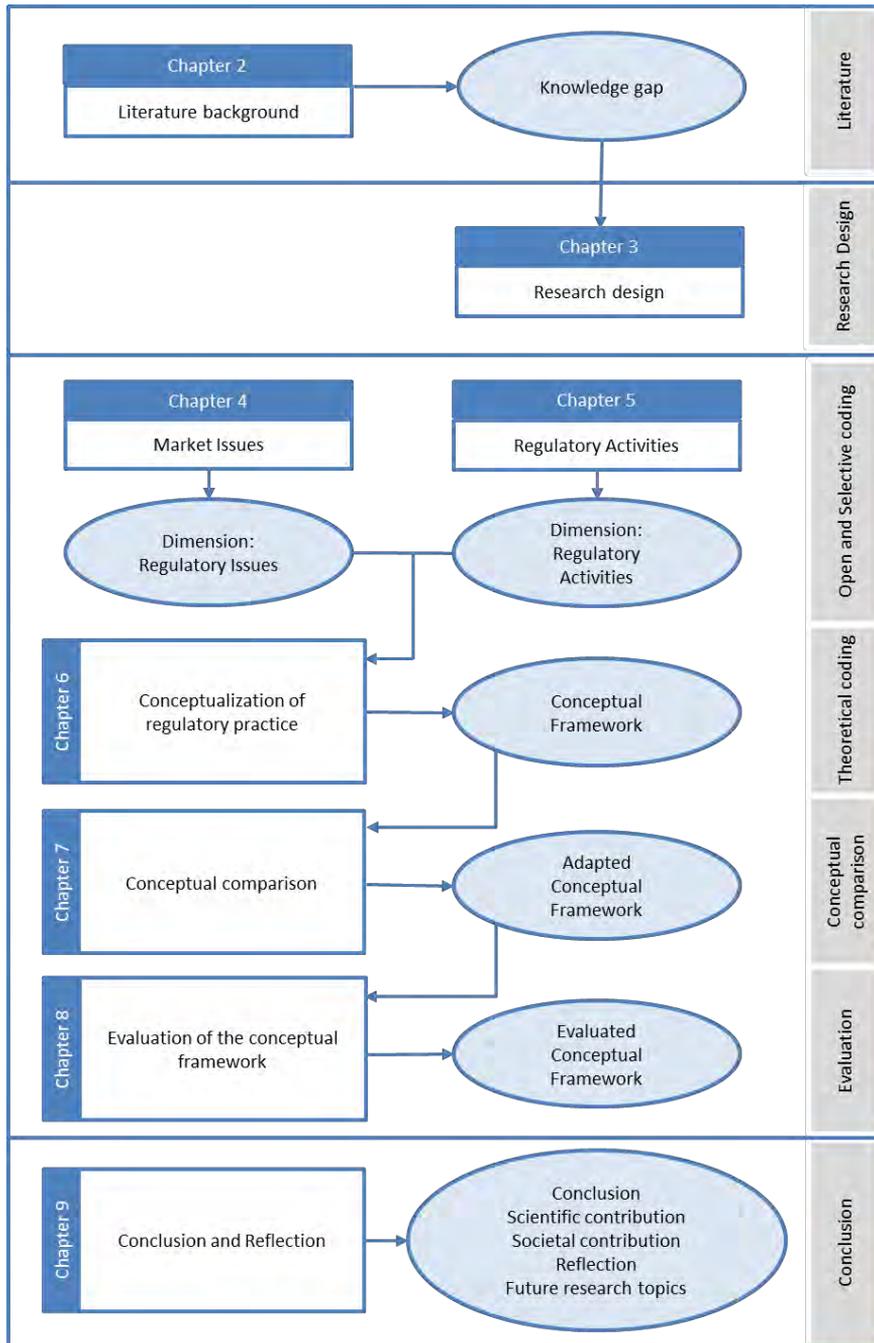


Figure 2 Structure of this thesis

2. Literature Background

Regulation is 'the need to navigate a route between the Scylla of monopoly power, network integration and political interference, and the Charybdis of free market competition, network fragmentation, and government indifference to social consequences' (Mansell, Davies & Hulsink, 1995)

2.1. Introduction

Regulation of the mobile telecommunications market has two major objectives: safeguarding public values and fair competition in the market. In section 1.4 we presented the tensions in the mobile telecommunications market that can hamper these objectives. In the EU Member States sector-specific NRAs were installed to monitor the telecommunications market after the liberalization in the 1990s. Their task is to contribute to solving the tensions between the market parties that arise from conflicting interests. In addition they monitor the extent in which the market contributes to the public values that have been formulated by policy makers (see visualization in Figure 1). If necessary the authorities develop regulatory arrangements to deal with market issues that hamper either of the two objectives of safeguarding public values and/or reaching fair market competition.

In this chapter we present the origins and institutionalization of the NRAs to introduce the context of their functioning. Thereafter we present a literature review of academic studies that analyzed the way in which they regulated the mobile telecommunications market.

We start with a historical overview of the changing landscape of regulation after the liberalization of the telecommunications market the EU Member States in section 2.2. With this overview we describe the background of the installment of the regulatory authorities as part of the liberalization of the telecommunications market in the 1990s. Next, we address the motivations and the institutional design of these sector-specific regulatory authorities to characterize these organisations in section 2.3. From their inception and throughout their years of operation, many researchers in a diversity of academic disciplines published research into the functioning of NRAs for the telecommunications market. In section 2.4.3 we present our literature review in which we analyze how academic researchers addressed the way in which regulatory authorities dealt with tensions in

the mobile telecommunications market. We use this literature review to substantiate the knowledge gaps in academic literature on regulatory practice. Based on this literature review we present our research objective to conceptualize regulatory practice in section 2.5.

2.2. Changes in the institutional subsystem

CSTS are averse to large changes as “large mature systems would usually accept only incremental change often characterized by technology lag and very slow adaptation of structure” (Bonon, 1979, p. 2). Yet, major changes occurred in the 1980s when the institutional context of infrastructure-based markets in general and the telecommunications market specifically changed rapidly.

In the 1980s the political perception of the role of the state changed from centralization towards decentralization. This led to a reconceptualization of the role of formal institutions. As Moran and Prosser present: the increased focus on market forces was not only about economics, but also about trends in politics and constitutions (Moran and Prosser, 1994a, p. 1). This paradigm shift led to a shift in the provision of services provided by state monopolists towards competitive markets in which private companies manage the networks and services (Picciotti, 2002, p. 1-11). The paradigm shift required new policies to create laws and regulation to operationalise this transition. In the next sections we provide a condensed overview of how this paradigm shift led to a major change in the institutional subsystem of the telecommunications system.

2.2.1. Phases of governance of the telecommunications market

As shown in Figure 3 four main phases can be discerned in the governance of the telecommunications market:

Phase 1: In the late 19th/early 20th century telephony services in Europe were provided over a limited number of networks in private exploitation. Telecommunications services started as a private initiative.

Phase 2: In the early/mid-20th century telephony services were considered to be a public necessity due to their value to society. The economic view of those days was that a state monopoly was the best option to take care of the delivery of telecommunications services and the management of telecommunications networks. This was translated into a model of monopoly exploitation of public telecommunication networks, exploited by national state companies, which were called the national PTTs (Post, Telegraphy and Telephony) (Hulsink, 1999). This led to one unified national telecommunications network.

Phase 3: In the late 20th century the European Commission (EC) initiated the full liberalisation of the telecommunications market, leading to interconnected local and (inter)national telecommunications networks provided by private companies, including the privatized former state monopolist. Sector-specific regulatory laws aimed at stimulating competition in the market.

Phase 4: from 2002 onwards a new regulatory framework (NRF) based on concepts from general competition law was implemented in the EU Member States to sustain the competition in the telecommunications market.

In this study we focus on phase 3: the transition from a monopolist market towards a competitive market. In the following paragraphs, we provide a condensed historical overview of the liberalisation and privatization that led to this phase that is characterized as a phase of competition engineering.

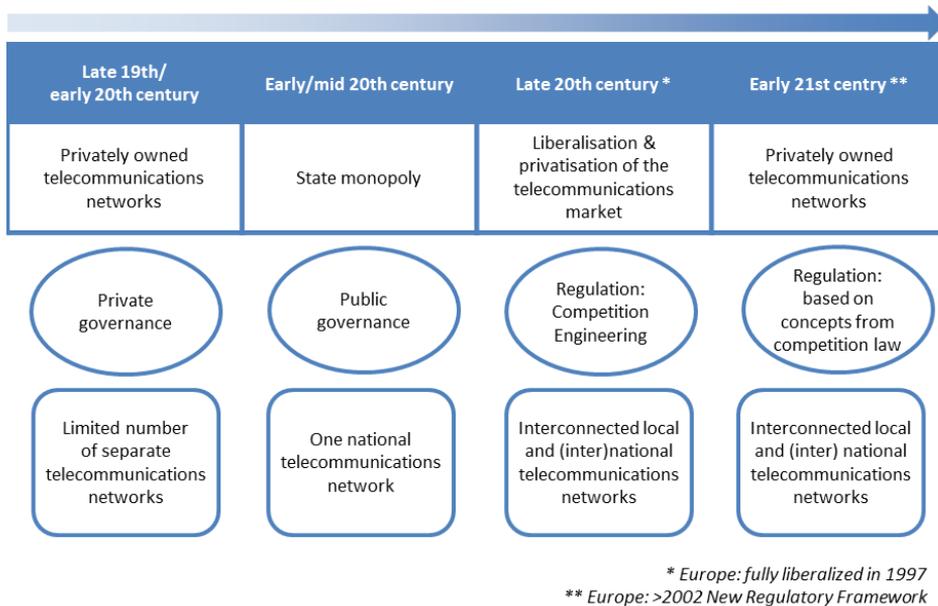


Figure 3 Phases of governance in the telecommunications market in Europe

2.2.2. From monopoly to a competitive telecommunications market

The model of monopolistic exploitation of phase 2 was challenged in the 1980s and 1990s by an overall wave of privatization and the creation of a regulatory state in the Western world. The perception was that market forces had to be the main driver for economic growth, as opposed to the reliance on the role of government. Discussing the consequences for infrastructure-based sectors, Künneke and Groenewegen describe this as a “readjustment of governance [that] consists of stronger involvement of private sector initiatives, allowing for competition in certain parts of the value chain, and arm’s length regulation of governments” (Künneke and Groenewegen, 2009, p. 1). This reliance on market forces changed the perception of the structure for the delivery of utility services, including the telecommunication sector (Hulsink, 1996; Majone, 1997). Hulsink mentions four driving forces behind the regulatory reform in the telecommunications market:

- the digital revolution in information and communication technology (ICT);
- globalization and differentiation of communication markets;
- international deregulation (specifically in the United States of America, the United Kingdom and Japan) and
- European integration leading to community-wide policies (Hulsink, 1999, p. 75-76)

Technological advance in the last decades of the 20th century led to chances for innovative telecommunications applications and services and thus to opportunities for economic gain. The EU recognized that the politicized and bureaucratic nature of the state monopolist telecommunications

operators prevented them from taking full advantage of these opportunities. In comparison to the United States, the European telecommunications sector performed poorly in quality, end user tariffs and technological innovation (Nihoul, 2002, p. 8). In reaction to this situation the EC decided to start a major liberalization program for the telecommunications sector (like in other network-based sectors) (Nihoul, 2002).

In its vision to create a common market with free movement of goods, persons, services and capital, the EU set up a regulatory reform program for network-based industries such as the telecommunications, energy and public transport sector (European Commission, 1993b). The reform program for the telecommunications industry was based on the desire for a broader variety of telecommunications services at more attractive tariffs, specifically for international corporate users (Verhoest, 1996; Hulsink, 1999). Also, governments felt an urge to provide incentives for new investments and innovation in networks and services in order for the European telecommunications industry to compete with the already liberalized telecommunications industries in the United States of America and Japan (Verhoest, 1996, p. 211). The EU desired fully interoperable and interconnected trans-European telecommunications networks and services because of their supporting role in other sectors of economic activities (Verhoest, 1996, p. 212; Melody, 1999, p. 9). And finally, a well-managed and innovative ICT sector was considered paramount for the transition into an information age, which the EU considered as one of the means to battle against the then high level of unemployment and falling economic productivity in the EU Member States (European Commission, 1993b; Verhoest, 1996, p. 212).

In the EU Member States decentralization of governance meant that policy implementation was no longer the exclusive domain of national governments. On the one hand new models for governance were created that were more in line with the neo-liberal trend towards market competition. Bureaucracy made way for new arrangements such as privatization, public-private partnerships, quasi-public corporations, franchises, covenants, etc. (Osborne & Gaebler, 1992; Moran & Prosser, 1994a; Van Thiel, 2000). This trend led to the instalment of expert agencies that received regulatory powers to act independently from political control. On the other hand the role of international regulation, specifically that of the EU, became increasingly important. Independent international regulatory agencies increasingly set the scene in Europe (Majone, 1996, p. 2; Coen and Thatcher, 2008) and European law increasingly defined the statutory frameworks for NRAs. These two trends have had an important impact on the design of regulatory frameworks in network-based industries in the EU Member States.

The EU regulatory reform of the telecommunications market consisted of several elements that were captured by the EU Directives to operationalize the new regulatory framework:

1. liberalization and harmonization;
2. deregulation;
3. generic competition law and
4. privatization (Dommering *et al.*, 1999, p. 123).

We describe these elements in the following paragraphs.

2.2.3. Liberalization of the telecommunications market

Liberalization entailed that the regulation of the telecommunications sector was changed in such a way that the sector gradually transformed into a sector where the forces of supply and demand became dominant. This led to opening of the market for entry to other (competing) network operators and SPs. This process was guided by a series of EU Directives that aimed at the introduction of competition in an increasing number of market segments, such as the market for terminal equipment in 1988 (European Commission, 1998b) and the mobile market segment in 1996 (European Commission, 1996b). The liberalization process was completed in 1998 by the Full Competition Directive for the opening of the entire telecommunications market (European Commission, 1996c).

The liberalization process was combined with the *harmonization* of regulatory frameworks in all EU Member States. These was addressed in EU Directives such as the *Open Network Provision Directive* and the *Licensing and Interconnection Directives* (European Parliament and the Council of the European Union, 1998a). More specific directives were aimed at harmonized norms for and mutual recognition of end user devices such as *Directive 1999/5/EC on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity* (Dommering *et al.*, 1999, pp. 123-124; 143-149; European Parliament and the Council of the European Union, 1999).

2.2.4. Deregulation of the telecommunications market

The deregulatory aspect of the regulatory reform meant a shift from a principal/agent planned governance of the market towards the regulation of private competitors in a liberalized market. As the term regulatory reform indicates, deregulation did not equal less regulation or the abolishment of regulation.

First of all, former regulation by means of state ownership had to be replaced by another form of governance of the telecommunications market because liberalization would not solve all market imperfections. Moran and Prosser correctly state that deregulation is in many cases not the same as the retreat of the State. Deregulation can also require “the creation of new institutions and the development of newly elaborated rules” (Moran and Prosser, 1994, p. 9).

Secondly, especially deregulation in network-based industries does not mean ‘no regulation at all’ when they are labelled as utility sectors. Because of the socio-technical characteristics of the telecommunications market as presented in section 1.3, the market cannot do without some form of regulation after liberalization. In order to illustrate the potential tension between these two in the telecommunications market, Melody states that “[f]rom an economic perspective the services should satisfy the full range of consumer demand and be supplied under conditions of optimal efficiency. From a social perspective, the service should be made available to everyone on reasonable terms, whether or not it is profitable to do so” (Melody, 1997, p. 15).

Third, political considerations can support the wish to continue regulation of specific sectors (Wymbs, 2004). Wymbs refers to the role of self-interest of governments and regulators that leads them to retain a grip on (telecommunications) markets through regulation. He sees telecommunications regulation as a means for government bargaining and states that “throughout

the century government has maintained its authority to regulate and has faced strong political pressure to keep prices unrealistically low to encourage one group of customers to cross subsidize a more politically sensitive customer set.” (Wymbs, 2004, p. 690). Spiller also refers to possible opportunistic behavior in utility regulation. Once an organization in a utility sector has largely invested in specific assets and its service are massively consumed, political influence may be exerted to influence retail price levels or to encourage specific investments or a specific employment policy. Spiller calls this type of political influence “expropriation of the firms’ sunk assets” by administrative means (Spiller, 1996, p. 480).

2.2.5. Generic competition law

During the process of institutional reform special attention had to be paid to the relationship between generic competition law and sector-specific regulation because the latter also contains rules on competition and anti-competitive behavior between organizations.

Specifically in the first stages of liberalization of network-based industries, the application of general competition law by competition authorities to regulate market behavior is not considered sufficient because competition in the sector is not reached (yet). A Competition Authority is equipped to monitor competitive markets in order to prevent them from becoming less competitive. This is done by the application of general competition law. The tasks of a sector-specific regulator is developing and controlling the rules on which market competition is based in such a way that the market makes a transition from a monopolist structure towards a competitive structure or stays sufficiently competitive (Dommering, Verberne, Burger & Sitompoel, 1999) .

Thus, sector-specific regulation is aimed at *ex ante provisions* in order to prevent anti-competitive behavior by setting and monitoring rules that market parties need to adhere to. These *ex ante* rules are aimed at making non-competitive markets more competitive (Intven, Oliver & Sepúlveda, 2000a). Generic competition law, more specific the anti-trust component, is based on *ex post evaluation* of anti-competitive behavior, to safeguard a degree of competitiveness in an already competitive market (UNESCAP, 2001b). The distinction between these two was particularly clear during the early years of liberalization, but gradually when the telecommunications market became more competitive, a new regulatory framework was developed by the EC that included a market analysis approach that is more based on concepts from generic competition law (see phase 4 in Figure 3). This new regulatory framework for electronic communications (Directives 2002/21/EC on a common regulatory framework for electronic communications networks) became valid from 2002 onwards (and was adapted in 2009) (European Parliament and the Council of the European Union, 2002).

2.2.6. Privatization of the telecommunications market

As last element of the regulatory framework the privatization provisions in the EU Directives entailed that the ownership structure of the former monopolist PTT changed from state into private hands. In the beginning many national governments retained a (golden) share in these privatized PTTs and only gradually reduced this share over the years (Hulsink & Schenk, 1998). The entire regulatory reform was aimed at lower prices for telecommunications services, a higher level of innovation and a wider choice in telecommunications services. A competitive environment in which commercial

organizations optimize their networks and services to meet market demand was expected to offer more incentives for satisfying “the preferences of [the] customers” (Sappington and Weisman, 1996, p. 2) than a state monopolist that operates within a politicized budgeting framework. The regulatory reform led to a change in the structure of the sector from services supply by a public monopoly to competitive services supplied by privately owned companies (Eliassen and Sjoavaag, 1999, p. 6).

The changes in the regulatory framework turned the telecommunications market from a monopolistic market with one network operator that manages a unified infrastructure into a more CSTS based on a network of subsystems that are managed by multiple private operators. In chapter 1 we already described the complexities in the multi-actor system and the technical system and how they are connected. In the next section we present why and how NRAs were created to perform a regulatory role in the multi-actor system.

2.3. Sector-specific regulatory authorities

The EU Directives that led to the liberation of the telecommunications market in the European Members States (European Commission, 1996c) contained the requirement to all Members States to install an independent NRA for the telecommunications market. In the following paragraphs we present the motivations to install a sector-specific regulator in the EU, their institutional design and their functions.

2.3.1. Motivations to install a sector-specific regulator

In the academic literature, the following motivations for the instalment of (sector-specific) regulatory authorities in network-based industries are presented.

First, the wish to *disconnect politics from the operation of the networks*. Also after liberalization and privatization, the state often retains a (golden) share in the companies of former state monopolists. The role of government as stakeholder in a privatized network industry is at odds with the desire to enhance competition in the same sector (Hulsink, 1999). The form of an independent regulatory authority was chosen to keep some sort of control by government while putting policy implementation at arm’s length of politically motivated bureaucrats;

Second, the intention to *enhance efficiency and effectiveness of policy implementation* by pushing decision making down to lower levels of government, by which faster decision making is accommodated (Osborne & Gaebler, 1992);

Third, to allow for *organizational specialization and expertise*. As regulatory authorities operate closer to the market, they can develop a better knowledge of the environment and be more reactive to the events in the market. The complexities in the market requires in-depth knowledge and as such the authorities are considered to act more efficiently (Haggard, 1999).

Fourth, the idea that regulatory authorities fit in with the trend from vertical, command/control relations in governance towards horizontal networked governance (Osborne & Gaebler, 1992; De Bruijn & Ten Heuvelhof, 1995; Majone, 1997). This works two ways. An OECD study mentions: “input to the regulator that is based on real-life experience in the activity of being regulated can help the regulator to find better solutions” (OECD/PUMA, 2000, p. 19). In addition: “substantive dialogue

between regulators and the target group contributes to a win-win strategy, since dialogue can increase the quality of regulation and ease compliance concerns, which is good for both sides” (OECD/PUMA, 2000, p. 19).

Fifth, the institutional framework for regulatory authorities, allows for a *more elaborate toolbox* for regulation than possible under competition law such as Competition Authorities do. Therefore a regulatory authority is deemed to be more flexible in its response to anti-competitive behavior or sub-optimal social outcomes than a Competition Authority that is restricted to applying general competition law and regulations (OECD, 2000, pp. 8-9).

Sixth, Egan mentions a political consideration that plays a role in the decision to install an authority that takes care of regulation: “If agents are unable to reach some form of negotiated agreement, being able to shift the blame onto agents may be another reason for choosing to delegate” (Egan, 1998, p. 488). In the regulatory framework for liberalization of the telecommunications market, the EC included the obligation for the EU Member States to install independent regulators in order to limit the role of politically inspired decision making after sector reform. In the next paragraph we present the institutional design that was chosen for these NRAs.

2.3.2. Institutional design of a sector-specific regulator

One of the first steps in the liberalization process was to separate the regulatory function from the operational functions. In the *Green Paper on the development of the common market for telecommunications services and equipment* of 1987, the European Commission states that the “separation of regulatory and operational activities is a most important prerequisite for any effective application of competition rules to the providers of telecommunications services” (European Commission, 1987, par. 4.3.2), but see (Council of the European Communities, 1988, point 5), where the addition ‘with due regard for the situation in each individual Member State’ is given.

In the *Services Directive* that followed the *Green Paper*, the EC included the following article: “Member States shall ensure that from 1 July 1991 the grant of operating licenses, the control of type approval and mandatory specifications, the allocation of frequencies and surveillance of usage conditions are carried out by a body independent of the telecommunications organizations” (European Commission, 1990, art. 7). The intention was to separate the operational activities and management of the telecommunications networks from the regulatory function. Therefore, in order to limit the role of politically inspired decision making after sector reform, the EC prescribed the instalment of independent regulators to monitor the telecommunications market. These sector-specific regulatory authorities in the EU Member States had to be formally independent from interested parties such as telecom operators and ministries.

The EC did not prescribe the formal form of this ‘body’: the choice of institutional form and the specification of their mandates were left to the EU Member States. Steinfield, Bauer and Caby comment that “[t]he Green Paper on telecommunications called only for a separation between the regulatory and operational functions of telecommunications administrations – it did not contain any specific guidelines as to how this separation should be achieved.” (Steinfield, Bauer and Caby, 1994, p. 43).

According to *Directive 97/13/EC* an NRA is “the body or bodies legally distinct and functionally independent of the telecommunications organizations” (European Parliament and the Council of the European Union, 1997a). This definition means that the following institutions can take up the role of regulator: the Competition Authority, a “functionally separate regulatory body within the Ministry”, the Ministry itself or an independent regulatory (OECD, 2000, p. 11).

In practice all EU Member States chose for a sector-specific regulator for the telecommunications market that was independent not only from the telecommunications organizations but also from the national Ministry for Telecommunications (OECD, 2000, p. 8). This choice to separate regulation and legislation was the most obvious one especially in those countries of which the governments retained shares in the telecommunications organization after privatization. In all cases, a politically independent regulator was considered the best basis for non-biased regulation in a market with new entrants that come to compete with the former monopolist (with subsequent shrinking market shares for the latter and its shareholders, including national governments).

Usually formal arrangements laid down in law or more informal arrangements e.g. in the form of a mutual protocol were set up to specify the relationship between the telecommunications regulator and the competition authority. These arrangements had to prevent forum-shopping by market parties (Nihoul, 2002, p. 15). But the arrangements were also made in order to prevent the regulators from getting into conflict over specific market issues. In the case of overlapping jurisdiction, the arrangements provided protocols for dealing with this. Such arrangements served to limit regulatory uncertainty in the sector. In the legal co-ordination mechanism it is even possible that the NRA has powers that are based on general national competition law (OECD, 2000, pp. 22-23).

2.3.3. Functions of the sector-specific regulator

The sector-specific regulatory authorities were installed to stimulate the transition of the telecommunications market from a monopoly to a competitive market. Their roles were to interpret and apply the national telecommunications law in order to assist the market to develop from a non-level playing field with a dominant former state monopolist into a (more) competitive environment with new entrants. This entails mitigating the negative network externalities in favor of a more competitive market in which new entrants are able to have an attractive business model. On the other hand to prevent cherry picking by new entrants that could endanger the provision of public universal services that need cross-subsidization. On the other hand in the realm of consumer-oriented social regulation the end users of telecommunications services needed to be made aware of their own choice and empowered to make use of the growth in providers and services. The end users went from a situation of having no choice at all to a situation of a multitude of services, choice of SPs and choice of end user equipment.

In practice, many telecommunications regulators were limited to telecommunications carriers and services, with other institutions (separate regulators or Ministries) that monitored the radio and television broadcasting and the cable industry. Over time, due to the increased convergence between these formerly separate markets and increase in market competition, the functions of the regulatory authorities involved can merge into one authority, or into sub departments of the NCA. In our study, we focus on the function of the sector-specific regulator in the (mobile)

telecommunications market, thereby excluding the domains of broadcasting and the cable industry, which can also fall under the jurisdiction of the regulator.

Since the installment of the NRAs for the telecommunications market, they have been subject to many academic studies, from many different perspectives. We are interested in the way in which the NRAs dealt with tensions in the mobile telecommunications market. Therefore we performed a systematic literature review of academic literature on regulatory practice in the mobile telecommunications domain. We present the results of this literature review in the following section.

2.4. Contextual literature review on regulatory practice

We conducted a systematic literature review into regulatory practice in mobile telecommunications markets. We analyzed academic research into the functioning of the NRAs in the mobile telecommunications market to discover which aspects of regulation have already been studied. This literature review is used to characterize the academic research in the domain of regulation of mobile telecommunications markets, to formulate the knowledge gap to which we wish to contribute and to present the scientific relevance of our study.

We followed a three staged literature review approach of selection, reviewing and synthesis of the literature (Webster & Watson, 2002):

1. **Selection process:** in this phase the search terms and the databases for the literature review need to be selected. This phase is presented in 2.4.1;
2. **Reviewing and assessing the sources:** in the reviewing phase the retrieved sources are subjected to criteria for inclusion and exclusion. The remaining sources are analyzed following a protocol that serves to describe the extant literature. This phase is presented in 2.4.2;
3. **Synthesis of the literature review:** in the synthesis phase the sources are thematically compared to characterize the research domain and to draw conclusions on the themes that are addressed in the literature. This phase is presented in 2.4.3.

2.4.1. Phase 1: Selection process

For our literature review we searched for extant literature in the domain of regulation of mobile telecommunications markets. The databases that we used for retrieving the literature in this research domain are: Scopus, Web of Science, SSRN and JSTOR.

The search terms that we used are presented in Table 3. We chose search terms for the regulatory activities performed, for the object of regulation and for the perspective of the regulatory actor. As such the search terms capture the literature that addresses the regulation of the mobile telecommunications market from the perspective of the regulatory authorities. The synonyms were selected in relevance to the domain of study. The online resource Synonyms.com was used to formulate these synonyms.

Table 3 Search terms for the contextual literature review

To represent the regulatory activities:	To represent the object of regulation:		To represent the regulatory actor:
regula* for:	wireless	market	telecom* for:
regulatory practice	mobile	sector	regulatory authority
regulatory decision-making	GSM	domain	telecommunications
regulatory process	GPRS	industry	telecom
regulatory activity	UMTS		telecoms
regulatory action	2G		telco
regulatory procedure	3G		communication*
regulatory strategy	4G		network*
regulatory governance	5G		infrastructure*
regulatory decision			system*
regulatory execution			
regulatory intervention			
regulatory arrangement			
regulating			
regulation			
regularization			
regularisation			
decision making			
de facto regulation			
polycymaking			

In Appendix A the exact search strings for the four databases and the results are presented, which led to a total of 191 references (double mentions excluded), ranging in the period 1989 to 2019, which are listed in App Table 7. Table 4 shows an overview of the retrieved number of references for each database, this literature search was last updated in September 2019. In the next section we review and assess these 191 sources.

Table 4 References selected from the databases

	no of sources
Web of Science	91
Scopus	52
JSTOR	26
SSRN	24
Subtotal	193
-/- Double mentions	2
Total	191

2.4.2. Phase 2: Review and assessment of the domain literature

In the second phase of a systematic literature review, the references that were initially found need to be reviewed and assessed (Webster & Watson, 2002; Brereton, Kitchenham, Budgen, Turner & Khalil, 2007). To this objective, we gained access to the original 191 documents, using Google Scholar, Mendeley and the Library of Delft University of Technology as additional gateways to retrieve the full documents. Based on perusal of these full documents, 26 articles were eliminated for the following reasons:

First, seven articles could not be found or did not allow access by any means (paid or not).

Second, upon closer review, five more articles were double in the selection.

Third, we deleted 10 references that were no academic references (e.g. commentary, short journalistic article, a business case paper).

And finally we deleted 4 references that were clearly not in the domain of mobile telecommunications (e.g. switched international services, land use planning, and computers). This review round led to the deletion of 26 references in total, see Table 5 in which this assessment round is summarized.

Table 5 Deletion of sources from the original selection

Original selection	191	Reason for deletion (format and/or content wise):
No access to article	7	article could not been found or no access was allowed
Double references	5	doublures
No academic format	10	commentary, journalistic article, conference report, business case paper
Not about mobile sector	4	switched international services, computers, direct satellite broadcasting, land use planning
Total deleted sources	-/ - 26	
Remaining	165	

The remaining 165 references were published between 1989 and 2019; in Figure 4 the spread in year of publication is shown. We notice a clear uptake in studies on regulation of the telecommunications market from 2005 onwards.

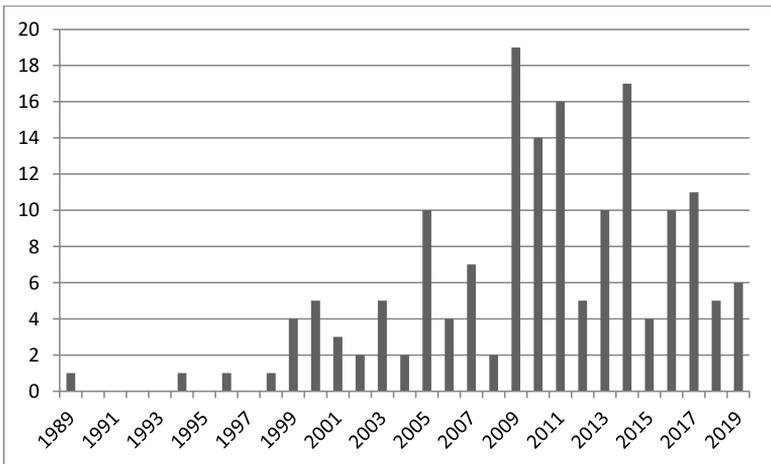


Figure 4 Year of publication of the 165 references on regulation of mobile telecommunications markets (1989-2019)

For these 165 references we used an extraction form in the format of an Excel overview (Tranfield, Denyer & Smart, 2003). We used the following characteristics for a descriptive analysis of the literature: types of sources, type of study reported on and the objective of the study.

In the following paragraphs we present the descriptive analysis of the literature following these characteristics.

Types of sources

The classification of the types of sources was as follows: book, book chapter, conference paper, discussion paper, journal article, research paper, review paper and working paper. For the classification we followed the way in which the authors themselves classified their article. This serves to obtain an overall impression of the references.

In Table 6 an overview of the source type of the 165 references is presented. We see that the research into regulation of mobile telecommunications markets is predominantly published in journal articles (112 references), with book chapters (22 references) and conference papers (18 references) ranking second and third.

Table 6 Types of sources of the references

Types of sources:	number
Journal article	112
Book chapter	22
Conference paper	18
Review paper	7
Discussion paper	2
Working paper	2
Book	1
Research paper	1
Total	165

Types of study

Next, we assessed the types of study on which the author(s) report. With the type of study we wish to characterize the research domain by the overall nature of the studies. This classification was developed in an interactive way during the literature review process, to remain as close as possible to the original intentions of the authors and to the domain of research: what did the author(s) want to contribute to the research domain of governance of the mobile telecommunications system? This leads to the following classification for type of study:

- *Exploratory*: publication is forward looking to new developments, e.g. a next generation of mobile telecommunications technologies such as 3G or 4G;
- *Design oriented*: publication is aimed at the design of a framework or future scenario;
- *Technical*: publication is mainly on a technical device or architecture;
- *Theory oriented*: publication aims for theory falsification or theory development;
- *Evaluative*: publication assesses the impact of a regulatory measure or policy framework on the mobile telecommunications market;
- *Predictive*: publication assesses a new development in order to provide specific input for future regulatory measures, policy making or regulatory frameworks;
- *Process oriented*: publication looks into the process of regulation or policy making;
- *Comparative*: the main objective in the publication is to present a comparison between national mobile telecommunications markets or national frameworks;
- *Business analysis*: publication aims at the analysis of business opportunities.

Table 7 shows that this is predominantly a research domain in which evaluations of policy making and regulatory interventions are presented: 48% of the studies are in the category of evaluative studies. Secondly, many predictive studies are performed that look into the effects of specific new developments such as new technologies (e.g. the evolution of mobile networks from 2G to 3G and beyond) and new policy making or regulatory frameworks (e.g. new telecommunications laws and regulations). This type of studies contributes to informed opinion making prior to the actualization of the new developments. The number of exploratory studies (13%) is illustrative for the uncertainty in the domain of policy making and regulatory interventions in the complex mobile telecommunications market. These studies are not linked to specific new developments but look into general developments in a broader perspective. Finally, the number of comparative studies (14 references) illustrates that the governance of national mobile telecommunications markets is far from uniform and national policies and regulatory frameworks can be compared to derive lessons learnt from other national governance schemes. Only 5% of the references take a process oriented perspective on regulation and policy making (9 references).

Table 7 Type of study that is reported in the references

Type of study	no. of references	in %
Evaluative	79	48
Predictive	28	17
Exploratory	21	13
Comparative	14	8
Process oriented	9	5
Business analysis	5	3
Technical	4	2
Design oriented	2	1
Theory oriented	2	1
Not known*	1	1
Total	165	100%

*access to one reference could not be established

Objective of the study

We also analyzed the objective of the studies that were reported upon in the references. For this we discerned the following objectives, again this list was developed in an interactive way to stay as close as possible to the objectives that are stated in the references or that became evident from the content of the publication:

- *Analytical*: the authors present an analysis;
- *Conceptual/theory oriented*: the author aims to develop a framework or concepts that are theory oriented;
- *Descriptive*: the aim is to present a description of a phenomenon or development in the market or new technological advance;
- *Design oriented*: the aim is to develop specific non-technical, practical artefacts such as guidelines or measures;
- *Opinion formulation*: the main aim of the author(s) is to present an opinion on market developments, policy making, regulatory interventions or future developments;
- *Research agenda*: the author(s) formulate(s) a research agenda;
- *Technical*: the main aim of the author is to present a technical artefact (e.g. a prototype; measurement, or technical module).

The data in Table 8 shows that the majority of the studies has an analytical objective (58 %) and a considerable amount of studies are of a descriptive nature (24%). 8% Represent studies that aim at opinion formulation on market developments, policy making, regulatory interventions or future developments. Only 7% of the studies go beyond the phases of analysis and description towards the presentation of a conceptual or theoretical contribution. And a minority of the articles has a technical objective (2%), is design oriented (1%), or develops a research agenda (1%).

Due to the selection of our key terms and exclusions we made in the selection phase of the references the number of studies that strive for a technical objective is low. After all, we already deselected the pure technical studies from our initial selection. Still a few remained as their overall character was not purely technical (2%). The single study that explicitly presents a research agenda can indicate that the research domain is still much diversified, in which rather partial issues are addressed instead of creating overall perspectives of the research domain (Tranfield et al, 2003, p. 215).

Table 8 Objective of study that is reported in the references

Objective of study:	no of references	% of references
analytical	95	58%
descriptive	39	24%
opinion formulation	13	8%
conceptual/theory oriented	12	7%
technical	4	2%
design oriented	1	1%
research agenda	1	1%
Total	165	100%

Descriptive synthesis of the literature

After we developed this initial overview of the domain studies into the mobile telecommunications market, we continued to scope down the list of references towards a set of references that is closely linked to regulation of mobile markets by NRAs. Therefore in this last step of our literature review we continued to select those references that belong to the realm of NRAs for the national telecommunications market. To this end we need to clarify the difference that we make between the terms 'policy making' and 'regulation'. In this study we reserve the term 'policy making' for the national level of governance, which is the realm of national Ministries that are responsible for developing the policy framework consisting of laws and regulations for the telecommunications market. In the European context, the national Ministries for telecommunications work within the frameworks as created by the EC; they transpose the European Directives into national telecommunication laws and regulations. Next, the NRAs are the independent authorities that are mainly responsible for the interpretation and application of the laws and regulation. In order to make a clear distinction, we reserve the term 'policy making' for the realm of the Ministries and 'regulation' for the realm of the NRAs. In practice this distinction is less strict than the terms seem to indicate, which is also apparent in the literature we found. Still in this literature review we use the distinction to select those references that come closest to the regulatory practice by NRAs that we wish to study in order to formulate the knowledge gap in this research domain.

Based on this distinction between policy making and regulation we re-assessed all 165 references and used the following criteria to scope down the number of references for our more in-depth literature review:

1. **Level of governance:** deselect the references that are at the national level of policy making or the development of the national institutional framework, two aspects that are prior to the phase of regulation by NRAs;

2. **Application or topic is not in the realm of an NRA:** deselect the references that are not directly in the realm of an NRA for the telecommunications system (e.g. ICT for Development (ICT4D) that we consider as an application of ICT which is the realm of a Ministry for Telecommunications, for Economics or for Development or e.g. the topic of Net neutrality which is an issue that belongs at the national level of policymaking/Ministry);

3. **No regulatory perspective:** deselect the references that do not represent a regulatory perspective at all, such as references in which a business perspective is dominant;

4. **General overview or review of the telecommunications sector reform:** deselect the references that present a general, higher level historical overview of the reform in the telecommunications sector or a review of this development;

5. **International level:** deselect the references that contain a study on an international level instead of the national level of an NRA, e.g. a study that presents a comparative study of OECD countries, or evaluates regulatory frameworks on an international level (e.g. EU, ITU or otherwise global level);

6. **Source of study:** deselect references that are opinionated;

7. **Own article:** we excluded one article that we published ourselves (Ubacht, 2016).

This list of criteria led to the overview in Table 9 which shows that despite the matching key words in the initial literature search, only 45 articles of the 165 articles from the initial set of references are actually on the regulation of mobile telecommunications markets for which NRAs are responsible.

Table 9 Exclusion of references for the final set of the literature review

	In numbers	Reasons for exclusion
Level of policymaking	61	Policy making
Application/topics not in the realm of an NRA	45	Banking sector, broadcasting, business data communications and the internet, content regulation, e-commerce, ICT4D, IP transition, long distance telecommunications, mobile banking, mobile health applications, mobile social networking, spectrum allocation, spectrum management, spectrum sharing, standardization, telecom sector in general, WiMAX
No regulatory perspective	10	Business perspective
	5	Other perspective
General overview or review of the telecommunications sector reform	26	
International level (cf national level of NRAs)	1	OECD level
	12	EU level
	2	Global level
	1	ITU level
Types of study	2	Opiniated article
	6	Technical study
Own article	1	
Number of excluded references	120	73%
Inclusion for the in depth literature review	45	27%
Totals	165	100%

*these do not count up to 120 as some sources were coded with more than one reason for exclusion

In the next section we present the synthesis of these 45 selected articles.

2.4.3. Phase 3: Synthesis of the domain literature review

After the assessment of the 165 references and the scoping towards those references that are close to the domain of NRAs, we derived a list of 45 references (see Table 11). These sources all represent research on the level of NRAs and the topics/themes they address are all in the specific realm of these authorities' regulatory activities. Comparing the set of 45 sources with the characteristics of the initial set of 161 sources does not yield major differences in types of sources, as can be seen in Table 10.

Table 10 Comparison for types of sources between the initial and final set of sources (165 vs 45)

Types of sources:	number 165 sources	number 45 sources	% 165 sources	% 45 sources
Journal article	112	31	68%	69%
Book chapter	22	5	13%	11%
Conference paper	18	6	11%	13%
Review paper	7	2	4%	4%
Discussion paper	2	0	1%	0%
Working paper	2	1	1%	2%
Book	1	0	1%	0%
Research paper	1	0	1%	0%
Total	165	45	100%	100%

The characteristics as presented in Table 11 are discussed in the next paragraphs.

Table 11 Overview of the included articles for the literature review, in alphabetical order of first author

Legend:

n.a.: not all studies look into a specific regulatory instrument

*Type of study: exploratory [EXPL], evaluation [EVA, predictive [PRED], process oriented [PRO], comparative [COMP]

**Objective of study: conceptual [C], analytical [A], descriptive [D], opined [O]

Author(s)/ year of publication	Type of study*	Objective of study**	Market issue	Regulatory instrument	Countries [in brackets the number of countries involved in the study, if >1]	Main perspective
(Andersson, Foros & Steen, 2004)	EVA	A	Consumer choice	Unbundling	Norway	Economic
(Armstrong & Wright, 2008)	EXPL	A	Mobile termination tariffs	Price cap	United Kingdom	Economic
(Baek, 2018)	EVA	A	Mobile number portability	Mobile number portability obligation	Diversity of countries (26)	Economic
(Binmore & Harbord, 2005)	EVA	A	Mobile terminations tariffs	Significant Market Power (SMP); Price cap	United Kingdom	Economic
(Camponovo & Cerutti, 2005)	EXPL	A	WLAN as private hotspots	Legal framework design	France, Switzerland	Legal
(Cho, Ferreira & Telang, 2016)	EVA	A	Mobile number portability	Mobile number portability obligation	EU Member States (15)	Economic
(Cohen, 2003)	EVA	A	Institutional framework	n.a.	South Africa	Legal
(Dewenter & Kruse, 2011)	EVA	A	Mobile termination tariffs	n.a.	Diversity of countries (84)	Economic
(Di Pillo, Cricelli, Gastaldi & Levialdi, 2010)	EVA	A	Mobile termination tariffs	Price cap	Generic	Economic
(Donovan & Martin, 2012)	EVA	A	Privacy	SIM registration obligation	African countries (55)	Political Science
(Effendi, 2016)	EVA	O	Network sharing	Network sharing obligations	Indonesia	Political Science
(Ehrlich, Eisenach & Leighton, 2010)	PRED	O	Consumer choice	Net Neutrality	United States of America	Economic
(Falch, Henten & Tadayoni, 2009)	PRED	A	International mobile roaming	Price cap	EU Member States (27)	Economic
(Faulhaber, 2009)	PRED	A	Consumer choice	Unbundling	United States of America	Economic
(Fuentelsaz, Maicas & Polo, 2012)	EVA	A	Switching costs	Retail price regulation	EU Member States (7)	Economic
(Garcia-Murillo, 2007)	EXPL	A	Mobile number portability	Mobile number portability obligation	Central America (9)	Economic
(Genakos & Valletti, 2011)	EVA	A	Consumer welfare	Price cap	Diversity of countries (20)	Economic
(Grzybowski, 2008)	EVA	A	Mobile number portability	Mobile number portability obligation	EU Member States (15)	Economic
(Grzybowski, 2005)	EVA	A	Mobile number portability, interconnection charges	Mobile number portability obligation	EU Member States (15)	Economic
(Gupta, Gupta & Rajamanickam, 2017)	EVA	D	Unsolicited mobile marketing calls	National Consumer Call Preference Registry (NCCPR)	India	Political Science

Author(s)/ year of publication	Type of study*	Objective of study**	Market issue	Regulatory instrument	Countries [in brackets the number of countries involved in the study, if >1]	Main perspective
(Hazlett, Oh & Skorup, 2016)	EVA	A	Bundling of hardware and services	Unbundling	EU Member States (15)	Economic
(Höffler, 2009)	EVA	A	Mobile termination tariffs	Price cap	Generic	Economic
(Kensi, Barka & Hajji, 2019)	EVA	A	Mobile number portability	Mobile number portability obligation	Morocco	Economic
(Kongaut & Bohlin, 2014)	EVA	A	Mobile termination tariffs	Price cap	European countries (13)	Economic
(Laakso, Rubin & Linturi, 2012)	EVA	A	Several	Several	Finland	Political Science
(Luis López, 2011)	PRED	A	Mobile termination tariffs	Price cap	Generic	Economic
(Macmillan, 2005)	EVA	D	Institutional framework design	n.a.	India	Legal
(Pereira, 2013)	EXPL	D	Access network regulation	Market definition for access networks	Generic	Political Science
(Riccardi, Ciriani & Quelin, 2009)	EXPL	A	MVNO market entry	n.a.	EU Member States (10)	Economic
(Ruhle & Freund, 2013)	PRED	A	Inequality app providers vs operators/service providers	Level playing field regulation	Austria	Legal
(Sandbach & Van Hooft, 2010)	PRED	A	Mobile termination tariffs	Price cap	United Kingdom	Economic
(Shim, 2016)	EVA	A	Price regulation	Price regulation	European countries (28)	Economic
(Srinuan, Srinuan & Bohlin, 2011)	EVA	A	Market entry	Market entry relaxation	Asian countries (7)	Economic
(Sung, 2014)	EVA	A	Market performance	n.a.	OECD Member States (24)	Economic
(Sutherland, 2011d)	COMP	A	National roaming obligations	National roaming obligations	Diversity of countries (6)	Political Science
(Sutherland, 2012)	COMP	D	International mobile roaming	Price cap	Diversity of countries/continents	Economic
(Sutherland, 2010)	COMP	D	International mobile roaming	Price cap	Diversity of countries/continents	Economic
(Sutherland, 2011b)	EVA	A	International mobile roaming	Price cap	Arab states (22)	Political Science
(Sutherland, 2011c)	EVA	A	International mobile roaming	Price cap	European countries (22)	Political Science
(Sutherland, 2007)	EVA	A	Quality of service	Quality of service regulation	Diversity of countries/continents	Political Science
(Sutherland, 2011a)	EVA	A	International mobile roaming	Price cap	Diversity of countries (17)	Economic
(Tangerås & Tåg, 2016)	EVA	A	International mobile roaming	Price cap	Generic	Economic
(Troshani & Rao Hill, 2009)	EXPL	A	End-user protection	Co-regulation	Australia	Economic
(Troshani & Rao Hill, 2011)	EXPL	A	Institutional framework design	Co-regulation	Australia	Political Science
(Voon, 2013)	PRED	D	International mobile roaming	Price cap	Australia	Legal

Types of study

When comparing the types of study between the two sets the only major difference is in the percentage of evaluative studies which is higher in the smaller set of 45 sources, see Table 12. This can be explained by the fact that the 45 sources have a shorter range in terms of year of publication. The 165 sources were published between 1989 and 2019, whereas the set of 45 was published between 2003 and 2019 (see Figure 5). The rise in empirical data for evaluation appeared from 2000 onwards when the liberalisation of the telecommunications market in Europe started to take effect. In the set of 45, no studies looked into the process of regulation, nor does the set contain any references that cover technical, business analysis, design and theory oriented types of studies.

Table 12 Comparison for type of study between the initial (165) and final set of sources (45)

Type of study	no. of 165 sources	no. of 45 sources	% 165 sources	% 45 sources	Explanation of type of study:
Evaluative	79	28	48%	62%	Article assesses the impact of regulatory measure or policy framework
Predictive	28	7	17%	16%	Article assesses a new development in order to provide specific input for future regulatory measures or policy making (frameworks)
Exploratory	23	7	14%	16%	Article is forward looking to new developments
Comparative	14	3	8%	7%	Within the article the main objective is to make a comparison between countries/national frameworks
Process oriented	9	0	5%	0%	Article looks into the process of regulation or policy making
Technical	4	0	2%	0%	Article is mainly on a technical device or architecture
Business analysis	3	0	2%	0%	Article aims at the analysis of business opportunities
Design oriented	2	0	1%	0%	Article is aimed at the design of a framework or future scenario
Theory oriented	2	0	1%	0%	Article aims for theory falsification or development
Not known	1	0	1%	0%	Due to no access to the source
Total	165	45	100%	100%	

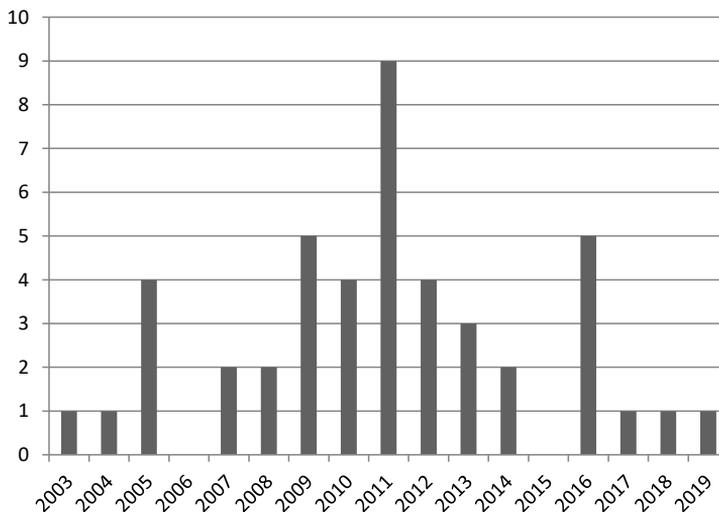


Figure 5 Year of publication of the 45 references on regulation of mobile telecommunications markets (2003-2019)

Objective of the study

Comparing the objectives of the studies that are reported upon in the sources, we discern a slight inclination towards more analytical oriented studies in the set of 45 sources, and a lower percentage of descriptive studies (see Table 13). This may be due to the same observation as above: analytical oriented studies require the availability of empirical data to analyse, which became available from the year 2000 onwards. The absence of conceptual/theory oriented studies in the set of 45 articles is an important aspect that we will discuss in section 2.5.

Table 13 Comparison for objective of study between the initial and final set of sources (165 vs 45)

Objective of study:	no. of 165 sources	no. of 45 sources	% of 165 sources	% of 45 sources	The objective of the study is to:
analytical	95	37	58%	82%	present an analysis
descriptive	39	6	24%	13%	present a description of a phenomenon or development in the market or new technological advance
opinion formulation	13	2	8%	4%	present an opinion on market developments, policy making, regulatory interventions or future developments
conceptual/theory oriented	12	0	7%	0%	develop a framework or concepts that are theory oriented
technical	4	0	2%	0%	present a technical artefact (prototype; framework, measurement, module)
design oriented	1	0	1%	0%	develop measures for standards openness
research agenda	1	0	1%	0%	formulate a research agenda
Total	165	45	100%	100%	

Geographical orientation

Looking at the countries, continents and EU Member States that were subject in the 45 studies (see Table 14) it is evident that especially the European countries and the EU Member States were object of study (with a total of 17 out of 45 references). The nucleus of research in the domain of regulation of mobile telecommunications markets is on themes on the European continent.

Table 14 Countries/continents/Member States represented in the studies

Legend: 'EU Member States' is an indication that more than one member state is referred to in the study. In case a single EU member state is the object of study it is listed by its own name. 'European countries' indicates that other than EU Member States are included as object of study.

Countries/continents/member states addressed in the references	no of studies	Countries/continents/member states addressed in the references	no of studies
African countries	1	France & Switzerland	1
Arab states	1	Generic	5
Asian countries	1	India	2
Australia	3	Indonesia	1
Austria	1	Morocco	1
Central American countries	1	Norway	1
Diverse set of countries or continents	8	OECD Member States	1
EU Member States	7	South Africa	1
European countries	3	United Kingdom	3
Finland	1	United States of America	2
Total no of studies	45		

Disciplinary perspective

In Table 11 we also categorized the literature according to the authors' main disciplinary perspective on the mobile telecommunications market. This categorization shows that the majority of authors take an economic perspective (30 articles) in which either economic analyses on market aspects are presented, e.g. by means of modelling, or the economic characteristics of the market are analysed, e.g. by means of market competition analysis. The perspective of political science is predominantly used to evaluate the effects of extant regulation or to assess the effects of envisaged future regulation on the market (10 articles). Authors with a legal perspective analyse the relevant (principles of) telecommunications law and regulation for the design of an institutional framework or analyse the legal aspects of single market issues such as international mobile roaming (5 articles).

In the next paragraphs we present the synthesis of the market issues that were subject to research and the regulatory instruments that were analyzed in these 45 references.

Synthesis on types of market issues in the literature review

The literature overview in Table 11 indicates that almost all sources present studies into a single market issue. We define a market issue as any reason for an NRA to perform activities in order to develop a regulatory arrangement. The most studied issues are on international mobile roaming (8), mobile termination tariffs (MTTs) (8) and mobile number portability (6). Consumer choice (3) and institutional framework (design) (3) are two of the more generic issues. See Table 15 for an overview of the market issues that were referred to more than once amongst the 45 sources; all other market issues are uniquely reported upon. Only one study by Laakso, Rubin & Linturi looks into a range of issues (Laakso, Rubin & Linturi, 2012). In their article they present a longitudinal study in which the effects of regulatory measures on the mobile business in Finland during the period 1985-2009 are assessed (Laakso, Rubin & Linturi, 2012).

Table 15 Market issues addressed

Market issue*	no of studies
Mobile termination tariffs	8
International mobile roaming	8
Mobile number portability	6
Institutional framework (design)	3
Consumer choice	3
Total	28

*only those that were studied more than once in the 45 sources

Synthesis on regulatory instruments in the literature review

In Table 16 we present a full overview of the regulatory instruments addressed in the sources. This overview shows that price cap regulation in the mobile telecommunications system was subject to the majority of studies. In addition the obligation to introduce mobile number portability was studied in six other sources. It is also clear that the majority of the studies report upon the use of a single regulatory instrument. Only the study by Binmore & Harbord explicitly addresses the combination of the two instruments of Significant Market Power (SMP) and a price cap regime (Binmore & Harbord, 2005) and the study by Laakso, Rubin & Linture addresses more than two instruments (Laakso, Rubin and Linturi, 2012). No source presents a more extensive overview of regulatory measures over a longer period of time.

Based on the findings on the market issues and the regulatory instruments used to address them, we conclude that although many studies are conducted on the regulation in the mobile telecommunications market, only slices of regulation are covered. Either a single market issue and/or a single regulatory instrument is addressed. In the next section we present our conclusion based on our syntheses of the literature review to substantiate our research objective.

Table 16 Regulatory instruments addressed

Regulatory instrument	No of sources	Regulatory instrument	No of sources
Price cap	15	National roaming obligations	1
Mobile number portability obligation	6	Net Neutrality	1
n.a.*	5	Network sharing obligations	1
Unbundling	3	Price regulation	1
Co-regulation	2	Quality of service regulation	1
Market entry relaxation	1	Retail price regulation	1
Legal framework design	1	Several	1
Level playing field regulation	1	Significant Market Power (SMP); Price cap	1
Market definition for access networks	1	SIM registration obligation	1
National Consumer Call Preference Registry (NCCPR)	1		
Total no of sources	45		

* n.a.: not all studies look into a specific regulatory instrument

2.5. Research objective

In this chapter we presented the institutional changes that led to the liberalisation and privatization of the telecommunications market in the EU from 1997 onwards. In this major change sector-specific regulatory authorities were installed to regulate for fair competition and to safeguard public values. Based on a systematic review of sources over the period 1989-2019 we found that conceptualization is rarely the aim of the authors' research activities, the majority of the sources look into a single market issue or a single regulatory instrument, a process-orientation on regulation is lacking and the majority of the studies represent an economic and legal perspective on regulation.

Based on these findings, we formulate the following research contributions:

1. The contextual literature review shows an uptake in studies on regulation after the liberalisation of the telecommunications market in the EU of 1997, see Figure 4 and Figure 5. However, the number of studies that aim for conceptualization of regulatory practice is lacking in this field. Most studies aim for evaluation, exploration or prediction, but none of these studies take a further step towards conceptualization that goes beyond describing singular regulatory events. Therefore a comprehensive overview of the tensions in the market over a longer period of time is lacking. We aim to provide such an overview and want to explain how regulatory authorities dealt with the tensions and uncertainties in the mobile telecommunications system after the major change of liberalization occurred.
2. Very few studies within our contextual literature review look into a range of market issues and the majority of the studies focuses on a single regulatory instrument. The two exceptions are both evaluative studies, looking at the effect of regulatory measures on the mobile telecommunications market. As such these studies are outcome-oriented instead of process-oriented. We will go beyond the regulation of a single market issue by looking into a range of market issues in the mobile telecommunications market.
3. No study has taken the regulatory process itself as object of study, which entails that no integral overview of the regulatory process of sector-specific NRAs is available. Once a CSTS becomes more dynamic through changes, such as the liberalization of the telecommunications market, the tensions in the market and uncertainties in the CSTS increase. This entails that NRAs will not only have to address the tensions, but while doing so also need to take uncertainties into account. Several authors specifically studied these interactions on the institutional level in complex socio-technical systems in general (Finger & Varone, 2009; Künneke, Groenewegen & Auger, 2009) or in the electricity market (Glachant, 2009; Ilic & Jelinek, 2009) and in water supply systems (Menard, 2009). However, the way in which regulatory authorities deal with tensions and uncertainties on a practical level when regulating the mobile telecommunications market requires further investigation.
4. In the majority of the studies an economic and legal perspective is taken to analyse regulatory practice. These studies provide for in-depth analysis of a single regulatory instrument or assess the effect of the use of a regulatory instrument on the market. We want to address the interactions between the technical, multi-actor and institutional subsystems that lead to uncertainties for regulation, as well as the tensions that arise from the conflicting interests between market parties, end users and regulatory objectives. Therefore, we choose a socio-

technical perspective on regulatory practice to uncover these uncertainties and tensions and how these influence regulatory practice.

Based on the knowledge gaps in the academic literature, we formulate the deliverable of our study as a conceptual framework that explains how regulatory authorities deal with the regulation of the complex mobile telecommunications market in an era of a major change. This major change is the liberalization of the mobile telecommunications market in the EU from 1997 onwards, which is a major change in the institutional subsystem. The conceptual framework will show and explain the way in which sector-specific regulatory authorities address the market issues and uncertainties in the social-technical system. This is termed regulatory practice, which we define as the activities of a sector-specific NRA in the process of regulating the mobile telecommunications system.

The research objective for our study is ***to develop a conceptual framework of regulatory practice that explains how regulatory authorities deal with the tensions and uncertainties in the mobile telecommunications system.***

In the next chapter we present the research design for developing this conceptual framework.

3. Research Design

"Theory derived from data is more likely to resemble the "reality" than is theory derived by putting together series of concepts based on experience or solely through speculation" (Strauss and Corbin, 1998, p. 12)

3.1. Introduction

In section 2.4.3 we presented our systematic literature review on regulation of the mobile telecommunications market and formulated our objective to develop a conceptual framework of regulatory practice that explains how regulatory authorities deal with the tensions and uncertainties in the mobile telecommunications system in section 2.5.

In this chapter we present our research design for the development of the conceptual framework. We start with our research philosophy in section 3.2. Based on our beliefs regarding ontology, epistemology, axiology and methods, we choose for a GT approach. In section 3.3 we first provide a general introduction to the research process of GT studies as well as an overview of the variations in GT that developed over time. We use one of these variants, the classic GT approach (CGT), to develop our research strategy in section 3.4, which includes the sub questions that relate to the research phases of the CGT, the research methods as well as the empirical data to be used. In section 3.5 we visualize our research strategy by means of a research flow diagram that represents the phases and research activities leading towards the development and evaluation of the conceptual framework.

3.2. Research Philosophy

Guba and Lincoln define a research paradigm as "the basic belief system or worldview that guides the investigator, not only in choices of method but in ontologically and epistemologically fundamental ways" (Guba and Lincoln, 1994, p. 105). They position that the research paradigm is defined by the philosophical beliefs that refer to the way in which the researcher relates to the nature of reality (ontology), the nature of knowledge (epistemology) as well as to methodological

assumptions. Other researchers (Orlikowski & Baroudi, 1990) add the axiological assumption, which is about the “values and intentions researchers bring to their work” (Orlikowski and Baroudi, 1990, p. 9).

Over the years a wide variety of philosophical beliefs and their variants have been developed and discussed, especially in the social sciences (see a.o. (Denzin & Lincoln, 1994)). No ultimate set of definitions is available as the beliefs are based on interpretation and subject to change over time (Guba and Lincoln, 1994, p. 109). Guba and Lincoln offer three questions which they call the Inquiry Paradigm, which is “summarized by the responses given by proponents of any given paradigm to three fundamental questions, which are interconnected in such a way that the answer given to any one question, taken in any order, constrains how the others may be answered” (Guba and Lincoln, 1994, p. 108). We will use their three questions to argument for our research beliefs on ontology, epistemology, and methods. In addition we present our axiological belief.

3.2.1. Ontological belief

Guba and Lincoln define the ontological question as “What is the form and nature of reality and, therefore, what is there that can be known about it?” (Guba and Lincoln, 1994, p. 108). The main ontological beliefs are positivism, postpositivism, critical theory and constructivism.

The ontology of positivism is (naïve) realism. Haig mentions that "realism maintains that there is a real world of which we are a part and that both observable and unobservable features of that world can be known by appropriate use of scientific methods" (Haig, 2018, p. 90). Positivist researchers aim for generalization and belief that reality can objectively be constructed (Orlikowski & Baroudi, 1990; Guba & Lincoln, 1994; Van Engelenburg, 2019). As such they consider themselves as an objective researcher who does not interact with the world they study (Orlikowski & Baroudi, 1990).

The ontology of postpositivism is critical realism. This ontology shares many aspects of positivism such as the search for prediction and control and the expert role of the researcher. However, a “postpositivist paradigm assumes that an objective, observable reality exists but acknowledges that it can never be perfectly apprehended as attempts to understand it are influenced by human understanding” (Rieger, 2018, p. 2).

A researcher with a critical theory belief aims to reveal the inherent tensions in social systems that have become accepted and that influence the social reality in which humans can act. The ontology of critical theory is historical realism (Guba and Lincoln, 1994, p. 110). Orlikowski and Baroudi state that “[c]ritical studies aim, through the exposure of deep-seated structural problems, to critique the status quo and remove contradictions from organizations and society” (Orlikowski and Baroudi, 1990, p. 6). By their very nature of evaluation, critical studies show a social reality that has its limitations and the researcher wishes to change that underlying social system in order to battle injustice(s). Myers describes this aim as follows: “[t]he main task of critical research is seen as being one of social critique, whereby the restrictive and alienating conditions of the status quo are brought to light. Critical research focuses on the oppositions, conflicts and contradictions in contemporary society, and seeks to be emancipatory i.e. it should help to eliminate the causes of alienation and domination.” (Myers, 1997, n.p.).

In a constructivist belief that is based in the ontology of relativism the researcher will put the interaction of human subjects at the core of research and will study how these interactions lead to social constructions (Urquhart, 2001). Bryant and Charmaz describe it as follows: "A constructivist paradigm assumes that reality cannot be objectively discovered, but instead people, including researchers, construct the realities in which they participate" (Bryant and Charmaz, 2007c, p. 607). When choosing the constructivist ontology the researcher will interact with the social subjects and study how they interact with each other in their natural context. Therefore a constructivist study is linked to time and context of the actual social processes under study. As Annells puts it: "the constructivist paradigm ... perceive[s] the nature of reality as a local and specific mental construction formed by a person and multiple mental constructions collectively exist regarding reality" (Annells, 1996, p. 385).

We adhere to constructivism with its ontology of relativism as we believe that the interactions between multiple actors create the social context in which they live. Their activities lead to social processes from which their world is created and never fixed: "as meanings are formed, transferred, and used, they are also negotiated, and hence that interpretations of reality may shift over time as circumstances and constituents change" (Orlikowski and Baroudi, 1990, p. 15). We believe that there is no such thing as one reality, the actors all have their own perception of reality and create their common world based on the meaning they attribute to it (Goldkuhl & Cronholm, 2019).

3.2.2. Epistemological belief

The epistemological belief refers to the question "[w]hat is the nature of the relationship between the knower or would-be knower and what can be known?" (Guba and Lincoln, 1994, p. 108). We use the epistemological beliefs within the paradigms that we previously discussed to substantiate our epistemological belief.

The epistemological belief of positivism is an objective researcher who investigates the real world from a distance. This fits with the positivistic belief that reality can be captured in an objective way. The knowledge derived from the research process is seen as independent of the researcher (Polit & Beck, 2017, p. 739) and as such the epistemology of positivism is labelled as dualist. The researcher will ensure that the validity of the research is guaranteed and that influence from the researcher on the results and vice versa are eliminated by following rigorous procedures (Guba and Lincoln, 1994, p. 110).

The postpositivist researcher is different from the positivist researcher in that their epistemological belief is 'modified dualist': the researcher acknowledges that objectivity is still an ideal goal, but one that can hardly be attained. Procedures such as peer and expert reviews are used to counterbalance influences of the researcher on the research results (Guba & Lincoln, 1994).

In contrast, the critical theory researcher will enter into a dialectical interaction with the persons involved in the study (Annells, 1996, p. 384). Therefore the epistemology of critical theory is labeled as transactional: "[a] reconstructive dialogic and dialectical process is facilitated with the aim of restitution and emancipatory praxis" (Annells, 1996, p. 384). The epistemology of critical theory studies entails that "the role of the researcher is to bring to consciousness the restrictive conditions of the status quo, thereby initiating change in the social relations and practices, and helping to eliminate the bases of alienation and domination" (Orlikowski and Baroudi, 1990, p. 22). As such, the

researcher uses the dialectical interaction to bring about change in personal lives and is part of the world in which the interactions take place.

In an epistemological belief based in constructivism, the researcher is also looking into how human actors create meaning in their own context, but not necessarily as part of their world in a physical sense. The interaction is aimed at the interpretation of processes in which human actors interpret the world around them to create meaning and to act accordingly. Based on (Guba & Lincoln, 1994), Annells characterizes the epistemology of constructivism as "...the knower is subjectively and interactively linked in relationship to what can be known" (Annells, 1996, p. 385). We follow Orlikowski and Baroudi who state that "[u]nlike the premises of the positivist perspective where researchers are presumed to "discover" an objective social reality, interpretive researchers believe that social reality can only be interpreted...." (Orlikowski and Baroudi, 1990, p. 15). The epistemological belief of constructivism is interpretivism.

Our epistemological belief is in interpretivism as we consider ourselves as an interpreter of processes between human actors, institutions and the technical system within CSTS. We do not believe in discovering an objective truth, but are foremost interested in the interactions that take place and how these are formed in the context of a CSTS.

3.2.3. Axiological belief

The axiological belief is about "what researchers believe is appropriate to accomplish with their research work, and what they intend to achieve with a given research study" (Orlikowski & Baroudi, 1990, p. 9).

The positivist researcher will strive for a value free role in finding truth (Van Engelenburg, 2019). Orlikowski and Baroudi describe it as follows: "[a]s an impartial observer, the researcher can objectively evaluate efficient and effective actions or processes, but should not get involved in moral judgements or subjective opinion" (Orlikowski & Baroudi, 1990). As such the axiological belief of a positivist researcher will be foremost in unveiling a reality that is independent from their role as researcher. The same goes for a postpositivist researcher who is however aware that the relationships can be tested but are subject to change and human interpretation. The postpositivist researcher acknowledges that their own world view will influence their research.

In the critical research belief, the researcher will strive to bring about change in the phenomena of research. Orlikowski and Baroudi state that "the role of the researcher is to bring to consciousness the restrictive conditions of the status quo, thereby initiating change in the social relations and practices, and helping to eliminate the bases of alienation and domination" (Orlikowski and Baroudi, 1990, p. 22). Thus, the axiological belief of critical theory is to bring about change in social structures. Therefore, the role of the critical researcher is considered as subjective and value-driven.

In the constructivist belief the researcher strives for understanding and in order to do so interprets the processes in which meaning is developed (Orlikowski & Baroudi, 1990; Van Engelenburg, 2019). Orlikowski and Baroudi make a distinction between the weak versus the strong constructivist belief. These beliefs differ in the extent of interaction with the world they study. In the weak variant the researcher uses the empirical world to understand processes and why and how agents interact in their social context. In the strong variant the researcher will be living the social reality of the domain

of study. In both types the interpretation is done by the researcher to develop constructs that explain social processes in a relevant research domain (Orlikowski & Baroudi, 1990).

Our axiological belief is rooted in a 'weak' constructivist view because we value the interpretation of processes in society and want to understand the interactions between actors involved when a change occurs in their context. However, we do not value the weight of actually living the social reality ourselves as we wish to balance the social, institutional and technical subsystems in the interaction. We believe that if we live the social reality ourselves, this will put more emphasis on the social processes on an individual level whereas we value the interactions on a systems level.

3.2.4. Methodological belief

A last element of an Inquiry Paradigm is based on the "[m]ethodological assumptions [that] indicate which research methods and techniques are considered appropriate for the gathering of valid empirical evidence" (Orlikowski and Baroudi, 1990, p. 9).

The methodological belief of positivist researchers is rooted in the use of quantitative research methods to discover and test (cause and effect) relationships between factors. The verification of hypotheses or testing of propositions is at the core of the research, with the aim of generalization of the research findings (Orlikowski and Baroudi, 1990; Guba and Lincoln, 1994). The factors are predefined based on previous academic evidence. As such positivism is foremost linked to using quantitative data that allows for the generalization of the study results by following a deductive research approach (Guba & Lincoln, 1994).

In postpositivism it is not the verification but the falsification of hypotheses that is aimed for (Guba and Lincoln, 1994, p. 110). To this aim a combination of quantitative and qualitative research methods can be used.

In a study that takes critical theory as methodological belief, the researcher will use interactive, dialogic research methods to unravel the factors that over the years have led to (dominant) social constructions. Guba and Lincoln use the term "historical revisionism" to reconstruct these constructions over a longer period of time taking "social, political, cultural, economic, ethnic and gender antecedents of the studied situation" into account (Guba and Lincoln, 1994, p. 114). The critical researcher has access to social interactions taking place within a specific context, e.g. via fieldwork, participatory observation and interviews in order to reveal the intricate interactions between systemic institutionalized rules and their influence on human behavior and social relations in the system (Guba & Lincoln, 1994; Rieger, 2019).

A constructivist belief requires research methods that allow for a dialectical process between the researcher and the human agents (Goldkuhl & Cronholm, 2019). The researcher is part of the context of the study and discusses interpretations with the social actors involved to assess whether they recognize the outcomes. Interpretivism aims at capturing dynamic, social processes in context; no a priori framework for analysis is needed; the perspective of the subjects involved is taken as a starting point for an in-depth understanding of the specific context under study. Interpretivist researchers will use qualitative research methods to analyze "processes by which .. meanings are created, negotiated, sustained, and modified within a specific context of human action. The means or process by which the inquirer arrives at this kind of interpretation of human action ... is called

Verstehen (understanding)" (Schwandt, 1994, p. 120). The key available qualitative research methods for interpretivist researchers are case studies, interviews, observations and document analysis because they allow for in-depth analysis of the processes they study (Klein and Myers, 2011, p. 220). Their research yields detailed analysis of the empirical data.

Our methodological belief is in interpretivism, because we value the interpretation of processes in society (our axiological belief) and aim to understand the dynamic interactions within a CSTS. We believe that these processes and interactions in a particular context are best studied by means of qualitative research methods. We value an open research approach to do justice to the tensions and uncertainties in the system without preselecting an analytical framework that restricts the researcher to focus on specific factors.

3.2.5. Synthesis on research philosophy

Our research philosophy is based in constructivism, we consider ourselves as an interpretive researcher. We believe that there is no such thing as one reality, human actors all have their own perception of reality and create their common world based on the meaning they give to it (Goldkuhl & Cronholm, 2019). Their activities lead to social processes from which their world is created and never fixed: "as meanings are formed, transferred, and used, they are also negotiated, and hence that interpretations of reality may shift over time as circumstances and constituents change" (Orlikowski and Baroudi, 1990, p. 15). Our epistemological belief is in interpretivism as we consider ourselves as an interpreter of processes between human actors, institutions and the technical system within a CSTS. We do not believe in discovering an objective truth, but are foremost interested in the interactions that take place in the context of a CSTS.

This is described by Klein & Myers as follows: "Interpretive research does not predefine dependent and independent variables, but focuses on the complexity of human sense making as the situation emerges; it attempts to understand phenomena through the meanings that people assign to them" (Klein and Myers, 2011, p. 220). Orlikowski and Baroudi also state that "[i]nterpretive studies explicitly adopt a nondeterministic perspective, attempting to explore the phenomena of interest in its natural setting, deliberately not imposing any a priori understanding on it" (Orlikowski and Baroudi, 1990, p. 6). As such, interpretivism is aligned with taking an open socio-technical perspective to study the interactions between the multi-actor, technical and institutional subsystems of mobile telecommunications. We want to study regulatory practice without imposing an a priori framework for the data analysis (Orlikowski & Baroudi, 1990). Orlikowski & Baroudi state that "[i]n particular social processes can be usefully studied with an interpretive perspective, which is explicitly designed to capture complex, dynamic, social phenomena that are both context and time dependent" (Orlikowski & Baroudi, 1991, p. 20).

Consequently, we choose an open, inductive research approach for this study. The research approach needs to allow for the use of qualitative data towards the development of a conceptual framework that explains regulatory practice grounded in empirical data. Based on our ontological, epistemological and axiological beliefs we choose for a GT approach, which supports an exploratory, inductive research strategy to study regulatory practice by means of empirical data. It also allows for conceptualization of regulatory practice by means of a structured way of working. In the next section

we present the GT approach in more detail in order to select a particular type of GT approach for developing our research strategy.

3.3. Grounded Theory approach: general introduction

The GT approach was developed by the American sociologists Barney Glaser and Anselm Strauss and first reported on in their book *The Discovery of Grounded Theory: strategies for qualitative research* in 1967 (Glaser & Strauss, 1967). Glaser and Strauss' aim was to develop original theory based on empirical data in addition to the aim of positivist social researchers in those days that conducted research to test hypothesis and theories based upon existing theories and knowledge. While working on their project on the topic of dying in hospitals, "they developed systematic methodological strategies that social scientists could adopt for studying many other topics" which supported "developing theories from research grounded in data rather than *deducing* testable hypotheses from existing theories" (Charmaz, 2006, p. 4).

Glaser and Strauss developed their qualitative methodological approach during their sociological research projects in the healthcare sector. They characterize it as an interpretive analytical approach which entails "a nonmathematical process of interpretation, carried out for the purpose of discovering concepts and relationships in raw data and then organizing these into a theoretical explanatory scheme" (Strauss and Corbin, 1998, p. 11). Since their first publication, the GT approach is used within research projects that aim at theory construction in many scientific disciplines: in the social, organizational, as well as technical sciences. For example Urquhart presents an overview of the rise of GT in information systems (Urquhart, 2001; Morse, Stern, Corbin, Bowers, Charmaz & Clarke, 2009).

3.3.1. The Grounded Theory research process

The GT approach is characterized by an exploratory, iterative research process into real life phenomena. GT is considered a qualitative research method, but within a GT study, qualitative and quantitative data of all types, ranging from empirical data reported in documents to interviews and from blogs to (participatory) observations, can be used equally to derive theoretical concepts for the phenomena that is studied (Glaser, 2008).

A GT process consists of several phases in which empirical data collection is alternated with in-depth coding of the empirical data towards the construction of theory or theoretical concepts (Glaser & Strauss, 1967). It is an open inductive research process that consists of extensive empirical data collection, in order to ground the theoretical outcomes firmly in empirical (qualitative and/or quantitative) data (Charmaz, 2006). Charmaz defines induction as "a type of reasoning that begins with study of a range of individual cases and extrapolates from them to form a conceptual category" (Charmaz, 2006, p. 188).

The process for generating theory in a GT study is characterized by coding of the data in such a way that properties of the topic under study are discovered through the labeling of the data. Charmaz describes the coding process as follows:

“Coding means that we attach labels to segments of data that depict what each segment is about. Coding distills data, sorts them, and gives us a handle for making comparisons with other segments of data” (Charmaz, 2006, p. 3).

The process of coding involves interaction with the data by means of data collection activities, coding the data to derive emergent properties and constructing the core category. This core category represents how the main concern of the actors involved is “continually processed or resolved” (Holton, 2007, p. 279). The “core category merits its relevance and prominence by accounting for most of the variation in processing the concern or issue that has emerged as the focus of the study and by conceptually explaining the latent pattern of social behavior that accounts for its continual resolution” (Holton, 2007, p. 279). So the core category is the highest conceptual level and is at the core of the substantive area, other categories are related to the core category to complete the conceptualization of the substantive area (Glaser, 1998, p. 135).

The coding activities form an iterative process of coding called “the process of constant comparative analysis”, which Glaser and Strauss describe as follows:

“While coding an incident for a category, compare it with the previous incidents in the same and different groups coded in the same category... This constant comparison of incidents very soon starts to generate theoretical properties of the category” (Glaser and Strauss, 1967, p. 106)

During the coding process, the initial single codes (properties) are merged into conceptual (sub) categories that are elements of the emerging substantive theory. Once the conceptual categories emerge, they represent a set of dimensions (Urquhart, 2001). The constant comparative coding continues until saturation of the data is reached and the conceptual categories and dimensions can be determined (Bryant & Charmaz, 2007b). This process shows the development from description towards more abstract categories that represent the core of the phenomenon studied.

By means of constant comparison between the empirical data, the researcher develops general concepts and the relationships between those concepts (Bryant & Charmaz, 2007c). In the words of Strauss & Corbin: “[t]he grounded theory approach is a qualitative research method that uses a systematic set of procedures to develop an inductively derived grounded theory about a phenomenon” (Strauss and Corbin, 1990, p. 23-24). This type of research differs from deductive research in which the testing of hypotheses based on former established theory or a priori assumptions is at the core of the research design (Bryant and Charmaz, 2007a, p. 43).

The GT approach is based on repeated cycles of data collection and analysis and constant comparison. This cycle is repeated until new data gathering leads to minimal further fine-tuning of the theoretical conceptualization that the researcher strives for. The saturation is reached when new empirical data do not longer provide substantial contribution to the framework (Urquhart, 2001). Glaser and Strauss describe this moment of theoretical saturation as follows:

“Saturation means that no additional data are being found whereby the sociologist can develop the properties of the category” (Glaser and Strauss, 1967, p. 61)

O’Connor et al. (2008) add a more pragmatic touch to the moment of saturation by stating that:

“From an interpretive perspective, constant comparison is not sufficient. Until the results can be displayed in a descriptive graphic, illustration, or table or until the results can be stated in no more than a paragraph, neither the degree of empirical grounding has been established .., nor has meaning been constructed... from constant comparison” (O’Connor, Netting and Thomas, 2008, p. 42).

Whereas mainstream textbooks refer to GT as purely inductive, more recently researchers indicate that the approach also contains elements of abduction, labelling GT as having an inductive-abductive logic⁵. Reichertz defines abduction as “assembling or discovering, on the basis of an interpretation of collected data, such combinations of features for which there is no appropriate explanation or rule in the store of knowledge that already exists” (Reichertz, 2007, p. 219). The abductive elements can be illustrated by the role of theoretical literature in GT research designs. The process of a GT study is characterized by non-sequential, overlapping phases of data collection, data coding, interpretation, conceptualization and a continuously revisiting of the empirical data. The empirical data are in essence individual cases, but by means of coding and categorization theoretical concepts emerge. Subsequently, the analytical activities lead to the theoretical components that represent the phenomenon that is studied (Glaser & Strauss, 1967; Strauss & Corbin, 1998; Charmaz, 2006). Next, a grounded theorist compares these components with existing theory and uses the theory to continue to develop the concepts that emerge from the empirical data. So whereas the starting point is to study individual cases in an inductive manner, existing theory or concepts are used to compare the emerged concepts with. This can lead to the discovery of new knowledge that is not already covered by existing explanations or rules, that is: abduction.

Strauss and Corbin mention that “[c]reativity is also a vital component of the grounded theory method. Its procedures force the researcher to break through assumptions and to create new order out of the old” (Strauss and Corbin, 1990, p. 27). Bryant and Charmaz label this interaction between empirical data, emergence of theoretical concepts and existing theory as elements of abduction within the GT approach (Bryant and Charmaz, 2007a, p. 46; pp. 50-51). By keeping an open mind to deviations from existing knowledge by way of coding for new concepts and for new theory, the GT approach offers a combination of inductive as well as abductive reasoning and inferences.

The role of abduction was an important aspect in the evolutionary development of GT approaches throughout the years. Reichertz states that

“Grounded Theory was to a very small extent abductive from the start and became more and more abductive in its later stage; at least in the work of Strauss. Thus the Glaser-Strauss controversy can be characterized, at least in part, as one between induction and abduction” (Reichertz, 2007, p. 215).

⁵ Bryant and Charmaz provide an overview of the history of GT in which they report that originally the GT approach was presented as being a positivist/objectivist approach (Bryant & Charmaz, 2007a). However, the authors pledge for a repositioning of GT by discerning a positivist/objectivist variant and a constructivist variant. They see this as an answer to the epistemological discussions around the method over time. Their impression is that Glaser and Strauss were, in the early years of GT development, focused on providing an alternative to the dominance of quantitative hypothetical-deductive mainstream sociological research, thus neglecting the abductive elements of the approach.

The GT research process will first lead towards a substantive theory, but when the study is continued this can develop into a formal theory, which we discuss in the next section.

3.3.2. Substantive versus formal theory generation

The aim of a GT approach can be either to develop a substantive or a formal theory. A substantive theory is defined as “a theoretical interpretation or explanation of a delimited problem in a particular area, such as family relationships, formal organizations, or education” (Bryant and Charmaz, 2007b, p. 610). Whereas substantive theory is developed for a specific group, place or set of activities, formal theory is more general and abstract and applies to several situational contexts, it therefore has “broad social applicability” (Lempert, 2007, p. 246). In order to develop formal GT (FGT), the process of constant comparison and theoretical sampling (in the same or other substantive areas) needs to be continued, by focusing on the core category of the substantive theory. Lempert illustrates this as follows:

“By taking analyses to higher levels of abstraction and conceptual integration in a variety of contexts and groups, Grounded Theory methodology provides the means to develop formal theories from substantive theories” (Lempert, 2007, p. 247).

During this continued GT process the core category as found in the substantive theory may be adapted because of the use of new empirical data (Glaser, 2007, pp 99-101). Glaser stresses that “FGT in generating the general implications focuses only on conceptually general categories and hypotheses, not on descriptive differences and similarities” (Glaser, 2007, p. 104). By this statement, Glaser contrasts FGT with qualitative data analysis (QDA) that is aimed at a descriptive inventory of data that serves to perform comparisons between substantive areas. In contrast, FGT leads to general conceptualization and not to general description (Glaser, 2007, p. 100). This transition process from properties to categories and their relations, towards a substantive theory and from several substantive theories towards an FGT theory is illustrated in Figure 6.

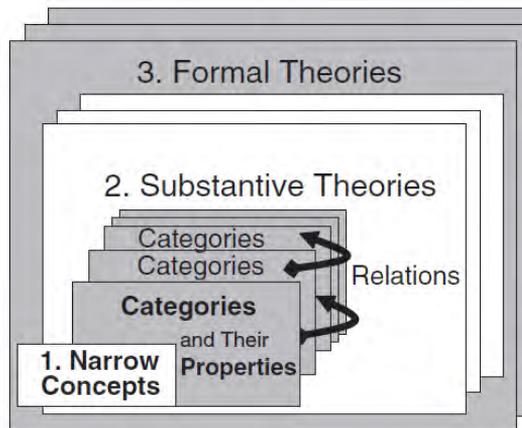


Figure 6 Progression of theory development in GT (copied from (Urquhart, Lehmann and Myers, 2010, p. 364))

An example of this process is given by Charmaz on the development of a theory of identity loss. Starting with exploring this theory with a study of young people with new disabilities, one can extend the core categories that are found in that substantive area by also looking into empirical data on identity loss in cases of other social events such as job loss, the death of a partner or losing one's house due to a natural disaster (Charmaz, 2006, p. 8). Thus, the early concept of 'identity loss' can be developed into a concept of identity loss that is more generally applicable. This illustrates the phases of going from narrow concepts to a substantive theory and ultimately to a formal theory.

Over time, different variants of the initial GT approach were developed. In order to substantiate our choice, we present these variants in the next section.

3.3.3. Variations within the Grounded Theory approach

Since the early methodological publications by Glaser and Strauss in the 1960s and 1970s, the GT approach has evolved into several variants. Glaser continued to elaborate on the original methodological approach, whereas Strauss, in the beginning of the 90's (with Corbin) developed a variant to the original GT approach with the publication of *Basics of Qualitative Research. Grounded Theory Procedures and Techniques* (Strauss & Corbin, 1990). They are now generally known as the classic Glaserian and the neo-Straussian-Corbin school respectively. More recently, the Constructivist GT approach has been put forward by Charmaz (Charmaz, 2006), which, according to Morse, represents a combination of aspects from both the classic Glaserian and the neo-Straussian-Corbin (Morse, Stern, Corbin, Bowers, Charmaz & Clarke, 2009). Other variants are dimensional analysis (initiated by Schatzman) and situational analysis (as represented by Clarke). See Figure 7 for an overview of the variants that have been developed over time.

Before presenting the way in which we apply the GT approach in our study, we shortly present the characteristics of the three dominant approaches: the Classic Glaserian, the Straussian and the Constructivist approach.

Classic Glaserian Grounded Theory

In the classic Glaserian school a researcher starts with studying empirical data right from the beginning without doing a thorough literature review first, as is common in other types of academic research strategies. The motivation to do so is that the researcher should enter the research domain without preliminary concepts in mind that would limit the open mind of the researcher towards the empirical data. In Glaser's view the coding activities and memo writing in the GT process should not be contaminated with a full, upfront overview of the state of the art in the research domain. He argues that this would hinder the emergence of concepts from the empirical data (Glaser & Strauss, 1967). In classic GT, the emergence of data is central and the influence of the researcher's own background on the data gathering and coding is not made explicit. This standpoint has been a focal point of critique in later reflections on the GT approach. As Bryant and Charmaz comment: "Glaser does not acknowledge that researchers' own standpoints, historical locations, and relative privileges shape what they can see" (Bryant and Charmaz, 2007a, p. 44).

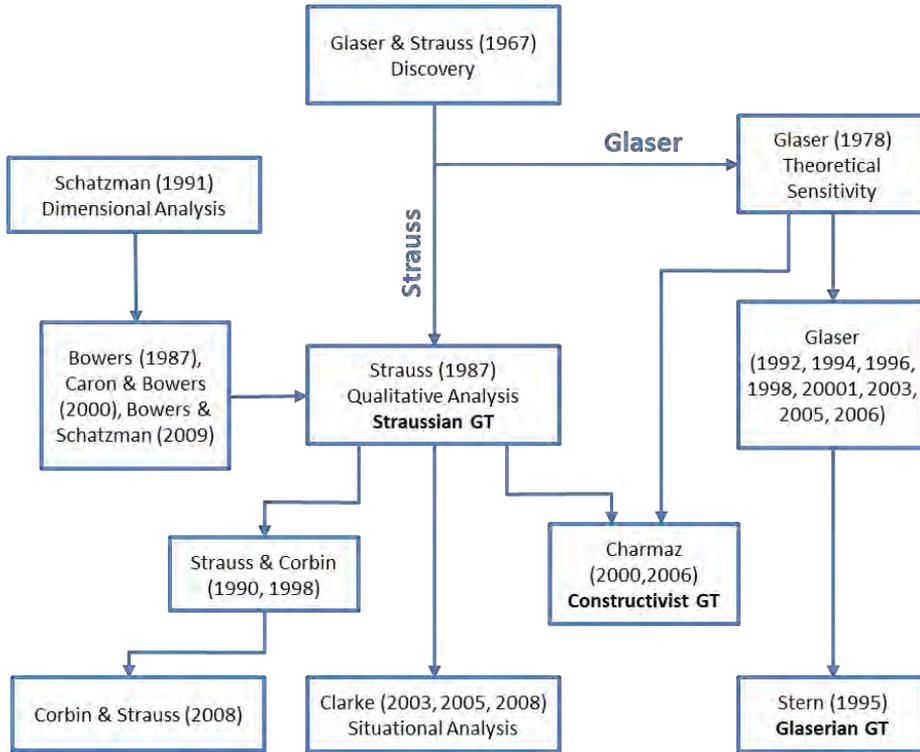


Figure 7 An overview of variants of the Grounded Theory approach, based on (Morse, 2009, p. 17)

Glaser positions the role for literature review in the evaluation phase of a research project: “Similarities and convergences with the literature can be established after the analytic core of categories has emerged” (Glaser and Strauss, 1967, p. 37). This conception of the role of literature within a scientific research project entails that the status of a literature review is not different from the status of all other empirical data. This is in contrast with the majority of scientific research approaches which require an extensive literature review at the very start of a research project. Glaser’s famous words on this special interpretation of the role of literature are: “all is data” (Glaser, 2001, p. 145). Glaser attributes no special status to existing literature, but considers all data to be of equal status for a researcher who follows the Glaserian approach within GT. The data can have the form of interviews, conversations, Internet discussions, newspaper articles or academic literature, video, etc. (Glaser, 2001). All these sources can be used equally during the several phases of using the empirical data towards the formulation of core concepts.

Straussian Grounded Theory

Strauss and Corbin developed another stance towards the role of prior knowledge at the start of a GT process. They proposed to value and profit from this prior knowledge by making it explicit by means of formulating “sensitizing concepts” that can be taken as a starting point for looking at empirical data (Strübing, 2007, p. 587). In this interpretation, they follow Blumer who distinguishes ‘sensitizing concepts’ from definitive concepts as follows: “Whereas definitive concepts provide

prescriptions of what to see, sensitizing concepts merely suggest directions along which to look" (Blumer, 1954, p. 7). Instead of Glaser's rejection of previous knowledge or prior theoretical concepts because of the risk that these become predominant in the ensuing analytical process and hinder the process of emergence of concepts from data, Strauss and Corbin value prior knowledge and concepts differently because they can make the analytical process more efficient. They propose to use the knowledge as a filter through which the empirical data analysis process can be structured. In addition, by using sensitizing concepts researchers make their prior knowledge and perceptions on the topic more explicit, but not by letting it dominate the research process. Strübing illustrates this by saying: "[t]he attitude called for would be to let ourselves be inspired to look in directions indicated by this knowledge without assuming that this would be the only solution to our research problem" (Strübing, 2007, p. 587).

Constructivist Grounded Theory

Charmaz presents a third approach for applying GT (Charmaz, 2000). Charmaz stresses the fact that researchers are not objective in the process of data collection and interpretation but take their own reality with them and thus influence the subjects that are selected for the empirical data collection:

"In short, constructing constructivism means seeking meanings—both respondent's meanings and researcher's meanings. To seek respondent's meanings, we must go further than surface meanings or presumed meanings ... A constructivist approach necessitates a relationship with respondents in which they can cast their stories in their terms" (Charmaz, 2000, p. 525)

Thus: *"[w]e construct our grounded theories through our past and present involvements and interactions with people, perspectives, and research practices"* (Charmaz, 2006, p. 10).

In her interpretation of GT, Charmaz criticizes the supposed objectivity of the GT researcher in the classic Glaserian school and prefers to make the subjectivity of the researcher an integral part of the research project. In her opinion, the researcher and the subjects involved create theoretical concepts in interaction: "[p]eople construct texts for specific purposes and they do so within social, economic, historical, cultural, and situational contexts" (Charmaz, 2006, p. 35), be they elicited texts (i.e. written upon request by the researcher such as written surveys, diaries or logs, etc.) or extant texts (i.e. texts that are written out of the context of the research project and thus are not influenced by the researcher, such as government reports, medical charts, Internet discussions etc.) (Charmaz, 2006, p. 35). Also, the choices of a researcher in the selection and evaluation of data or in selecting research methods are influenced by individual objectives or subjective interpretation. Therefore, Charmaz formulates her critique on the classic Glaserian approach as follows:

"Glaser (1978, 1992) assumes that we can gather our data unfettered by bias or biography. Instead, a constructivist approach recognizes that the categories, concepts and theoretical level of an analysis emerge from the researcher's interactions within the field and questions about the data" (Charmaz, 2000, p. 514).

Nevertheless, she does stress that every GT practitioner needs to remain open to whatever the data contributes, especially during the early stages of a research project (Charmaz, 2000). In an interview with Puddephatt in 2006 Charmaz makes this point very clear by stating: "I think that the notion that

we go into our studies with a blank slate is impossible. You haven't been a very good student if you're totally a blank slate in your area. But you can go in with an open mind" (Puddephatt, 2006, p. 15).

In a discussion of one of her articles on Constructivist GT (i.e. (Charmaz, 2000)), Glaser strongly objects against Charmaz' variant of the GT approach, claiming her intentions as a way of moving GT into the QDA domain (Glaser, 2002b). Glaser opposes this move because the QDA domain is, in his opinion, too much focused on accuracy of the data and on descriptive research instead of the emphasis on analytical research for theory construction, where GT stands for. He claims that during the cyclic coding process many voices will be heard, but subjectivity is levelled out by the richness of the data (Glaser, 2002b).

3.3.4. Synthesis on Grounded Theory approach

A GT approach aims for theory development through a systematic, interpretative process of coding empirical data towards conceptualization. The coding process leads to the formulation of a core category that conceptually explains how social actors resolve their main concerns. Integration of the core category and other (sub) categories lead to a substantive theory for the area of study. This substantive theory explains the behavior of the social actors involved. A GT study does not take a theoretical or conceptual framework as a starting point, but relies on the emergence of concepts during the process on constant comparison (Rieger, 2019, p. 5). A GT approach is particularly suited to study processes and their inherent complexities in their context and to provide for explanations of the behavior of the social actors involved (Myers, 1997; Urquhart and Fernández, 2013, p.2-3). Therefore this research approach fits with our main objective to conceptualize regulatory practice in the complex mobile telecommunications system.

The ontological and epistemological beliefs in the three main GT variants that we presented in 3.3.3 is a point of discussion amongst academics (Urquhart, 2001; Fernández & Lehmann, 2005; Rieger, 2019). Whereas some authors claim that GT is foremost a generic approach, independent from ontological and epistemological beliefs, other authors position the GT variants in a wide range of research beliefs, from positivist, to realist, interpretivist and pragmatist (Holton, 2007, p. 267). Lehmann et al. mention that "[t]here is considerable disagreement and debate with regard to the underlying philosophical assumptions of grounded theory. Grounded theory belongs to the realm of qualitative empiricism and has been variously described as positivist, interpretive or critical" (Urquhart, Lehmann and Myers, 2010, p. 360).

The GT approach is originally developed "as a method to explore social processes and reveal the human characteristic of anticipating and responding to various life circumstances" (Lomborg and Kirkevold, 2003, p. 191). GT has its roots in symbolic interactionism and was developed as a reaction to the dominance of deductive, quantitative research approaches in sociology in the 1960s (Lomborg and Kirkevold, 2003, p. 191). As a general approach, it had no clear philosophical stance in the early years of development (Urquhart, Lehmann and Myers, 2010, p. 360), and co-originator Glaser calls the approach "paradigmatically neutral" (Glaser, 2001). But the original approach developed over the years into the main variants of Classic Glaserian GT, Straussian GT and the Constructivist GT approaches. Annells reflects on the evolution in the discussion on the philosophical positioning of GT: "it is vital to recognize that the method is subject to evolutionary change with differing modes

resultant and is therefore not static in regard to philosophical perspective, fit with a paradigm of inquiry, and research process (although key elements may remain unchanged)" (Annells, 1996, p. 391).

These differences have implications for the research design of a GT study and require researchers to reflect on them in presenting their research design (Urquhart, Lehmann and Myers, 2010, p. 361). Therefore, researchers who use a GT approach need to position themselves within the ongoing discussion on types of GT and be explicit on their ontological and epistemological stance.

In 3.2.4 we presented that our research belief is based in constructivism. Our methodological belief in interpretivism allows the use of empirical data from the past. As a consequence we will not interact with the social actors in their substantive context, which is more central in a constructivist GT approach. We will not use sensitizing concepts from previous literature nor theoretical concepts in order to allow for a full emergence of concepts for our framework from the empirical data. We do adopt an open socio-technical perspective, in contrast to the studies of our contextual literature in which predominantly an economic or legal perspective on regulation is taken.

In the Straussian GT approach the dialectical research setting and the use of sensitizing concepts as well as the use of coding schemes and the incorporation of previous knowledge experiences is more common than in the Classic GT (Rieger, 2019). Although Straussian GT offers guidance for the coding process, the coding schemes are also deemed more rigid (Goldkuhl & Cronholm, 2019). Classic GT is more tolerant in its coding process by not requiring sensitizing concepts and puts more emphasis on the emergence of concepts from the empirical data. For explanatory theory development, the classic GT variant is more suitable as it allows for emergence of concepts from the empirical data without the more rigid procedures of coding paradigms that are commonly used in the Strauss & Corbin variant (Urquhart, Lehmann and Myers, 2010, p. 362; Rieger, 2019, p. 5). The classic GT approach does refer to coding families that are indicative for what to look for in the data, but is not prescriptive in using them (Glaser, 1978). We therefore choose to follow a classic GT approach. In the next section we develop our research strategy.

3.4. Research Strategy

We develop the research strategy for our research based on the CGT approach by formulating the leading sub questions linked to the phases of the CGT approach. The research methods and empirical data for answering them and the envisaged intermediate deliverables are formulated and the criteria that we will apply to evaluate our conceptual framework are presented.

In this study, we use the terms open, selective and theoretical coding to present the coding phases of the empirical data within our GT study (Glaser, 1978, 1992; Rieger, 2019) (Glaser, 1978; 1992; Rieger, 2019). Other researchers speak of the exploration, specification and reduction/integration phase (for example (Peters & Wester, 2007). Although using different terms, the intentions of each phase are the same: in the first (open) phase a researcher codes for properties; in the second (selective) phase the aim is to order these properties into higher level (sub) categories with causal or contextual relations between them to formulate dimensions and in the third (theoretical) phase the dimensions are integrated into a theoretical framework in which the core category is presented

(Glaser, 1978, 1992; Rieger, 2019). The dimensions serve as the main body of the theoretical framework (Glaser & Strauss, 1967; Strauss & Corbin, 1998; Urquhart, 2001; Vallet, 2003).

3.4.1. Research phases

Open and selective coding

As our objective is to develop a conceptual framework of regulatory practice in mobile telecommunications markets, we first need to know which market issues led to interventions by NRAs. Therefore, we develop the first dimension for our conceptual framework by analyzing the market issues that were addressed by the NRAs. In this thesis a market issue is any reason for an NRA to perform activities in order to develop a regulatory arrangement. In this thesis a regulatory activity is an action that an NRA undertakes in order to solve a market issue. The relevant sub question to be answered is:

1. How to conceptualize the market issues that a national regulatory authority in the mobile telecommunications system deals with?

Our next aim for the development of the conceptual framework of regulatory practice is to explore how the NRAs dealt with these market issues. We therefore look at the activities that the NRAs deployed to develop regulatory arrangements for dealing with the market issues that we identified:

2. How to conceptualize the activities that a national regulatory authority in the mobile telecommunications system performs to deal with market issues?

These two sub questions are answered by the open and selective coding of the empirical data. The first sub question will yield the dimension *Market Issues* (developed in chapter 4) and the second sub question will yield the dimension *Regulatory Activities* (developed in chapter 5). These two dimensions are combined to develop the core category for our conceptual framework (in section 6.2).

Referring to the contributions to academic literature that we formulated in 2.5 we will use empirical data from a period in which a major institutional change in the mobile telecommunications system occurred. The data needs to yield an overview of market issues over an extended period of time instead of focusing on a single market issue. This context cannot be studied in real-time interaction with the social actors because the major institutional change took place in the late 1990s. We therefore chose to use historical document analysis to reconstruct the regulatory processes with a focus on the interactions between the multi-actor, technical and institutional subsystems. Document analysis is suitable for an in-depth exploration of regulatory practice and allows us to go back and forth between the documented data to study the way in which NRAs dealt with tensions in the market by means of regulatory activities. As NRAs are for reasons of transparency legally required to publicly publish their considerations, to report upon the process of developing their regulatory arrangements and to argue for their decisions, we used document analysis to collect the empirical data for our coding process. We do acknowledge that historical documents will represent formalized accounts of regulatory practice, which may not be unbiased due to political considerations or the socio-cultural context in which they were published (Yin, 1994, p. 80).

Therefore we will critically reflect on the limitations and consequences of historical document analysis in section 9.4.2.

We use the regulatory activities in an inductive way to understand regulatory practice within the empirical context of the mobile telecommunications market (Orlikowski and Baroudi, 1990, p. 14). This fits with the interpretivist belief, described by Klein and Myers as: “the foundational assumption for interpretivists is that our knowledge of reality is gained only through social constructions such as language, consciousness, shared meanings, documents, tools and other artifacts” (Klein and Myers, 2011, p. 220). As mentioned before, we will not use sensitizing concepts for the analysis of the empirical data as our “*primary endeavor is to describe, analyze and understand the social world from the actors' perspective, and any rigid a priori researcher-imposed formulations of structure, function, purpose and attribution are resisted (Glaser & Strauss 1967)*” (as cited in Orlikowski & Baroudi, 1991, p. 15).

The empirical data is based on a full overview of regulatory dossiers in the mobile telecommunications market in three European countries: the United Kingdom, the Netherlands and France. To this end, we made an overview of all market issues that these three NRAs dealt with between 1997- 2002:

- OFTEL: the Office for Telecommunications in the United Kingdom⁶;
- OPTA: the Onafhankelijke Post en Telecommunicatie Autoriteit in the Netherlands⁷,
and
- ART: the Autorité de Régulation des Télécommunications in France⁸.

These NRAs are described in full in section 4.2.

We chose these three regulatory authorities for practical reasons: we are able to read their publications in their original language, which makes us independent from translations that are not always available. This relatively easy access to data allows us to analyse a multitude of regulatory dossiers over a longer period of time (three regulators and a five years' period). In this thesis a regulatory dossier is a series of documents that pertain to a specific market issue and as such represent the sequence of regulatory activities to develop a regulatory arrangement. The published formal documents range from NRA guidelines, decisions, market reviews to website content and yearly reports. A full overview of these documents is provided in Appendix B.

Our data collection period is from January 1997 for OFTEL and ART and from August 1997 for OPTA, until December 2002⁹. The choice for this period is based on the fact that from 1997 onwards, the telecommunications market in Europe was formally fully liberalized (European Commission, 1987; European Parliament and the Council of the European Union, 1998a). Part of this liberalization

⁶ Currently part of the Office of Communications (OFCOM).

⁷ Currently part of the Autoriteit Consument en Markt (ACM).

⁸ Currently l'Autorité de Régulation des Communications Électroniques et des Postes (ARCEP).

⁹ Whereas the NRA in the United Kingdom OFTEL was installed earlier in 1984 under the Telecommunications Act 1984, the other two NRAs in our study were installed in 1997. The ART was installed on January 5th 1997 and the OPTA became operational in August 1997.

process was the installment of NRAs (European Parliament and the Council of the European Union, 1997, art. 2.1.b). The liberalization led to many market issues that the NRAs had to deal with. This will yield rich data on the sources of uncertainties as well as on the regulatory practice to deal with market issues for the open and selective coding phase of our GT approach.

Our period of analysis ends in 2002, the year in which the EU New Regulatory Framework (NRF) came into force in April 2002. Whereas between 1997 and 2002 the main rationale for regulatory intervention was the encouragement of competition by means of asymmetric, technology-dependent and sector-specific regulation, the NRF started a new era of regulation that is more based on principles of general competition law (articles 81 and 82 of the European Treaty). The NRF consists of a set of five Directives that had to be translated into national telecommunications law in the EU Member States by July 24th 2003 (European Parliament and the Council of the European Union, 2002; Ubacht, 2006). This NRF entailed a shift in regulatory activities towards the execution of economic market analysis as the core of regulatory practice. As we chose to explore regulatory practice in the period of competition engineering (in contrast to competition safeguarding under the NRF), the empirical data analysis is performed on dossiers until January 2002.

The three NRAs published their decisions in publicly available documents in order to adhere to formal requirements of public representation and transparency. The choice for using the formal NRA documents to retrieve the empirical data was made for reasons of:

- *Accessibility & availability*: the documents are well archived and online accessible, therefore the material could be revisited again and again during later coding activities;
- *Spatial and temporal reasons*: no other sources can yield that many (accurate) data on events in three different countries that occurred in the past;
- *Chronological reconstruction*: the documents enable a reconstruction of the regulatory dossiers, which is necessary to obtain a good overview of the activities of regulatory practice over an extended period of time.

We reconstruct the regulatory dossiers by means of a search for documents that constituted the regulatory dossiers, such as guidelines, decisions, statements, market reviews etc. We integrate the raw empirical material into elaborate textual descriptions of the sequence of activities taking place in a chronological order within each regulatory dossier. In total 61 dossiers are reconstructed for coding purposes. A full overview of the sources used for this reconstruction is presented in Appendix B and the full list of the market issues can be found in Appendix C.

For the open and selective coding phases of the empirical data we used the software Atlas.ti for QDA (Peters & Wester, 2007; Urquhart, Lehmann & Myers, 2010; Friese, 2016). In the coding we remained as close as possible to the terms used in the documents. For consistency in the coding, two research assistants also coded the properties and the (sub)categories in the open and selective coding phases. Any deviations in interpretation and coding were discussed face to face and solved.

Theoretical coding

In the theoretical coding phase we combine the two dimensions *Market Issues* and *Regulatory Activities* to create the core category for regulatory practice. This core category explains the main concern of the NRAs in dealing with the tensions and uncertainties in the market. By means of conceptualizing the pattern(s) by which they deal with the market issues we formulate the core

category in chapter 6. In addition we present the other dimensions for the conceptual framework and show how they are related. This answers our third sub question:

3. Which are the dimensions and their relationships for the conceptual framework for regulatory practice in the mobile telecommunications system?

The deliverable of the theoretical coding phase is a first version of our conceptual framework of regulatory practice.

In the theoretical coding phase we use the empirical data in Atlas.ti and apply logical reasoning for developing the core category and the additional dimensions for the conceptual framework. The creation of the core category is based on constant comparison of the market issues and the regulatory activities in order to discern a pattern between these two dimensions. The additional dimensions are based on coding of the empirical data in Atlas.ti.

Conceptual comparison

Following the CGT approach we continue the development of our conceptualization of regulatory practice in mobile telecommunications markets by comparing our conceptual framework with extant theoretical concepts in the field of regulation. This comparison has two objectives: to evaluate our conceptualization in a theoretical way and to argue for our contribution to extant conceptualizations in literature in the domain of regulatory practice.

In a CGT approach a literature review is performed towards the end of the study to serve two functions (Glaser, 2001, p. 145). First, the literature review is considered to be an integral part of the CGT method of constant comparison of data (Scott, 2007, p. 95). The literature is considered as data that is used to further develop the core category into a substantive concept, just like the empirical data has been used in the previous phases.

A second function of the conceptual literature review is making the connection between our conceptualization and extant theoretical concepts. When extant theoretical concepts can contribute to the further development of the concepts in our study, likewise our concepts can be used to critically assess and contribute to extant theoretical concepts of regulatory practice. Thus, by means of a conceptual comparison we can position our conceptualization within a broader domain of relevant academic literature.

In the CGT approach this is the conceptual comparison phase, for which we formulate the following sub question:

4. How does the conceptual framework of regulatory practice in the mobile telecommunications system compare and relate to extant theoretical concepts of regulatory practice?

For the comparison phase we conduct a conceptual literature review to find extant theoretical concepts from generic regulatory literature. The conceptual literature is coded in Atlas.ti. Based on the coding we develop a concept-matrix to analyse the literature and to compare the findings with our conceptual framework. The deliverable of the comparison phase is an adapted conceptual

framework in which extant theoretical concepts are integrated into the initial version of our conceptual framework. In addition we present our contribution to extant theoretical concepts. This is presented in chapter 7.

Evaluation of the conceptual framework

In the last phase of our CGT approach we evaluate our conceptual framework by answering the sub question:

5. To which extent does the conceptual framework explain how regulatory authorities deal with the tensions in the mobile telecommunications system?

We use a condensed literature overview on evaluation criteria that are commonly used in GT studies. We select the evaluation criteria that match with our CGT approach. These are fit, relevance, workability and modifiability. The evaluation phase is presented in chapter 8.

Concluding the research

In the conclusion chapter 9 we present and discuss our final conceptual framework of regulatory practice as the deliverable of our study and address our scientific and societal contribution. We also reflect on the research process and research limitations and formulate future research questions.

3.5. Research flow diagram

In Figure 8 we present a visual representation of our research strategy as presented in the previous section. In this research flow diagram we show:

1. the sub questions;
2. the corresponding chapters;
3. the research phases based on the CTG approach:
 - open and selective coding,
 - theoretical coding,
 - conceptual comparison and
 - evaluation
4. the subdeliverables of the phases;
5. the final deliverable.

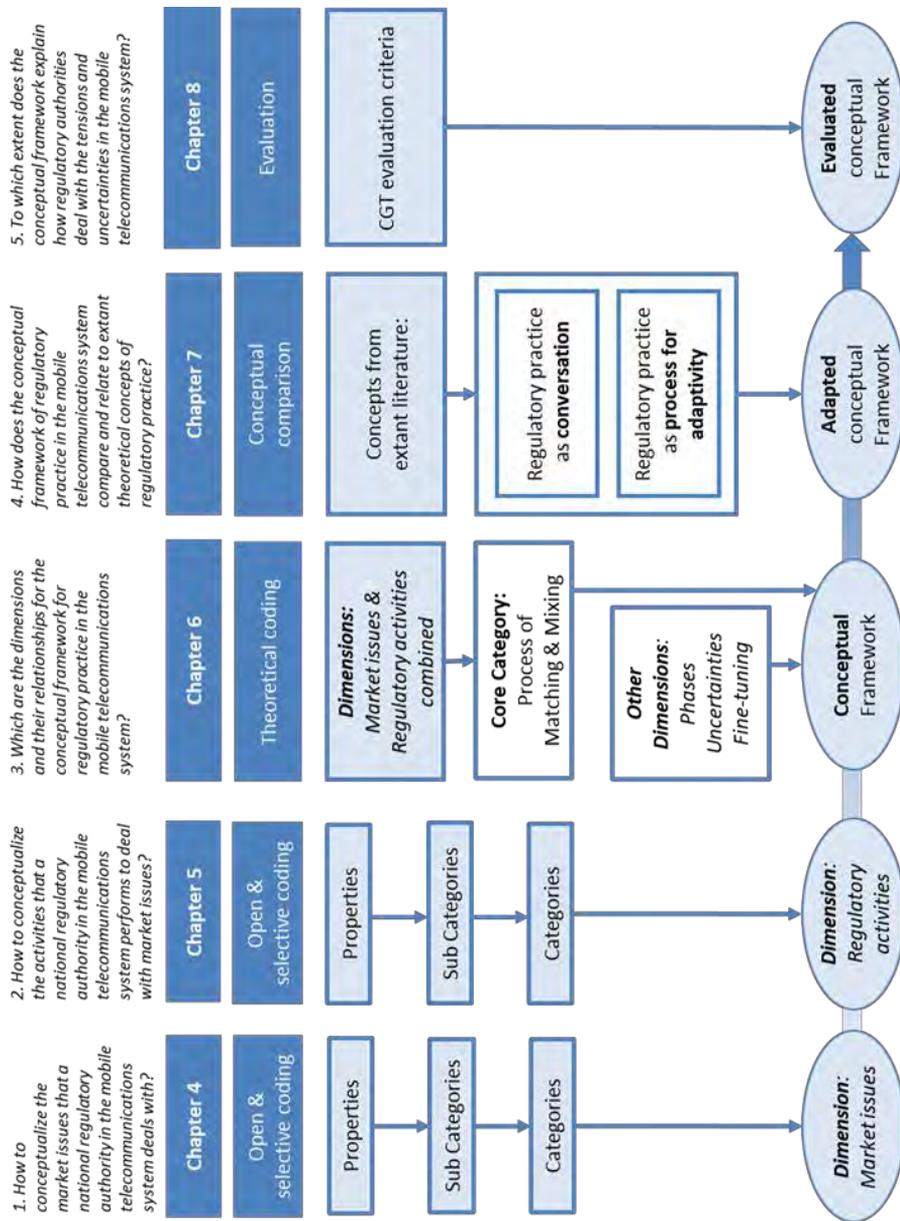


Figure 8 Research flow diagram

4. Dimension: Market Issues in Mobile Telecommunications Systems

"...it would be naïve to assume that network industries can only be commercially driven. Public values and national interests are at the core of these industries and often demand public involvement and governmental interference" (Künneke and Groenewegen, 2009, p. 2)

4.1. Introduction to the market issues¹⁰

In order to develop a conceptual framework of regulatory practice in mobile telecommunications systems, we first need to know which market issues led to interventions by NRAs. We define a market issue as any reason for an NRA to perform activities in order to develop a regulatory arrangement. For this research phase we formulate the following sub question:

1. How to conceptualize the market issues that a national regulatory authority in the mobile telecommunications system deals with?

Conceptualization of market issues requires a sufficient amount of empirical data from a diversity of contexts to create higher level concepts. Therefore, to collect the empirical data for our GT approach we reconstructed the market issues in the mobile telecommunications market that three sector-specific NRAs dealt with. These NRAs are OFTEL in the United Kingdom, OPTA in the Netherlands and ART in France. The empirical data is from the period 1997 until 2002: the first years of full liberalization in the EU Member States. These years are characterized by regulatory efforts targeted at creating fair competition between the market players and safeguarding public values at the same

¹⁰ We presented preliminary outcomes of chapter 4 in: (Ubacht, 2004, 2006).

time. Once the mobile licences were allocated to allow for new market entry, tensions in the retail and wholesale markets led to issues that were subject to regulation.

In Appendix B the full overview of documents can be found that we used to reconstruct the regulatory dossiers by means of process tracing in the format of chronological accounts of events and regulatory activities. These reconstructions were inserted into Atlas.ti for coding purposes, not only to code for the dimension of market issues (as presented in this chapter) but also to code for the dimension of regulatory activities (to be presented in chapter 5) and additional dimensions of the framework (to be presented in chapter 6).

The empirical data shows that the NRAs dealt with market issues that originated from tensions between the main actors in the mobile telecommunications market as illustrated in Figure 1. A full overview of the market issues is presented in Table 17. This overview is based on the empirical data of 61 regulatory dossiers. In the table a “market issue” is at the lowest level such as raising the quality of service by means of information provisioning. A “theme” is a collection of market issues on a higher level, e.g. raising the quality of service contributes to the theme of end user empowerment.

The overview shows that not all NRAs dealt with the same market issues, but collectively the 61 dossiers yielded a large amount of empirical data for the coding process. In the following sections summarized descriptions of the themes are presented in order to illustrate the creation of the dimension *Market Issues* for the conceptual framework.

The remainder of this chapter is structured as follows. In section 4.2 we first introduce the main players in the national mobile telecommunications markets in the United Kingdom, the Netherlands and France in the period 1997-2002. This provides for the national regulatory context for the illustrative examples the we use in the sections 4.2-4.6 in which we present the themes and their market issues. In section 4.7 we construct the dimension *Market Issues* based on the open and selective coding process of the market issues. In section 4.8 we conclude by answering sub question 1.

Table 17 Full overview of the market issues in the mobile telecommunications market that OFTEL, OPTA and ART dealt with from 1997 to 2002.

Legend: PDx refers to the number of the primary doc in Atlas.ti, the software in which we coded the regulatory activities in the open and selective phase of our GT Approach. The symbol - means the issue was not dealt with by the NRA. The market issues to which the PD numbers refer can be found in Appendix C.

Theme	Market Issue	OFTEL	OPTA	ART
Social rationale/Retail level: mobile services provision and end users (section 4.3)				
End user empowerment	Information provisioning: quality of service	PD19	-	PD51
	Information provisioning: transparency of terms of use (tariffs & contract conditions)	PD20	PD5	-
	Consumer complaint handling	PD15	PD1	-
	Eliminating switching barriers: SIM lock	PD17	PD3	-
	Eliminating switching barriers: mobile number portability	PD16	PD2	PD50
	Jamming of mobile signals			PD55
Mobile retail tariffs	Fixed to mobile termination tariffs	PD18	PD4	PD60
	On-net versus off-net mobile tariffs	PD22	-	-
	International mobile roaming retail tariffs	PD21	-	-
Economic rationale/Wholesale level: relationship mobile network operators mutually (section 4.4)				
Interconnection	Guidelines for interconnection and interoperability	PD23	-	-
	Terms & conditions: frequency of interconnection charge reviews	PD28	-	-
	Tariffs: equality of termination tariffs for international and national calls	PD27	-	PD53
	Tariffs: interconnection charges for originating calls to free phone numbers	PD26	-	-
	Routing: international rerouting	PD31	-	-
	Routing: routing of inbound international traffic	PD32	-	-
Interoperability	Technical protocol for interoperability	-	-	PD56
	The customer network interface	PD29	-	PD52
Mobile coverage	Infrastructure sharing: 2G period	PD24	PD6	PD61
	Infrastructure sharing: 3G period	PD25	PD7	PD54
	National roaming	PD30	PD8	PD61
Economic rationale/Wholesale level: relationship mobile network operators with service providers (section 4.5)				
Service providers: administrative access	General framework for mobile service provision	PD39	-	-
	Cross-subsidization	PD37	-	-
	Retail promotions	PD43	PD11	PD59
	Unbranded and unstructured airtime	PD45	-	-
	Wholesale pre-pay mobile services	PD47	-	-
	Wholesale terms and conditions	PD49	PD14	-
	Wholesale promotions	PD48	-	-
Service providers: special access	Introduction of new services by mobile operator: BT's Genie service	PD34	-	-
	Introduction of new services by mobile operator: Personal numbering services	PD41	-	-
	Introduction of new forms of special access: indirect access	PD40	PD10	PD57
	Introduction of new forms of special access: services based on roaming (MVNO)	PD44	PD12	-
	Preferential treatment: Services for charge card operators	PD38		
	Preferential treatment: Access to network intelligence	PD33	PD9	-
	Preferential treatment: Connection of SMS platforms to the networks	PD36	-	-
	Preferential treatment: Value added services	PD46	PD13	-
	Preferential treatment: Portal control	-	-	PD58
Economic rationale/Wholesale level: relationship mobile network operators with retailers (section 4.6)				
Retailers	Claw back clauses	PD35	-	-
	Resale price maintenance	PD42	-	-

4.2. The national regulatory contexts

As introduction to the market issues that we present the sections 4.2-4.6, we provide an overview of the main government authorities, committees, organization for end user representation and industry interest groups that were involved in the regulation of the mobile telecommunications

markets in the United Kingdom, the Netherlands and France. This overview is not meant to be exhaustive, the selection is based on the presence of these organizations in the empirical data, see Table 18. In addition we present an overview of the MNOs that were operational in the three countries, see Table 19 to Table 21. The number of service providers and retailers is too high and with too many mutations to include.

Note that this overview relates to the period of the empirical data that we used for our study, i.e. 1997–2002. Since then the national sector-specific authorities have merged into new authorities, Ministries have other names and the MNOs may have changed names through acquisitions or mergers. We adhere to the names as mentioned in the empirical data, from which we use examples in this chapter to illustrate our coding process of the GT approach. In the following paragraphs we follow the order as presented in Table 18.

4.2.1. United Kingdom

National sector-specific regulatory authority: OFTEL

The Office of Telecommunications (OFTEL) was established in 1984, by the *Telecommunications Act 1984*. OFTEL started as an organizational unit within its line Ministry the Department of Trade and Industry, but with the appointment of the first Director General in August 1984, it became a non-ministerial Governmental department (Hall, Scott and Hood, 2000, pp. 26-27). As such, OFTEL's expenditure was controlled by the Treasury and accountable for its functioning to Parliament (Andenas and Zleptnig, 2004, p. 221). OFTEL had a hierarchical structure as it was led by a single official, the Director General of Telecommunications (DGT), who was appointed by the Secretary of State for five years, but could be re-appointed (*Telecommunications Act, 1984, art. 1.2*; Intven, Oliver & Sepúlveda, 2000a). If the Secretary of State was of the opinion that the DGT showed incapacity or misbehavior, the DGT could be removed (*Telecommunications Act, 1984, art. 1.3*). Thus, the DGT was a government-appointed official and subject to civil liability in case of malfunctioning. The DGT could also be subject to a mandamus in case of failing to exercise discretion (Long, 1995, p. 36).

Prosser speaks of a “personalized system of regulation” with “powers vested in an individual director-general assisted by an office with legal responsibility vested in him or her alone” (Prosser, 1997, p. 9). But Hall et al. contest this image of a powerful DGT and of “all-powerful regulator with uncontrolled discretion” (Hall, Scott and Hood, 2000, p. 82). They argue that the presence of other institutions in the regulatory space limited OFTEL independence and power. To illustrate their argument, we quote a passage from their book:

“...Ofstel as a regulatory agency was highly constrained in each of its main spheres of activity by relations of interdependence with other actors in the regulatory space. This characterization of interdependence was a product not only of the formal structure of the regime in which significant regulatory power was given to actors other than Ofstel, but the other capacities possessed by actors who shared the regulatory space deriving from experience, possession of information, and ability to bestow legitimacy on the regulator's activities” (Hall, Scott and Hood, 2000, p. 82).

Table 18 Overview of the main regulatory actors in the mobile telecommunications market in the United Kingdom, the Netherlands and France in 1997-2002.

	United Kingdom	the Netherlands	France
National sector-specific regulatory authority	Office of Telecommunications (OFTEL) currently: Office of Communications (OFCOM)	Onafhankelijke Post en Telecommunicatie Autoriteit /Independent Post and Telecommunications Authority (OPTA) currently: Autoriteit Consument en Markt (the Netherlands Authority for Consumers and Markets (ACM))	Autorité de Régulation des Télécommunications (ART) currently: Autorité de Régulation des Communications Electroniques et des Postes (ARCEP)
Ministry/department responsible for telecommunications	Department of Trade and Industry (DTI)	Ministry of Transport, and Public Works and Water Management: General Directorate on Telecommunication and Postal Services (HOTP)	Ministère de l'Économie, des Finances et de l'Industrie (Ministry of the Economic, Financial and Industry Affairs): Direction Générale de l'Industrie, des technologies de l'information et des postes (DiGITIP) (General Directorate for the Information Technology and Postal Services)
Appeal	High Court or House of Lords MMC if based on the <i>Competition Act</i>	Court of Rotterdam; College van Beroep voor het Bedrijfsleven (the Trade and Industry Appeals Tribunal)	Cour d'Appel de Paris or the Conseil d'Etat
National competition authority	Monopolies and Mergers Commission (MMC); Competition Commission (CC)	Nederlandse Mededingingsautoriteit (Netherlands Competition Authority) (Nma)	Conseil de la Concurrence (currently: Autorité de la Concurrence)
Radiocommunications authority	Radiocommunications Agency (RA)	Rijksdienst voor het Radioverkeer (Radiocommunications Agency)	Agence National des Fréquences (French Frequency Agency) (ANFR)
Consumer interests	Office of Fair Trading (OFT)		Directon Départementale de la Concurrence de la Consommation et de la Répression des Fraudes (DDCCRF)
Committees	Network Interoperability Consultative Committee (NICC); Operator Policy Forum; Interconnect Policy Forum (IPF); Independent Service Provider Forum; Network Futures Group (NFG)	Forum voor Interconnectie en Speciale Toegang (FIST)/Forum for Interconnection and Special Access;	Comité de l'interconnexion; Commission Consultative des Radiocommunications (CCR); Commission Consultative des Réseaux et Services de communications électroniques (CCRST)

	United Kingdom	the Netherlands	France
End user representation	National Consumer Council (NCC); Consumer Association (CA); independent Advisory Committees on Telecommunications (ACTs); Telecommunications Advisory Committees (TACs); Advisory Committee on Telecommunications (ACT) for Disabled and Elderly People; Business Advisory Committee on Telecommunications Office of the Telecommunications Ombudsman (OTELO)	Consumentenbond (National Consumer Association); Geschillencommissie Telecommunicatie (Conciliation Board Telecommunications)	Association Française des Utilisateurs de Téléphone et des Télécommunications (AFUTT); UFC Que choisir;
Industry interest groups	Telecommunications Managers Association (TMA, later: Communications Managers Association, CMA); Federation of Communication Services (FCS); Industry Group of Mobile Independent SPs (MISP); Other Licensed Operators Group (OLO); Federation of Wholesale Distributors	Stichting Telecomgebruikers Nederland (sTN) (Telecommunications User Council); Nederlandse Vereniging van Bedrijfstelecommunicatie Grootgebruikers (BTG) (Heavy User Council)	

In the regulatory arena, the primary responsibilities of the DGT were “to monitor and collect information about telecommunications activities, enforce license conditions, and to investigate complaints” (*Telecommunications Act*, 1984, s47, s17 and s49; Andenas and Zleptnig, 2004, pp. 221-222). The DGT’s secondary responsibilities were “to promote the interests of consumers, purchasers and other users, to maintain and promote effective competition, to promote efficiency and economy among the SPs and to promote research” (*Telecommunications Act*, 1984, s3(1) & (2); Andenas and Zleptnig, 2004, p. 222).

For the purpose of accountability each year OFTEL published an Annual Report and it kept a Public Register of all its formal decisions. If summoned, OFTEL had to appear before Select Committees (committees of members of the Houses of Commons or Lords that investigate a particular issue) or the Public Accounts Committee (PAC), a parliamentary committee that oversees government expenditures or the Trade and Industry Select Committee (OfTel, 1999e, 2.3). OFTEL also had to take policy advices from the four independent Advisory Committees on Telecommunications and the two committees for Elderly and Disabled People and the Business Advisory Committee on Telecommunications into account. As for its accountability towards end users and market parties, OFTEL’s working procedures contained consultation periods on particular issues and the publishing of informed consultation documents and transparent decisions in market issues (OfTel, 1999e, 2.4-2.7 & Annex C, point C.5).

In the *Telecommunications Act 1984* the Direct General of OFTEL was given the following statutory functions:

- modification of licences and enforcement of licence conditions;
- in the case of consent by the Secretary of State or in accordance to a general authorisation, the issue of licences
- advise the Secretary of State for Trade and Industry on licensing proposals;
- approval of contractors and apparatus for connection with public telecommunications systems;
- collection and publication of information relating to the telecommunications sector;
- to inform and protect consumers and interested parties;
- to review telecommunications activities;
- to handle complaints relating to services and terminal equipment;
- to approve telecommunications contractors, apparatus and meters;
- to apply specific provisions of the Fair Trading Act and the Competition Act.

The DGT could set standards of performance for the provision of relevant services of an operator. Non-compliance with the standards was subject to compensation to individual users and could also be fined by the DGT (Long, 1995, pp. 33-34; Oftel, 1997c, Annex C, table C2).

From December 29th 2003 onwards under the *Telecommunications Act 2003*, OFTEL has been integrated into a new horizontal regulatory body for the communications sector: the Office of Communications (OFCOM). Also the Broadcasting Standards Commission (BSC), the Independent Television Commission (ITC), the Radio Authority (RAU), which dealt with management of the radio spectrum and the Radiocommunications Agency (RA) were integrated into OFCOM (Andenas and Zleptnig, 2004, p. 223). This installed OFCOM as the regulator for television, radio, telecommunications and wireless communications services.

In contrast to OFTEL which was led by a Director-General with sole decision-making power, OFCOM is headed by a Board of executive and part-time board members that are collectively accountable. OFCOM has retained the concurrent powers with the Office of Fair Trading (OFT) that OFTEL already had. As a consequence of the new institutional structure and the fact that OFCOM will also regulate the content sector (such as broadcasting), OFCOM has closer relationships with the Department for Culture, Media and Sport (DCMS) than OFTEL had (Parliament of the United Kingdom, 2003).

Ministry/department responsible for telecommunications: Department of Trade and Industry (DTI)

DTI is the Department of Trade and Industry, the line Ministry for the telecommunications sector in the United Kingdom. The department acted as governmental representative in the role of shareholder in BT, but in 1993 UK Government sold its last shares in BT as a step in the privatization and liberalization process in the telecommunications sector. DTI had the legislative power to make primary and secondary legislation (Scott, Hall and Hood, 1997, p. 235).

During the period of our empirical data, the Secretary of State for Trade and Industry had a complementary role to the one of the DGT. They shared specific duties for the telecommunications sector. The Secretary of State for Trade and Industry was responsible for general telecommunications policy and legislation. The Secretary of State appointed the DGT and if the Secretary of State was of the opinion that the DGT showed incapacity or misbehavior, the DGT could

be removed (*Telecommunications Act*, 1984, art. 1.1 & 1.3). Also the Secretary of State could give general directions to the DTG on priorities or could indicate certain considerations for its regulatory practice.

Appeal: High Court or MMC

Decisions by OfTel were subject to appeal within 48 days through judicial review by the courts (Prosser, 2005, p. 1997), in case “.. the DGT is believed to be acting beyond the scope of his statutory power or terms of license conditions; have incorrectly interpreted the license; or have acted improperly or unreasonably” (OfTel, 1997g, Annex C, point C.5). In a judicial review “the courts will assess whether the decision is tainted by illegality, irrationality or procedural impropriety” (Prosser, 2005, p. 197). In other words, it was not about a re-evaluation of the arguments of the decision, but rather about the legal and procedural aspects of the decision. The court could only quash the decision; it was not able to offer an alternative decision. Appeal to OFTEL decisions based on the Competition Act (in contrast to the Telecommunications Act) had to be lodged with the Monopolies and Mergers Commission (MMC).

National competition authority: Monopolies and Mergers Commission (MMC)

The Monopolies and Mergers Commission (MMC), later the Competition Commission (CC) played an important role in cases in which OFTEL intended to regulate via a licence modification or when OFTEL consulted the MMC in a case of anti-competitive behavior (*Telecommunications Act*, 1984, art. 13; Hall, Scott and Hood, 2000, p. 93). The MMC was transferred into the CC on April 1st 1999 by the Competition Act 1998 and is an independent body (Andenas and Zleptnig, 2004, p. 225). They state their character and role as “an executive non-departmental public body, whose members conduct inquiries and make decisions in relation to: mergers; market investigations; and regulatory references (relating to sectors such as utilities, postal services, railways, airports, air traffic control and financial services)” (Competition Commission, 2005, p. 6). The CC cannot initiate its own investigations, but comes into action the moment they receive a case referred to them by for example the Office of Fair Trading, the Secretary of State or regulatory bodies such as OFTEL/OFCOM (Competition Commission, 2005, p. 6).

Radiocommunications Agency (RA)

The Radiocommunications Agency (RA) was an executive agency of the DTI responsible for spectrum management for civil applications and represented the UK government in international radio fora such as the World Administrative Radio Conferences (Long, 1995, p. 115, entry 7-13). The RA had enforcement powers against illegal transmitters, resolved interference complaints and supervised licence conditions pertaining to the correct use of assigned radio spectrum (Goldberg and Verhulst, 1997, p. 129). The RA also merged into OFCOM.

Consumer authority: Office of Fair Trading (OFT)

The Office of Fair Trading (OFT) deals with the protection and promotion of consumer interests in general. It was established in 1973 “as a national consumer protection agency” (Hall, Scott and Hood, 2000, p. 21). OFT’s mission is “to make markets work well for consumers. Markets work well when there is vigorous competition between fair-dealing businesses. When markets work well, good businesses flourish” (OFT, 2004, p. 2). Like OFTEL its structure used to be based on the hierarchical

approach: the OFT was directed by a Director-General (the DGFT) (Prosser, 1997, p. 9; Riley, 2000, p. 36). Under the *Enterprise Act 2002* the management structure of the OFT was changed into a Board with a Chair, a Chief Executive and five non-executive members, all to be appointed by the Secretary of State of DTI (OFT, 2003, p. 6). The OFT had powers under several Acts:

- the *Competition Act 1998* (into force in March 2001);
- the *Fair Trade Act 1973* (replaced by the *Enterprise Act 2002*);
- the *Unfair Terms in Consumer Contracts Regulations 1999*;
- *Consumer Protection (Distance Selling) Regulations 2000*;
- *Control of Misleading Advertisements Regulations 1988*;
- *Estate Agents Act 1979*;
- *Consumer Credit Act 1974*.

In October 1999 the OFT published a White Paper *Modern Markets: Confident Consumers* in which it extended the power to act against unfair contract terms to OFTEL but also to the industry regulators for gas, electricity, water and rail¹¹. OFTEL and the OFT had concurrent powers in case of anti-competitive behavior. In telecommunications cases OFTEL would take the lead, but only after consulting with the OFT (Andenas and Zleptnig, 2004, pp. 228-229).

Committees

Network Interoperability Consultative Committee (NICC)

In 1992 OFTEL installed the Network Interoperability Consultative Committee (NICC) (by its initial name of the Network Interfaces Coordination Committee) (OfTel, 1995, Annex B). The NICC consisted of operators, end users, suppliers and liaison members from OFTEL, DTI, and the British Approvals Board for Telecommunications (BABT), a telecommunications testing and certification organization and the British Standards Institution (BSI).

The Board of the Committee of the NICC consisted of an Independent Chair, an OFTEL staff member, representatives of the Interest Groups within the NICC and liaison members from BT, DTI, BABT and the BSI.

The committee was installed for discussing issues of interconnection and interoperability. OFTEL defined this committee as: "A committee set up to advise the Director General on interoperability issues and for the industry to provide guidance to standards bodies on these issues" (OfTel, 1998a; Annex E). Its main rationale was the encouragement of industry co-operation in the field of interconnection and interoperability issues. As such it advised the DGT on new and emerging interfaces. The NICC also took part in the process of the development of European and international standards (OfTel, 1995, Annex B).

Operator Policy Forum

Under the name of Operator Policy Forum, OFTEL held regular forum meetings with stakeholders in order to stimulate discussions and information sharing. Also future initiatives and its implications for

¹¹ In the documents used in this study no reference has been found that indicates that OFTEL used this power.

the stakeholders would be discussed during these meetings. The meetings were held every three months; attendance was based on invitation by OFTEL (OfTel, 1999n).

Interconnect Policy Forum (IPF)

The Interconnect Policy Forum (IPF) was a sub forum of the OFTEL Policy Forum. OFTEL described it as “A forum consisting of industry representatives and chaired by OfTel which meets periodically to discuss commercial and regulatory aspects of interconnection which are of interest to the industry generally”. (OfTel, 1998a, Annex E).

Independent Service Provider Forum

The Independent SP Forum was a sub forum to the OFTEL Policy Forum. OFTEL set up the Independent SP Forum in April 1997 to provide a platform to discuss issues with independent SPs (for fixed and mobile networks). This sub forum was also a place to inform independent SPs on OFTEL policies and activities and to elicit their contributions to the regulatory decision-making process. Members of the forum met regularly with OFTEL staff (OfTel, 1997l).

Network Futures Group (NFG)

An Industry Committee formed to advise OFTEL and the industry on generic issues associated with interconnection and interoperability (OfTel, 1998a, Annex E).

End user representation

Several organizations that represent the end users of telecommunications networks and services are active in the United Kingdom (mainly based on (OfTel, 1997g)):

- the National Consumer Council (NCC), the general consumer representative body which is publicly funded;
- the Consumer Association (CA), the private counterpart of the NCC;
- the independent Advisory Committees on Telecommunications (ACTs): installed by the *Telecommunications Act 1984* and managed by OFTEL, for consumers with complaints (Hall, Scott and Hood, 2000, pp. 91-92). The areas England, Scotland, Wales, and Northern Ireland each had their own ACT;
- the local Telecommunications Advisory Committees (TACs);
- the Advertising Standard Authority & the ITC: in the case that a citizen or company had a complaint on the way telecommunications were advertised, they could address the Advertising Standard Authority. In the case that their complaint was on advertisements that were broadcasted on the Independent television, then they could address the ITC as well.
- the OFT could be addressed in the case of individual complaints for example complaints on contracts of telecommunication SP.
- End users could also individually refer allegations of discrimination, billing disputes, complaints on deposits or standards of performance to OFTEL. The Consumer Representation Section within OFTEL would then deal with these complaints;
- Additionally, OFTEL had two special interest committees: the Advisory Committee on Telecommunications (ACT) for Disabled and Elderly People and the Business Advisory Committee on Telecommunications;
- In January 2003 a not-for-profit Ombudsman for telecommunications services was installed, independently from OFTEL. Its official name is Office of the Telecommunications Ombudsman (OTELO). The installment of this independent Ombudsman was the British response to the requirements to install a dispute resolution scheme under the Revised Voice

Telephony Directive (European Parliament and the Council of the European Union, 1998a). Otelo represents a voluntary scheme and only deals with complaints on telecommunications services (excluding internet service provision) of its voluntary members. Funding comes from membership fees and fees for dispute resolution cases (Office of the Telecommunications Ombudsman, 2003).

Industry interest groups

Several organizations represented businesses that were active in the telecommunications industry in the United Kingdom:

- the Telecommunications Managers Association (TMA, later: Communications Managers Association, CMA): an association for public and private corporate enterprises and for professionals that are active in the management of communications systems (CMA, 2020);
- Federation of Communication Services (FCS): “FCS is the not-for-profit industry association for companies which deliver professional voice and data communications solutions to business and public sector customers in the UK. Whatever the delivery platform, radio, mobile, copper or fibre, the FCS Mission is to champion and defend the role of the professional communications provider in the converging market place” (FCS, 2020). The structure of the FCS is made up by Industry Groups (amongst others the Mobile Independent SPs (MISP) until end 2003).
- Industry Group of Mobile Independent SPs (MISP), which represented the independent SPs, as part of the FCS from 1989 until the end of 2003.
- The Other Licensed Operators Group (OLO) was a group of new entrants in the telecommunications market¹². This Group discussed their problems as a new entrant with OFTEL on a regular basis (Hall, Scott and Hood, 2000, p. 90).
- the Federation of Wholesale Distributors that “represents cash and carry and delivery wholesalers in the United Kingdom,[who e.g.] sell pre-pay mobile phone vouchers” (OFT, 2002, p. 1).

Mobile network operators in the United Kingdom

In Table 19 we present an overview of the MNOs that were active in the United Kingdom in our period of empirical data. We list the operators with changes in their names in the course of time, the network (standards) that they employ(ed) and the dates of their licences (L), date of actual exploitation of the network (E) and if applicable, the date of closing down of the network (C).

¹² In March 2000 the OLO group consisted of: Atlantic Telecom, Eurobell, Kingston Group, ntl, Telewest, COLT, Cable and Wireless, Energis, GTS, Global Crossing, Global One, Hermes, MCI/Worldcom, Norweb Telecom, Thus, Teleglobe, Telia, Telinco, Telstra, Viatel, Dolphin, One2One, Orange and Vodaphone (Lord Chancellor’s Department, 2000). On their role in leveraging the information asymmetry between BT and OFTEL in the early days of regulation, see (Hall, Scott and Hood, 2000, pp. 136-138).

Table 19 Overview of MNOs in the United Kingdom (1997-2002)

United Kingdom		
Operator	Network standard	Date of licence (L) Date of exploitation (E) Date of closing down the network (C)
Cellnet (60% BT and 40% Securicor) later: mmO ₂ and O ₂ (owned by Telefónica)	Analogue: TACS (in the 900MHz band)	L: May 1983 E: January 1985 C: 2001
	Digital: GSM900	L: March 1994 (extension of former licence) E: July/September 1994
	3G (as BT 3G)	L: April 2000 E: October 2005
Racal Telecom Later: Vodafone	Analogue: TACS (900MHz)	L: May 1983 E: January 1985 C: 2001
	Digital: GSM900	L: December 1993 (extension of former licence) E: September 1993
	Digital: 3G	L: April 2000 E: February 2004
Mercury One-2-One (C&W and US West) Later: T-mobile	Digital: GSM1800	L: July 1991 E: September 1993
	Digital: 3G	L: April 2000 E: July 2004
Microtel Later: Orange (owned by France Telecom)	Digital: GSM1800	L: July 1991 E: April 1994
	3G	L: April 2000 E: July 2004
3 (owned by Hutchison Whampoa)	Digital: 3G	L: April 2000 E: May 2003

Sources for the United Kingdom: (JANET, no date; Long, 1995, p. 112, point 7-05; Oftel, 1996; Regli, 1997, p. 172; Valletti and Cave, 1998; European Commission, 2001: 14-15; Xavier, 2001; mmO2, 2004), the websites of the MNOs and their mobile licences.

4.2.2. The Netherlands

National sector-specific regulatory authority: OPTA

The Onafhankelijke Post en Telecommunicatie Autoriteit (the Independent Post and Telecommunications Authority, OPTA) was the sector-specific regulatory for the telecommunications market in the Netherlands from 1997 until April 2013. The OPTA was based on the OPTA Act of July 5th 1997 (*OPTA Wet, Wet van 5 juli 1997, houdende regels inzake instelling van een college voor de post- en telecommunicatiemarkt*, 1997). OPTA's mission statement was formulated as follows: "OPTA stimulates sustained competition in the telecommunications and post markets. ...a lasting situation in which private individuals and business end users can choose between providers and services in such a way that the price and quality supply in the various constituent markets is created by effective market incentives. In the event of insufficient choice OPTA protects end users" (OPTA, 2000a, Mission Statement).

A board of three persons, of which one was the Chair, headed the OPTA¹³. The members of the board were appointed for four years and could be re-appointed. The organisation was independent of the Ministry, who remained responsible for the appointment of the members and the Chair of the board; the approval of the OPTA statutes, initiated by the board; approval of the OPTA budget; and approval of contracts and investments that exceeded a financial limit specified by the Minister (*OPTA Wet, Wet van 5 juli 1997, houdende regels inzake instelling van een college voor de post- en telecommunicatiemarkt, 1997*).

The Ministry could provide general indications for the duties of OPTA, to be published in the *Official Gazette* (in Dutch: *Staatscourant*). So the Ministry could not give indications relating to specific cases e.g. for dispute settlement. Every four years, the Minister had to report to the Staten-Generaal on the efficiency and efficacy of OPTA (*OPTA Wet, Wet van 5 juli 1997, houdende regels inzake instelling van een college voor de post- en telecommunicatiemarkt, 1997*), including a report on whether or not the OPTA had to continue its activities (Ministerie van Verkeer & Waterstaat DG Telecommunicatie en Post, 1997, art. 25). OPTA had to report on its activities to the Ministry on an annual basis, including a description of the development of competition in the post and telecommunications sector (Ministerie van Verkeer & Waterstaat DG Telecommunicatie en Post, 1997, art. 17).

Appeal against OPTA Decisions were to be made at the Court of Rotterdam, higher appeal was possible with the College van Beroep voor het Bedrijfsleven (Trade and Industry Appeals Tribunal).

Formally, OPTA was able to use the following measures:

- Requesting information and gaining access to documentation;
- Developing procedural rules in the event of disputes between providers;
- Imposing fines to a maximum of NLG 1,000,000 each in the event of infringement of the law;
- Imposing penalties by way of law enforcement;
- Cancellation, in specific cases, of a telephone number having previously been issued" (OPTA, 2000a, p. 8)

OPTA cooperated with the NMa (Netherlands Competition Authority) on the basis of a protocol which they signed in 1998. It lists the following intentions:

- to publish consistent decisions in cases to which both the Telecommunication Act and the Competition Act are applicable;
- to reach mutual agreement on definitions in competition law and
- when appropriate to formulate joint policy rules (OPTA/NMa, 2000).

Contrary to OFTEL in the United Kingdom, OPTA had no concurrent powers, so it had not the authority to apply general competition law itself. However, in 2003 the adoption of the European New Regulatory Framework for electronic communications infrastructure and associated services in

¹³ The number of members of the board was between three and five, including the Chairperson.

the Netherlands enabled OPTA to use regulatory concepts that were increasingly based on general competition law (European Parliament and the Council of the European Union, 2002).

In April 2013 the Netherlands Authority for Consumers and Markets ACM was installed. The ACM is a merger of the OPTA, the Consumer Authority, and the Netherlands Competition Authority. It became the regulatory authority for application of the Competition Act, for sector-specific regulation of the telecom, transport, post, energy and healthcare sectors and for consumer protection (*Instellingswet Autoriteit Consument en Markt, Wet van 28 februari 2013, houdende regels omtrent de instelling van de Autoriteit Consument en Markt, 2013*).

Ministry/department responsible for telecommunications: Ministry of Transport, Public Works and Water Management/Directorate on Telecommunication and Postal Services (HDTP)

The Ministry of Transport, and Public Works and Water Management, more specific the General Directorate on Telecommunication and Postal Services (HDTP) was responsible for the regulation of the telecommunications sector. On behalf of the Dutch government, the Ministry was shareholder in the former incumbent telecommunications operator KPN. The Ministry also performed the assignment of licences for the exploitation of public mobile telecommunications networks and the assignment of the frequencies that a licence holder needed for the execution of the concession by Ministerial decree. The Dutch regulator OPTA merely had an advisory role in the design of the licensing regime, including the method of assignment. The Ministry also supervised national safety aspects (for example in period of crisis or security issues that demand tapping of telephone conversations) and information security.

Until April 1995 the Minister was integrally responsible for control and monitoring of the telecommunications market. From April 1995 until August 1997 this control function was performed by the Directie Toezicht Netwerken en Diensten (TND), a special department within the Ministry. In September 1997 the regulatory activities of this department were transferred to the Dutch independent regulatory OPTA upon its instalment.

Appeal: Court of Rotterdam

The Court of Rotterdam was the court for first appeal against OPTA decisions. Higher appeal was possible with the College van Beroep voor het Bedrijfsleven (Trade and Industry Appeals Tribunal).

Appeal: College van Beroep voor het Bedrijfsleven (Trade and Industry Appeals Tribunal)

Appeals against Ministerial decrees and OPTA decisions (after first appeal to the Court of Rotterdam) could to be addressed to College van Beroep voor het Bedrijfsleven (the Trade and Industry Appeals Tribunal), which is located in The Hague (*Judicial System in the Netherlands*, no date). This is a special administrative court that deals with disputes in social-economic administrative law. In addition, this Tribunal was tasked with dealing with appeals for specific laws such as the *Telecommunications Act* and the *Competition Act (Wet van 19 oktober 1998, houdende regels inzake de telecommunicatie (Telecommunicatiewet), 1998, art. 17.1)*.

National competition authority: Nederlandse Mededingingsautoriteit (NMa)

The Nederlandse Mededingingsautoriteit (Netherlands Competition Authority) was installed on January 1st 1998 to supervise the application of the Dutch Competition Act, which came into force on May 22nd 1997 (*Mededingingswet, Wet van 22 mei 1997, houdende nieuwe regels omtrent de economische mededinging (Dutch Competition Act), 1997*). Before this Competition Act, there was no specific legislation on mergers and acquisitions. The Dutch Competition Act contains rules for:

- The creation of cartels;
- Abuse of economic market power and
- The development of market concentrations.

The NMa was authorized to grant releases for the prohibition on the creation of cartels, which is the only topic where *ex ante* regulation is applied. All other issues are based on *ex post* regulation. The NMa is led by a Board of three to five members, including the chairperson. The NMa was an agency for which the Minister of Economic Affairs held full ministerial responsibility. This implies that the Minister was able to provide for directions in issues that are considered by the NMa (Arnbak, 2002, p. 113). In April 2003 the NMa merged with the OPTA and the Consumer Authority into the Autoriteit Consument en Markt (the Netherlands Authority for Consumers and Markets).

Radiocommunications agency: Rijksdienst voor het Radioverkeer (RDR)

The Rijksdienst voor het Radioverkeer (Radiocommunications Agency) was responsible for the acquisition, assignment and protection of spectrum in the Netherlands. Until July 2002 it was a special department of the Ministry of Transport, Public Works and Water. It had three main tasks:

- frequency management and planning, Research & Development, policy evaluation and issue of licences (except for licences for public mobile infrastructures, which resides with the Ministry of Transport, Public Works and Water);
- setting rules for the use of telecommunication devices on a national and international level;
- monitoring and enforcement of spectrum usage (Ministerie van Verkeer en Waterstaat DG Telecommunicatie en Post, 2000)

On July 22nd 2002, after a short assimilation as the Telecom Division within the Inspectorate Transport and Water (*Inspectie Verkeer & Waterstaat*), the RDR became a department within the Ministry of Economic Affairs and was renamed into Agentschap Telecom (Telecom Agency). The Telecom Agency continued the main tasks of the RA (Agentschap Telecom, 2003, 2006).

Committees

Forum voor Interconnectie en Speciale Toegang (FIST)

OPTA had the Forum voor Interconnectie en Speciale Toegang (Forum for Interconnection and Special Access) consisting of telecommunication network operators and SPs, for discussing issues of interconnection, interoperability and special access, with no formal role for OPTA. It was initiated by OPTA's predecessor TND at the end of 1996. The market parties could voluntarily join this forum and OPTA had an advisory role in case of disagreements. Although decisions taken by the FIST are not legally binding, in practice they did result in mutual agreements on how to act in case of new

services that require interconnection or special access or in case new technologies had to be implemented into networks such as number portability. If the market parties could not reach an agreement, they could address the OPTA by submitting a request for dispute settlement (OPTA, 1999b, p. 16).

End user representation

Several organizations that represent the end users of telecommunications networks and services are active in the Netherlands. A distinction can be made in private versus professional end users.

- The National Consumer Association (*Consumentenbond*) is a consumers association that deals with the promotion of the interests of consumers in general, including complaints in the electronic communications domain. As an Association with private members, they are politically independent and their financial resources are based on membership and services/documents delivery. The Consumer Council regularly publishes comparison and testing reports on services and products. They also publish research reports on specific services or products that infringe upon the interests of consumers and exert their influence to abolish these infringements (*Consumentenbond (Dutch National Consumer Association)*, 2020);
- The Conciliation Board Telecommunications (*Geschillencommissie Telecommunicatie*) was a dedicated board to which private end users can address their complaints on the services of telecommunications SPs.

Industry interest groups

Several organizations represented business telecommunication users:

- The Telecommunications User Council (*Stichting Telecomgebruikers Nederland*, sTN) promotes the interests of business telecommunication users. Erected in 1996, they target their services mainly to small and medium sized businesses. These services include advisory services and discounts on telecommunications services via bulk contracts with telecommunications SPs (sTN, 2020);
- Another council targets the high end segment of business telecommunications users: the Heavy User Council (*Nederlandse Vereniging van Bedrijfstelecommunicatie Grootgebruikers*, BTG). This Council's main objectives are to function as an interests group for its members towards government, operators & SPs, knowledge sharing among heavy telecommunications users, advancement of new services and an advisory function for its members (BTG, 2006, p. 8).

Mobile network operators in the Netherlands

In Table 20 we present an overview of the MNOs that were active in the Netherlands in our period of empirical data. We list the operators with changes in their names in the course of time, the network (standards) that they employ(ed) and the dates of their licences (L), date of actual exploitation of the network (E) and if applicable, the date of closing down of the network (C).

Table 20 Overview of MNOs in the Netherland (period 1997-2002)

The Netherlands		
Operator	Network standard	Date of licence (L) Date of exploitation (E) Date of closing down the network (C)
PTT Telecom Later: KPN Mobile The Netherlands B.V	Analogue: NMT450	L: 1981 E: January 1985 C: October 1999
	Analogue: NMT900	E: 1989 C: October 1999
	Digital: GSM900 & 1800	L: June 1994 (temporary licence) L: April 1995 (definite licence) E: July 1994
	Digital: UMTS	L: July 2000 E: July 2004
Libertel N.V. Later: Vodafone	Digital: GSM900 & 1800	L: April 1995 E: September 1995 (GSM900) E: February 2000 (GSM1800)
	Digital: UMTS	L: July 2000 E: February 2004
Telfort Mobiel N.V. Later: O2	Digital: GSM1800	L: February 1998 E: September 1998
	Digital: UMTS	L: July 2000 Licence returned to government due to overtake by KPN
Dutchtone N.V. Later: Orange	Digital: GSM1800	L: February 1998 E: January 1999
	Digital: UMTS	L: July 2000 E: Merged with T-Mobile
Ben Netherlands Later: T-Mobile	Digital: GSM1800	L: February 1998 E: February 1999
	Digital: UMTS	L: July 2000 E: April 2006

Sources for the Netherlands: (OPTA, 2000a, 2001c; Stichting voor Economisch Onderzoek, 2001; European Radiocommunications Office, 2004; Anker, 2020) and the mobile licences.

4.2.3. France

National sector-specific regulatory authority: **Autorité de Régulation des Télécommunications (ART)**

The French national independent regulatory authority for the telecommunications sector was the *Autorité de Régulation des Télécommunications*, the ART. It was installed on the 5th of January 1997 based on Article L.36 of the Code des postes et telecommunications and the Décret 96-1138 of December 23rd 1996 (Code des Postes et des Télécommunications, 1996). The ART had to report to the Government and Parliament each year and was financed by government taxes and charges to market parties. The ART had regular contacts with permanent commissions in Parliament and with the *Commission supérieure du service public des postes et telecommunications* (OECD, 2004).

The ART slogan was *La concurrence au bénéfice du consommateur et de l'économie*. French law defined the following goals for regulation:

- “Encouraging *“exercise of effective and fair competition in favour of users”*. Competition is not an end in itself, but should be intended to ensure the provision to consumers of a better quality of service at lower prices;

- Monitoring "*the provision and financing of all components of the public telecommunications service*", for which the law has reaffirmed the principle in a competitive environment;
- Monitoring "the development of employment, innovation and competitiveness in the telecommunications sector". Competition will reach its goals only if it stimulates the growth of the market.
- Taking into account "*the interests of regions and users in access to services and equipment*". Competition must contribute to regional development" (ART, 2001).

The French President assigned three of the five members of the ART Board. The other two were assigned by the Président de l'Assemblée Nationale and the Président du Sénat. They were all assigned for five years, without prolongation (Organisation for Economic Co-operation and Development, 2000a, p. 169).

ART competences were divided into two main categories: the ones shared with the Minister of Telecommunications and Post and the others for which it takes full responsibility itself. The competences are part of the legislative framework of the 1996 Telecommunications Act (Code des Postes et des Télécommunications, 1996; OECD, 2004).

Whenever the Minister of Telecommunications and Posts worked on new legislation or regulation regarding the telecommunications sector, the ART would be consulted on draft versions and would collaborate in the implementation phase of new legislation/regulation (OECD, 2004, p. 169). It is the ART that could specify rules of a technical nature in case of telecommunications networks and services operation, interconnection and terminals, but decisions in this field had to be approved by the Minister. The ART had an administrative task in dealing with licence applications for public networks and public telephony services. It had an important role in preparing applications of licences for wireless public telephony, but it was the Minister who issued the licences (OECD, 2004). Every year the ART assessed the costs of the universal service and the contributions that operators had to pay, reporting these figures to the Minister. Tariff evaluation was also part of the ART's tasks, e.g. in the case of non-competitive services or universal service tariffs. Finally, the ART had a monitoring role in making sure that operators routing international traffic were treated equal on the basis of legislative provisions (ART, 2001).

In the second category of competences, the ART dealt with the issuing of licences for closed user groups, was manager of the national numbering plan and responsible for the assignment of frequencies and numbers to operators and users. In this field, the ART conducted the licensing process for public mobile networks, e.g. for GSM. However, the Minister retained the authority to effectively assign the licence to a market party and also to set the prices for the licences (ART, 2001; Penard, 2001, p. 6; OECD, 2004, p. 169).

Every year the ART analysed the relevant markets in order to assess which public network operators had SMP. These operators had to publish a standard interconnection offer, which the ART had to approve. Regarding the relationship between operators, the ART assessed interconnection agreements and could request modifications if competitive conditions were unequal or if the interoperability of services was endangered (since EC rules of December 2000). As for the terminal equipment, the ART dealt with conformity assessment of equipment connected to networks and

issues conformance certificates. It did not itself perform conformity tests but appointed test laboratories to do so (ART, 2001).

The ART powers were most prominent in the field of conciliation and the settlements of disputes. In the following areas, the ART could settle a dispute:

- “Refusal to make an interconnection, conclusion and performance of interconnection agreements and telecommunications network access conditions;
- Bringing into conformance of agreements with clauses excluding or making restrictions of a legal or technical nature on the supply of telecommunications services over cable networks;
- Possibilities and conditions for shared use of existing facilities located in the public field or on a private property” (ART, 2001).

The ART could issue decisions, either following a request for dispute settlement or in general on the basis of the Code des postes et télécommunications. In its turn the ART had the possibility to consult the Conseil de la concurrence (Code des Postes et des Télécommunications, 1996, art. L. 36-3). If sanctions were needed, the ART could advise the Ministry to either temporarily suspend a licence or revoke a licence. Also the ART could impose a fine of max. 5% of an organization’s turnover in case of a repeated offence (OECD, 2004, p. 169). The ART published all its decisions in the *Journal Officiel de la République Française*, the Official Gazette in France, apart from trade secrets protected by law.

In May 2005 the ART merged into the Autorité de Régulation des Communications Electroniques et des Postes (ARCEP) to also include the regulation of the postal sector.

Responsible Ministry/department: Ministère de l'Économie, des Finances et de l'Industrie/ Directorate Direction Générale de l'Industrie, des Technologies de l'Information et des Postes

The Ministère de l'Économie, des Finances et de l'Industrie (Ministry of the Economic, Financial and Industry Affairs) was responsible for the regulation of the telecommunications sector. The Ministry was active under this institutional name between 1997 and 2007. Its Directorate Direction Générale de l'Industrie, des Technologies de l'Information et des Postes (DiGITIP) was installed in November 1998 to strengthen the French economic sectors in general, with special attention to the post and telecommunications sector.

Its tasks were laid down in the law of 26 July 1996 that mentions the following regulatory objectives as a policy maker:

1. Effective competition for the benefit of consumers;
2. The provision and financing of a universal service;
3. The growth and competitiveness of the French economy;
4. Full coverage of the French territory by telecommunications networks (ART, 2002d).

The DiGITIP became the Direction Générale des Entreprises in 2005.

Appeal: Cour d'appel de Paris (Paris Court of Appeals)

Appeal against ART decisions first had to be filed with the ART itself. Second appeal was to be made to the Cour d'Appel de Paris.

National Competition Authority: Conseil de la Concurrence

The Conseil de la Concurrence (currently: Autorité de la Concurrence) applied the French competition law. It was set up by an Ordinance of December 1st 1986. It was an independent authority with an advisory role to the Government, Parliament and other public organizations that dealt with competition issues. Its main relationship was with the Direction Générale de la Concurrence, de la Consommation et de la Répression des Frauds which resided in the Ministère de l'Économie, des Finances et de l'Industrie (Ministry of the Economic, Financial and Industry Affairs). Its main legal documents were the Code of Commercial Law which prohibits anti-competitive behavior and, since 2001, the New Economic Regulations Act. The ART could, under statutory provisions, consult the Conseil de la Concurrence (Conseil de la Concurrence, 2020). Also, the Conseil de la Concurrence had an advisory role in the designation of parties with SMP in the telecommunications sector. As such, the ART annually consulted the Conseil de la Concurrence.

Radiocommunications agency: Agence National des Fréquences (ANFR)

In France, frequency management was performed by the Agence Nationale des Fréquences.

Committees

Comité de l'interconnexion

The ART had a Comité de l'interconnexion, consisting of operators and industry representatives, presided by the ART, for discussing issues of interconnection and interoperability.

Commission Consultative des Radiocommunications (CCR) & Commission Consultative des Réseaux et Services de communications électroniques (CCRST)

The Commission Consultative des Radiocommunications (CCR) and the Commission Consultative des Réseaux et Services de Communications Electroniques (CCRST) were both advisory committees that each consisted of 21 representatives from MNOs and SPs, from private and professional users of those networks and services and experts. The committees were erected by article L. 34-5 of the telecommunications law of July 26th 1996 (Code des Postes et des Télécommunications, 1996). The Minister of Telecommunications nominated the committee members and the ART had an advisory role for the appointment of the committee members. The committees provided the Minister of Telecommunications and the ART with advice, for example the CCR by reporting on issues in the field of radio communications that require policy guidelines and the CCRST on issues of licensing or changes in technical aspects (such as interconnection or numbers) of the networks or services as mentioned in the law (Code des Postes et des Télécommunications, 1996, L. 33-1, L. 33-2, L. 33-3, L. 34-1, L. 34-2, L. 34-4, L34-8 and L. 34.10; Mazar, 2008, p. 160).

Conseil Supérieure de la télématique (CST)

In the field of telematics, content regulation was the responsibility of the Conseil Supérieure de la télématique (the French telematics Council, (CST)). In art. D.406-1-2 of the *Code des postes et télécommunications* it was stated that "Le Conseil Supérieure de la télématique est chargé de formuler des recommandations de nature déontologique, visant notamment à la protection de la jeunesse applicables aux services offerts par les accès télématiques anonymes écrits ou vocaux et à leurs conditions d'accès" (Code des Postes et des Télécommunications, 1996, art. D.406-1-2).

Residing under the CST is the *Comité de la télématique anonyme* (CTA) that supervises the recommendations: “Le comité de la télématique veille au respect par les parties des recommandations visées à l’article D.406-1-2 et des clauses non strictement commerciales des contrats conclus entre elles” (Code des Postes et des Télécommunications, 1996, art. D.406-2). Any dispute in relation to the recommendations was to be brought before this committee. Appeal to decisions of the *Conseil* or the committee had to be brought before the *Tribunal de Grande Instance de Paris* (ART, 1998a). All decisions of the CST and the CTA were public, apart from the name of the provider of anonymous telematics services.

Mobile network operators in France

In Table 21 we present an overview of the MNOs that were active in France in our period of empirical data. We list the operators with changes in their names in the course of time, the network (standards) that they employ(ed) and the dates of their licences (L), date of actual exploitation of the network (E) and if applicable, the date of closing down of the network (C).

Table 21 Overview of MNOs in France (period 1997-2002)

France		
Operator	Network standard	Date of licence (L) Date of exploitation (E) Date of closing down the network (C)
France Télécom (from June 2001: Orange)	Analogue:R2000	E: 1985 C: July 2000
	Digital: GSM900	L: 25/3/1991 E: December 1992
	Digital: GSM1800	L: 17/11/1998 (by means of renewal of GSM licence) E: July 1992
SFR (Cégétel Group) (Vivendi)	Analogue: NMT450	L: 16/12/1987 E: 1989 C: 1999
	Digital: GSM900	L: 25/3/1991 E: December 1992
	Digital: GSM1800	L: 17/11/1998 (by means of extension of GSM licence) E: April 1993
Bouygues	Digital: GSM1800	L: 8/12/1994 E: May 1996

Sources for France: (Penard, 2001, 2002; European Radiocommunications Office, 2004); the websites of the MNOs and the ministerial orders containing (changes in) their licences.

Social and economic rationale for regulation

In the next sections 4.3 to 4.6 we present the market issues in the mobile telecommunications markets with illustrations from the 61 regulatory dossiers to sustain the coding process towards the creation of the dimension *Market Issues* in section 4.7.

We classified the market issues by means of the social and economic rationale for regulation. We introduced this distinction in 1.3.2 with reference to Prosser (1997) and Eckert (2018) (Prosser, 1997, section 2.3.4; Eckert, 2018). The social rationale is aimed at safeguarding public values by means of regulation of the mobile services provision to the end users (see number 4 in Figure 1). The

economic rationale for regulation is fair competition amongst the market players in the wholesale market (see numbers 1-3 in Figure 1).

4.3. Social rationale: mobile services provision and end users

First, we present the market issues that evoked regulatory activities by the NRAs that aim at the regulation of the mobile services in the retail market. These services are provided by the wholesale market to the end users of mobile services (see number 4 in Figure 1). The rationale for regulation is the social rationale to safeguard public values.

We discern two main regulatory themes: the empowerment of the end user and the regulation of mobile retail tariffs. They are described in the next two sections.

4.3.1. Theme: End user empowerment

In the theme end user empowerment we included all regulatory activities that support the end users to make their own choice for the MNO or SP with whom they want to have a contract for mobile services.

Information provision: quality of service & transparency of user terms

Regulatory activities in the *provision of information* were aimed at strengthening customer awareness of choice. This refers to information on e.g. the quality of service and the transparency of tariffs and contract conditions in order for the end user to be able to make a well-informed choice.

Consumer complaint handling

The provision of a consumer complaint handling service or procedures for dispute settlement resolution was chosen by all NRAs to support the end users of mobile services to exert their right to choose.

Eliminating switching barriers

In addition, NRAs intervened in order to eliminate switching barriers that network operators put in place in order to retain their clients. Examples are the regulation on the use of the SIM lock functionality and of mobile number portability.

SIM stands for Subscriber Identity Module and a SIM lock is a technical mechanism that is used by MNOs or SPs to prevent end users to use their mobile phone on a competitive network. The mechanism locks the phone and thus forces a user to remain with the MNO or SP for a specific period of time after taking a subscription. More specifically, in the case of offering a free mobile phone upon subscription, the network operator or SP will only annul the SIM lock after a Return of Investment is reached.

Regulation of mobile number portability enabled end users to keep their mobile number in case they wanted to switch to another MNO or SP. This regulatory intervention eliminated an important barrier for users to switch.

Jamming of mobile signals

The ART was the only NRA in our study that dealt with the issue whether or not jamming of mobile signals was legally allowed. Jamming is a means to block the radio signals from and to mobile phones within a particular local area (ART, 1998f). The use of jamming was considered as a means to reduce the risk of noise interruptions by mobile phones during performances. The French Ministry invited the ART to form an opinion on the market entry of mobile jamming systems and filters (ART, 1998f). The major question was whether the use of jamming of mobile signals in halls where performances for a public audience were taking place was at odds with the licence conditions of the MNOs that contained a condition for access to emergency services. After an investigation, the ART decided against a general allowance for these systems to be used (ART, 1999b). The ART based this denial on the conditions of the MNOs licences. These licences include conditions on the provision of a satisfactory level of service quality, coverage of a percentage of the population and the routing of emergency calls. Allowing jammers and filters would not agree with these conditions.

4.3.2. Theme: Mobile retail tariffs

In all three countries, mobile retail tariffs were subject to regulation. Three types of retail tariffs led to regulatory intervention: fixed to mobile termination tariffs (MTTs); on-net versus off-net tariffs and international mobile roaming tariffs.

Fixed to mobile termination tariffs

Within the theme of mobile retail tariff regulation, the main point of concern was the fixed to mobile termination tariffs (MTTs) for which MNOs had insufficient incentives to compete on. Mobile operators charge other (mobile and fixed) operators for terminating receiving calls on their network. So in case of a call to a mobile end user, the originating operator (the MNO or SP to which the caller has a subscription) will pay a MTT to the terminating MNO. The originating operator has no alternative in reaching the mobile user and thus the terminating MNOs have no incentive to lower their wholesale termination tariffs. Moreover, as their own customers do not pay for incoming calls, as a consequence lowering the termination tariff is not a marketing instrument to attract or retain more customers either. On the contrary, if one MNO would lower MTTs for calls from other than the proprietary networks, this would result in a competitive disadvantage because it would allow the competitor to lower their retail prices. As high wholesale MTTs lead to higher retail tariffs, potentially higher than justified by the costs of termination, the NRAs considered this to be a case in the customers' interests to investigate and eventually regulate this price component.

On-net versus off-net mobile tariffs

Retail tariffs that did not include a termination tariff, the so-called on-net tariffs (this relates to calls within the same mobile network) were subject to investigation as a disparity between on-net versus off-net tariffs was noticed. In the case that on-net tariffs are substantially lower than off-net tariffs, in a market with unequal sizes of operators, then the larger operators with more subscribers benefit more from a structure of high off-net and low on-net mobile prices. Not only from a retail point of view (attracting new customers with low tariffs for calls within the network) but also from a wholesale point of view: the larger the operator, the greater the volume of high termination rates for off-net calls that are received (Of tel, 2001, point A6.13). Therefore, this was also an issue for the regulators in the objective of creating a fair competitive market.

International mobile roaming retail tariffs

International mobile roaming retail tariffs were subject to regulatory investigation because they were considered as high and static over a longer period of time. An investigation by the EC showed that the competitive pressures on these tariffs were indeed weak due to structural market aspects (European Commission, 1999). An MNO had no incentive to lower the international mobile roaming tariffs as the wholesale tariffs were part of arrangements by the GSM Association that dealt with the administration and billing of international roaming traffic in Europe, leading to stable high wholesale tariffs. In this case, national regulation would negatively influence the domestic operators' competitive position in the market, therefore the NRAs asked for a European-wide approach to this problem by the EC and the European Regulator Group (ERG).

This group of market issues can be characterized by dealing with the low incentives to compete on specific (types of) retail tariffs due to structural market aspects such as

- new (smaller) market entrants versus incumbent (larger) mobile operators;
- the presence of infrastructural components for call termination that are dominated by a single mobile operator and
- the interdependency between different tariffs which leads to entrenchment in tariffs because the first MNO to lower a specific tariff takes a high risk of losing market share.

4.3.3. Synthesis on mobile network operators and end users

In the course of coding the market issues, we noticed that the market issues that relate to the relationship between the network operators and end users can be divided into two main categories: ex-post (in which the NRA acts in a reactive mode) and ex-ante social regulation (in which the NRA acts in a proactive mode). These two categories are used to derive a more abstract level for the purpose of conceptualization of the market issues: they are used to create the Dimension *Market Issues*. In section 4.7 we elaborate on this in more detail.

The first category is taking care of consumer interests by means of complaint handling. We label this as ex-post social regulation as the source of the dossiers is an individual end user complaint that led to regulatory activities by the NRAs. The NRAs role is reactive and evoked by a third party and is aimed at consumer interests.

The second category is taking care of public interests. In this category, the NRA is proactive and aims at the wider public, not a single end user. We therefore label this ex-ante social regulation as the source of these dossiers is the own initiative of the NRA or the NRA is triggered to activity by another policy maker such as a request from the EC or the national Ministry (e.g. by means of a ministerial request for advice) or a new European Directive. In this ex ante category, the NRAs took measures to ensure that the end users were able to make a choice from the growing number of MNOs after the liberalization. This prevented end users to be hampered by any informational or strategic barriers that were created by incumbent operators in order to prevent this switching. Also, terms of usage, quality of service and access to emergency calls (the jamming issue) were ensured by ex-ante regulation. In addition, one of the objectives of the introduction of market competition was lower end user tariffs. As the relationship between market and physical network characteristics did not lead to sufficient competition on tariffs during the early years of competition, the regulators decided to use wholesale tariff regulation that had to lead to lower retail mobile tariffs for the end users.

Table 22 Category social rationale for regulation

Categories	Sub categories		Properties
Social rationale: public values	ex post	Consumer interests	Complaint handling
	ex ante	Public interests	Terms of usage
			Mobile retail tariffs
			Quality of Service
			Jamming

In table 22 we summarize the properties and sub categories that form the category ‘social rationale for regulation’. These were the market issues that were aimed at the regulation of the mobile services that are provided by the wholesale market to the end users of mobile services in the retail market. In the next section, we present the themes and issues between the MNOs mutually that were subject to regulation.

4.4. Economic rationale: mobile network operators mutually

The second relationship that led to regulatory activities by the NRAs is on the wholesale level and is related to the relationship between the MNOs mutually (see number 1 in Figure 1). In a market in which incumbent operators have established their position before the market is liberalized, entrant network operators have an unfavorable starting position. In all three countries, incumbent operators were already operational before new entrants obtained their licences for the exploitation of a mobile network. Because of the scarcity in frequencies that are suitable for land-mobile networks, the number of MNOs is limited and market entry is governed by a licensing regime.

The regulation of the relationship between MNOs mutually focused on the themes of the technical interconnection between their networks, the interoperability on the services layer and the national coverage of the mobile networks.

Upon liberalization of the telecommunications industry, the construction of competitive networks requires the design of rules and guidelines for the connection between the several networks that are exploited by competing operators. As soon as MNOs obtain a licence to exploit a public mobile telecommunications network, their concern is to roll out their network as efficiently as possible. Some aspects in the roll out phase require negotiations between wireless and fixed network operators for (mutual) access to their networks, by means of interconnection and interoperability.

Interconnection refers to the physical connection of telecommunications networks. A definition of interconnection is “the physical and logical connection of the telecommunications facilities of organizations providing telecommunications networks and/or telecommunications services, in order to allow the users of one organization to communicate with the users of the same or another organization or to access services providers by third organizations” (European Commission, 1996b, art. 1.a.iii). De Vlaam et al. provide a broader definition of interconnection that also takes the commercial and operational aspects of interconnection into account. They define interconnection as

“the whole range of commercial, operational and technical agreements in accordance with which operators of telecommunications networks link their equipment, networks and services to each other in order to gain access to each other’s customers, services and networks” (De Vlaam, De Bruijn and Ten Heuvelhof, 1997, p. 170). This more elaborate definition points towards the potential strategic behavior that can lead to regulatory intervention related to interconnection as it is not only about the physical interconnection that is needed to have access to customers, services and networks, but also about the conditions under which this access is established. In case of high access prices for an entrant network operator, market competition will not ensue.

Interoperability refers to the ability of services to operate over a diversity of infrastructural components owned by several operators. A definition of interoperability is as follows: “Interoperability means the technical features of a group of interconnected systems (‘systems’ includes equipment owned and operated by the customer which is attached to the public telecommunication network) which ensure end-to-end provision of a given service in a consistent and predictable way” (OfTel, 1997c, art. 1.6). If interoperability between networks is not effectuated, it will not be possible to have services that run across interfaces between network components. This means that end users will have a more limited selection of services: they can only use the services that are provided by their own MNO that operate on its proprietary network.

If interconnection and interoperability are both established, the end user has access to end users on other networks and to services that are offered by other network operators or SPs. Fair and transparent interconnection and interoperability agreements are required for connectivity between competing networks and services. But both require mutual agreements between competing market players with their own strategic, competitive interests and, consequently, are usually subject to some form of regulation.

All three NRAs had a forum or committee in which combinations of telecom operators, SPs, industry suppliers and/or end users participated to discuss issues of interconnection and interoperability. OFTEL had the Network Interoperability Consultative Committee (NICC, consisting of operators, end users, suppliers and liaison members, with a staff member of OFTEL in the Board of the Committee), OPTA had the Forum voor Interconnectie en Speciale Toegang (FIST, consisting of telecommunication network operators and SPs, with no formal role for OPTA), the ART had a Comité de l’interconnexion (a committee consisting of operators and industry representatives, presided by the ART). None of the three bodies possess(ed) judicial powers. Therefore, in case of disagreement, the market parties still had to file a request for dispute settlement with the NRA. But the bodies did provide a platform to discuss issues of interconnection and interoperability in order to come to industry wide agreements on a voluntary basis and to advise the NRA’s upon request. The effect of such platforms is that many issues that had the potential to grow into a market issue that would enter the NRAs’ agenda were taken care of within the committee. This led to concerted efforts to ex ante solve implementation problems relating to interconnection and interoperability. Still, interconnection as well as interoperability issues led to formal regulatory interventions by the NRAs during our period of analysis. The main issues were the terms and conditions, interconnection tariffs and routing of mobile traffic over the networks. In the next paragraphs, they are described in more detail.

4.4.1. Theme: Interconnection

Guidelines for interconnection and interoperability

The EC Licensing Directive of April 1997 (European Parliament and the Council of the European Union, 1997a) and the Interconnection Directive (ICD) of June 1997 (European Parliament and the Council of the European Union, 1997b) were the start of a new phase in the UK interconnection policy. Especially the fact that under these Directives the possession of an individual licence was no longer prerequisite to have interconnection rights led to a major policy change in the United Kingdom. Under the former regime only the so-called Relevant Connectable System (RCS) status would allow operators special rights on interconnection. The only way for an operator to obtain this RCS status was to invest in proprietary infrastructure. In contrast, after the implementation of the European Interconnection Directive, the classification for a so-called Annex II status (which determines the rights and obligations to interconnection) was no longer exclusively the right of those operators who managed their own infrastructure. Also operators who exploited networks that were made up of leased infrastructure could now classify for an Annex II status. This was a major breach with the policy in the United Kingdom that aimed at the encouragement of investments in alternative infrastructures.

Terms & conditions: frequency of interconnection charge reviews

In the United Kingdom, the incumbent operator British Telecom (BT) was challenged by new market entrant One2One on the frequency of its reviews of interconnection charges. BT's Standard Interconnect Agreement stated that BT could propose reviews at any moment under the Operator Charge Change Notice (OCCN) procedure, but One2One wanted BT to limit itself to single annual reviews. However, OFTEL concluded that BT was in its right to hold on to any time reviews.

Interconnection tariffs

Interconnection tariffs played a major role in the lowering of the end user tariffs in the relationship between MNOs and end users (see above) as the interconnection tariffs are an important element of retail tariffs too. Therefore, for analytical purposes, it was hard to make a clear distinction between classifying the interconnection tariffs on the retail level (as described in section 4.3.2) or on the level of wholesale (this section). Still, in this section we only present those interconnection issues that were not directly mentioned in or related to the issue of mobile retail tariffs.

Tariffs: equality of termination tariffs for international and national calls

The level of interconnection tariffs for international and national calls was a intense dossier in the United Kingdom as well as France. Technically the termination service is the same for international as well as national calls to be terminated on a mobile network. Still, the GSM1800 operators One2One and Orange in the United Kingdom and the GSM1800 operators SFR and Bouygues in France filed requests for dispute settlements with OFTEL and ART against BT and France Telecom respectively, because they received lower termination tariffs for international calls.

In the United Kingdom, before OFTEL came to a decision in the disputes, the market parties came to an agreement and withdrew their dispute settlement request. In France, the discussion in the dispute led to an assessment whether it was SFR that had to offer interconnection for termination of international calls to France Telecom or whether it was France Telecom that offered transit

interconnection for international calls to SFR. In the case of transit interconnection, ART would not be authorized to regulate the tariffs. SFR claimed that France Telecom did not negotiate well enough with foreign operators on the tariffs for international interconnection. Upon which France Telecom responded that the difference in international and national MTTs was reasonable because of the higher costs for negotiation of international contracts with foreign operators. In addition, France Telecom claimed that it had no means to impose mobile surcharges on foreign operators and that the requested tariff would lay excessive charges upon France Telecom.

In the end, the ART deemed that the dispute was indeed an interconnection dispute between two national operators even though part of the financial aspects was subject to international interconnection agreements (ART, 2000g) and used a tariff regulation to settle the interconnection tariffs. The tariff regulation led to an increase in international call terminations charges to be received by Bouygues and SFR. This entailed that France Telecom had to renegotiate the international MTT in bilateral agreements with its international partners in order to reach a higher tariff.

Tariffs: interconnection charges for originating calls to free phone numbers

Another type of interconnection charges that led to regulatory activities was a request for dispute settlement in which Orange wanted to receive higher interconnection charges from BT for originating calls to free phone numbers. However, OFTEL did not sustain this request and after a market consultation on a draft determination, the case was closed without regulatory intervention. Nevertheless, OFTEL did encourage the industry to explore other charging arrangements for originating free phone calls from mobile phones.

Routing of interconnected international traffic

Finally, the routing of interconnected international traffic led to dispute settlement requests. One case was on the choice of the switch of the fixed operator where international calls for mobile phones would enter their own network. The other cases were on the fact that sometimes network operators in one country would reroute national calls via an international route back to a national network to profit from lower interconnection rates. The OECD defines this international rerouting or tromboning traffic for least cost routing as follows: "sending domestic fixed-to-mobile traffic via international routes to bypass domestic interconnection rates" (OECD, 2000a: 10). The ensuing dispute settlement request arose from the allegation that the British network operator BT made the other MNOs in the United Kingdom pay for the additional costs to solve the capacity problem that BT faced because of the increase in the volume of calls.

4.4.2. Theme: Interoperability

The issue of national interoperability was no problem in the monopoly era, with one network providing services to all end users connected to the network. However, with a diversity of mobile and fixed networks, with different switches from different manufacturers, interoperability can be a source of (technical and strategic) conflict. In the case of market power, interoperability can be troublesome as a dominant operator may lack incentives to provide interoperability to smaller competing operators or new market entrants, thus limiting their options for service delivery to end users.

Without interoperability, an innovative service may be accessible only for the end user of the network on which the service is implemented. With interoperability, the service can be extended to users of other networks than just the network of the launching SP. Dominant operators may prefer to preserve their innovative service to their own customers, whereas new entrants cannot do without access to addressable customers for marketing their new services. Therefore, interoperability is a potential source of conflict. The issues that relate to the theme of interoperability were on the technical protocol and the customer network interface, which we describe in the following paragraphs.

Technical protocol for interoperability

Only in the dossiers of the ART we found that the ART actively pursued the determination on a standard technical protocol for interoperability for the interfaces between (fixed and mobile) telecommunication networks. The aim was to replace a non-normalized proprietary protocol of France Telecom that was not flexible enough to allow for sufficient technical evolution in view of the vast growing flow of information between connected networks and the rapid development of new innovative services (ART, 1999d). The ART, with mutual agreement of all market players involved, decided on an internationally normalized signaling protocol (Sous-Système Utilisateur pour le RNIS (SSUR)), that was open, able to evolve and could incorporate different levels of evolution, which means that once an evolution takes place, this is not mandatory for all operators at once. The new protocol would also make it easier for new entrants to interconnect, it would facilitate end to end service interoperability and it would reduce the number of specific technological solutions in the France Télécom network in favor of a normalized technique.

Customer network interface

Interoperability at the interface between the network and the handset, called the customer network interface, is a specific form of interoperability. OFTEL provides the following description of the customer-network interface:

“Where a public telecommunications network is connected to a customer’s network or apparatus (at the Network Terminating Point) the network and the customer’s system must each be able to understand the technical operation of the other in order for services to interoperate across the connection boundary. The customer’s system and the network must both provide an interface at the point of connection and only where these interfaces are matched will there be interoperability. The technical characteristics that allow for that understanding is the customer-network interface” (OfTel, 1999: glossary).

The customer equipment market in the EU was already liberalized and competitive before the full liberalization of the telecommunications market came into effect. The technical standards were covered by the European *Telecommunications Terminal Equipment Directive* 91/263/EEC (“TTE Directive”)(Council of the European Communities, 1991). However, the Network Terminating Point (NTP) at which the network of a Public Telecommunication Operator (PTO) and the Customer Premises Equipment (CPE) connect can be subject to strategic behavior by operators. During the telecommunications liberalization process the standards for these interfaces became more relaxed whereas the technical specifications are important to ensure a correct operation of end-to-end services. Especially the first mover advantages for an operator could raise anti-competitive concerns.

For example, if a major operator would want to introduce a new service, it could dictate technical specifications for the end user equipment. Consequently, it would be attractive for a terminal equipment vendor to comply with these wishes merely because of the size of the operator's market for selling end user equipment. This situation could furthermore lead to a barrier for customers to switch to another operator because of having to invest in new equipment. This led to two regulatory dossiers for our study: one in the United Kingdom and one in France.

Mobile handsets are in general compatible with a diversity of networks for basic services. However, supplementary services could require network-specific handsets (OfTel, 1995, chapter 4, point 46). Therefore, in the April 1998 statement *Interconnection & Interoperability of Services over Telephony Networks*, OFTEL ruled that operators with market power had to give notice in advance on any alterations to their network and customer interfaces (OfTel, 1998b). The market power was defined as "control of access to addressable customers". As for the customer's interfaces, all PTO's were obliged to an advanced notification of changes. The period was set at fifteen months. In addition, operators with market power had to allow a consultation period on any changes they proposed for the customer interface. Interface specifications that were based on standards adopted by the international standardization organizations ETSI, CEN/CENELEC, ITU, ISO or IEC were exempted from this regime (OfTel, 1998, Annex B, point 28).

In its *Guidelines on Interconnection and Interoperability* of July 1999, OFTEL also included a description of the process that operators had to follow if they wanted to change the technical specifications of an interface between networks or between networks and customer equipment (OfTel, 1999, section 3).

The ART dealt with another aspect of interoperability at the customer interface: the one of using a device installed at the outlet of Private Automatic Branch eXchanges (PABX) that turned a fixed to mobile call into a mobile to mobile call. At that time, there was no formal direct interconnection between mobile networks so the device enabled companies to profit from lower tariffs for calls to mobile phones. The ART only studied the conformity assessment applications of the device and allowed the use of these devices (Code des Postes et des Télécommunications, 1996, L. 34-9).

4.4.3. Theme: Mobile coverage

In addition to interconnection and interoperability, the theme of mobile coverage was dealt with by the three NRAs. We define mobile coverage as the geographical area in which an end user has access to a mobile network to establish a connection by means of mobile end user equipment. Widespread network coverage is an issue for governments that wish to maximize the accessibility of mobile networks across their country. This objective can be in contradiction with the strategy of an MNO to cherry pick on only the financially most lucrative densely populated areas. Governments can also put forward environmental aspects in favor of the idea of sharing infrastructural components because this leads to less impact on the environment of people living in the neighborhood of antennas.

The network coverage of a mobile network depends on several factors:

1. Network coverage is usually translated into a licence requirement for exploitation of a national mobile network. These requirements can be formulated either in terms of coverage of the population (% of population) or in terms of territory (% of national territory to be covered). A

Ministry can choose for a phased approach, for example the first year after the licence the main cities, airports and traffic connections have to be covered, the second year the smaller cities and international traffic connections and in the third year the full percentage of coverage (in terms of population or territory) has to be reached [example based on the Dutch GSM licences].

2. The physical layout of a country is a factor that influences the network coverage. For example, it is far more difficult and costly to cover mountainous areas such as in France than a flat, condensed country such as the Netherlands. Therefore, network coverage was especially discussed in France where widespread coverage was financially an unattractive business case for the MNOs because of its mountainous areas and the unequal spread of users in the country. This led to many unexploited GSM-areas, the so-called 'zones blanches', which the French Parliament considered as unacceptable (ART, 2002a). Infrastructure sharing can contribute to covering these 'zones blanches' by requiring MNOs to each take their share to cover them.

3. The demographics of a country also play a role. If the spread of the population is unequal, with huge areas with few inhabitants versus few cities with a high percentage of the population, the network roll-out will be mainly concentrated on the commercially most attractive areas (of course this also depends on the licence requirements mentioned above).

4. The commercial uptake of the mobile services determines the roll out decisions of an MNO. If a vast uptake of mobile services occurs, commercial network operators will answer the demand for mobile services by means of a vast(er) rollout.

5. The regulatory conditions for network and/or site sharing and national roaming will influence the coverage of the GSM networks. Allowing MNOs to share network elements can stimulate roll out for example if the operators agree on each covering another part of the country (for a specified period of time). Also, setting up a regulatory framework for site/antenna sharing can stimulate roll out because new MNOs will have access to existing sites and antennas instead of having to build them. If a licence for a new entrant includes a condition that states that established competitors must provide access to their networks on the basis of roaming, then the new entrant is able to cover a larger area from the very beginning. Their end users will roam on the competitors' network as long as their own network is not complete yet. Usually this licence condition contains a sunset closure, after which the MNO must operate independently.

In the following sections, we describe the market issues of mobile coverage; they relate to infrastructure sharing and national roaming, respectively.

Infrastructure sharing (2G and 3G)¹⁴

Although an MNO can choose to have full control of its mobile network, in some cases it can be more attractive to enter into agreements with another MNO or several other MNOs for sharing

¹⁴ We consider infrastructure sharing as part of the network design of a mobile network, in which physical elements are shared among MNOs. In contrast, national roaming is allowing users to (temporarily) use the network of another operator. National roaming is based on a (commercial) agreement between MNOs.

infrastructure components of the network. The issue of infrastructure sharing played a role in two phases; during the roll out of the 2G networks and again during the roll out of the 3G networks.

During the 2G roll out, the incumbent mobile operators were reluctant to allow infrastructure sharing on their mobile networks in the United Kingdom. But also the new entrants had already rolled out their networks by the time the regulatory framework was in place and were not eager to share. This opinion changed after the high costs that MNOs spent on their licences during the auction of the licences for 3G mobile networks. Not only do 3G networks require higher investments costs, it was also a period of economic decline. Subsequently, the MNOs started to actively pursue the options for infrastructure sharing.

In principal sharing arrangements were subject to commercial negotiations. However, some of the far-reaching forms of infrastructure sharing can be in contradiction with licence obligations that require that an MNO needs to roll out its own network. Therefore, the NRAs in cooperation with the Ministry (UK, NL) and/or the competition authority (NL) and the Commission Consultative des Radiocommunications (CCR) (France) checked the several types of infrastructure sharing against possible anti-competitive effects on the market and set up guidelines for sharing. These agreements ranged from light forms of infrastructure sharing such as sharing antenna sites on building roofs to more complicated collaborative network designs. An NRA can choose to restrict and evaluate sharing arrangements by comparing the arrangement with licence obligations and its possible effects on the competitiveness of the market and this is what all NRAs did.

National roaming

Another way of 'sharing infrastructure' is the technical possibility of roaming. OFTEL defines the concept of roaming as follows: "Roaming is the use by a customer of one mobile operator of another mobile operator's network to make or receive a call, usually because the customer is out of reach of his own operator's base stations" (OfTel, 1999a, point 1.2). Roaming can play an important role in the aim to have full coverage within the national boundaries (=national roaming) or when a customer travels abroad (=international roaming). It is also an option for new entrants to reach faster mobile service delivery during the roll-out of a network. In this case the customers of the new entrant will (temporarily) roam on existing national competing networks. This supports the new entrant to grow a customer base during roll out, but usually such roaming arrangement applies to a limited period of time in order to encourage the entrant network operator to continue building its own network.

All three NRAs dealt with the issue of national roaming during our period of analysis; because of the role that roaming can play in the licences for new MNOs. During the roll out phase of these networks, some new entrants could exercise their right for national roaming during a specific period of time, as a last resort in the case that commercial negotiations with the incumbent operators would fail. In the Glossary a detailed description of the issue of roaming and its three dominant types is provided, they are here summarized as:

- Type 1: 2G/2G or 2G/3G roaming during network roll out phase;
- Type 2: 3G/3G roaming during network roll out phase;
- Type 3: 2G/2G or 2G/3G roaming in network saturation phase.

The issue was linked to the roll out of the 3G networks. The NRAs acted as advisors to the Ministry in the design of the licences with the aim to create a level playing field for new entrants. In the United Kingdom, the Ministry had to deal with complaints filed by two 2G operators that did not accept the changes in their 2G licences. But none of the three NRAs needed to deal with complaints on this issue.

4.4.4. Synthesis on mobile network operators mutually

The relationship between MNOs is characterized by an interdependency for services delivery. Within the theme of interconnection, network operators require access to each other's network to reach end users for their services. Especially in the beginning, new market entrants depend on the incumbent operators for access which is well illustrated by the case on international termination tariffs. When a new market entrant is relatively small in a national market, negotiating on international termination tariffs with foreign operators may be too cumbersome and they do not have sufficient bargaining power yet to press for higher interconnection tariffs. Instead they are dependent on the major mobile operators for attractive international interconnection tariffs.

Also in the case of interoperability, major operators may be able to dictate the technical specifications for interoperability, by which they exercise control over the end user market. In addition, interdependency exists in mobile coverage during several generations of mobile networks.

In all three themes the power of negotiation and the strategic decision making depends on the size of the operators. Regulatory intervention in these themes was based on the mobile licences or decisions by the NRAs in order to balance the negotiation power of the market parties. Decisions were made on technical specifications, wholesale tariffs and the requirements for national coverage to regulate strategic behavior and commercial interests from a competition engineering perspective.

In this section, we described the wholesale level on which market issues between MNOs mutually were dealt with. In the next section, we present another part of wholesale regulation that dealt with the relationship between MNOs and SPs.

4.5. Economic rationale: mobile network operators and service providers

In the period before liberalization of the telecommunications market, the common business model was based on a fully vertically integrated network operator who controlled the entire value chain of mobile service delivery to end users. After liberalization, a new type of service provision concept was created: the SP that does not possess a proprietary telecommunications network. This type of SP offers telecommunications services to all types of end users (business and residential), via fixed or mobile networks. To do so the SP needs to obtain access to these networks via commercial negotiations with network operators.

We make a distinction between proprietary, independent, and tied SPs, indirect access providers, value added SPs, content and information providers, mobile virtual network operators (MVNO), and system integrators. This distinction in types of providers that need access to mobile networks is summarized in Table 23; in the Glossary their roles are described in more detail.

Because of the differences in the nature of the SPs, we discern three types of access:

1. Proprietary SP is the label for MNOs or its parent group that are vertically integrated: they own their network and also provide services to end users. They have *de facto administrative access* to their own/parent network;
2. SPs that need *administrative access* to the networks of MNOs. Administrative access is required for SPs that merely repackage and resell the wholesale call minutes to end users and do not require any technical adaptations to the networks. Independent or tied SPs that are not linked to a mobile network need administrative access in order to provide their services to end users. Tied SPs collaborate with one MNO, whereas independent SPs sell services from more than one MNO;
3. Indirect access providers, value added SPs and content and information SPs, MVNO and system integrators that require *special access* to the networks of MNOs. Special access is defined as: “the request for interconnection at another point of presence than where most end users are connected” (see e.g. (OPTA, 1998b)). This type of access requires technical adaptations in the network because of routing arrangements (for the indirect access SP) or interoperability requirements (for the value added SPs and the content providers).

An overview of these types of SPs and the type of access to network components they require is presented in Table 23.

Table 23 Types of service providers and the type of access they require to mobile networks for their service delivery to end users

Type of service provider	Type of access to network (components)
Proprietary service provider	De facto administrative access
Independent or tied service provider	Administrative access (see 4.5.1)
Indirect access service provider	Special access (see 4.5.2)
Value added service provider	
Content and information provider	
Mobile virtual network operator	
System integrators	

In the following sections, we present the theme relating to the relationship between mobile networks operators and SPs that the three NRAs dealt with (see number 2 in Figure 1).

4.5.1. Theme: Service providers and administrative access

The theme of administrative access encompasses several issues that mainly arose from requests for dispute settlement on the part of independent SPs seeking access to mobile networks for enacting their service delivery. The issues raised refer to cross-subsidization, retail promotions, unbranded and unstructured airtime, wholesale pre-pay mobile services, terms and conditions, and promotions. Summaries of these issues are presented in the following paragraphs.

Cross-subsidization

Allegations on cross-subsidization were made on against MNOs who granted more advantages such as discounts and other incentive payments to their tied SP(s) than to independent SPs, leading to a possible margin squeeze for the latter.

Retail promotions

Allegations on retail promotions of an MNO referred to unauthorized use of end user information for promotional activities on the retail level. These were a breach of the code of practice on confidentiality of customer information between various departments of a (dominant) network operator, presumed to lead to unlawful customer poaching practices.

Unbranded and unstructured airtime

OFTEL considered taking measures against the MNOs with a dominant market position that would not offer a wholesale product of unbranded and unstructured airtime to independent SPs. As a consequence of this MNO practice, the independent SPs were not able to develop distinct retail services and tariffs to differentiate themselves from the retail services as offered by the MNOs and their dependent SPs. In other words: the independent SPs were bound by the packages of call minutes and tariffs that were determined by the MNOs. This hampered their ability to offer their own branded retail services that were different from the retail packages offered by the MNOs and their dependent SPs.

Wholesale pre-pay mobile services

Complaints on a variety of wholesale conditions by MNOs for offering retail pre-pay mobile services were made by independent SPs. They objected to the restrictions laid down by the MNOs. The independent SPs wanted access to the database of the MNOs that manages customer credits. In addition, they submitted complaints to OfTel on the terms and conditions of the MNOs, alleged cross-subsidization by MNOs, the restricted margins for reasonable returns, the pricing of pre-paid handsets by the MNOs and the allocation of numbers for offering wholesale pre-pay services. These were all subject to dispute settlement requests by independent SPs that wanted special access to offer retail pre-pay mobile services.

Wholesale terms and conditions

Independent SPs also complained about wholesale terms and conditions that showed undue preference to tied SPs or discriminatory and unreasonable standard SP agreements such as wholesale terms leading to a margin squeeze.

Wholesale promotions

Finally, independent SPs lodged complaints on wholesale promotions by MNOs that were only offered to tied SPs and as such were discriminatory. In addition they submitted complaints for having to pay extra marketing costs whereas the tied SPs could use the marketing material as offered by their network operator for free.

Synthesis on service providers and administrative access

The theme of SPs and administrative access is characterized by dispute settlement requests and complaints from the SPs that needed administrative access to the mobile networks. Especially in the United Kingdom many dispute settlement requests were filed with OFTEL. Only the issue of retail promotion and wholesale terms and conditions were dealt with by the other NRAs too, see Table 17.

The first core element of the dispute settlement requests were the wholesale terms with alleged margin squeeze and undue preference for tied SPs and discrimination in agreements, in short:

strategic behavior aimed at making the business case for independent SPs less attractive. The other core element was on the space that independent SPs had to develop their own services instead of being linked to the packages provided by the MNOs. The third element was about SPs that claimed to have to deal with unlawful customer poaching practices.

The NRAs took decisions in order to leverage the interests of the SPs and the MNOs with the objective of enhancing competition in the mobile telecommunications market.

4.5.2. Theme: Service providers and special access

In principle, the licence conditions of the MNOs had to be sufficient to prevent undue preference, undue discrimination and unfair cross-subsidization. However, the rise of the provision of enhanced services as opposed to basic voice services over mobile telephony networks introduced a new regulatory theme that centered on unbundling and access to network-based functionalities. These two concepts were indispensable for SPs that wished to enter the market via a request for special access on mobile networks.

The empirical data shows that SPs encountered two reactions to their request for special access to a mobile network. In the first case the type of value added services makes the package deal of an MNO more attractive for end users and subsequently a commercial agreement for access was reached between the MNO and the value-added SP. In the other case, if MNOs planned to offer a similar service in the future, they could refuse or delay access to their network or charge too much for such access. This strategy entailed that the value-added SP was denied access or granted access on unfavourable terms and thus was unable to offer the service with a profit. Depending on the situation, the regulator could decide that this is undesirable anti-competitive behaviour that hampers the growth in market competition and develop an intervention in the market by formulating a regulatory rule for the MNO(s).

In addition, changes in the regulatory framework over time led to a growth in dossiers. This was especially the case in the United Kingdom when the most relevant licence conditions that regulated the relationship between MNOs Orange and One2One on the one hand and the SPs on the other hand were made dormant. This led to many dispute settlements requests.

Within this theme the definition of the services and whether or not the then current EU Interconnection Directive was applicable, whether or not the MNO had SMP, the consequences of regulatory intervention on the market structure and competition and whether or not the NRA had the legal authority to regulate were part of the discussion and deliberations.

The many cases between MNOs and SPs represent the troubled relationship they had. Vertically integrated MNOs used a wide diversity of strategies to give preferential treatment to their proprietary (tied) SP and to make the business case of an independent SP less attractive or even impossible. In the regulatory dossiers, we identified the following strategies on the part of the MNOs in acting towards the independent SPs that requested access to their network:

- Refusal for access;
- The terms for access;
- The charges for access;
- A margin squeeze between wholesale and retail charges for call minutes;

- Delaying tactics in processing the demand for access;
- Discrimination in service packages for independent versus tied SPs;
- Cross-subsidization to the advantage of tied SPs;
- Strategically timing the introduction of new services, e.g. delaying the availability of wholesale service packages to independent SPs;
- Claiming maximal freedom in changing conditions for access;
- Limiting the scope of independent SPs for defining their own products;
- Creatively setting bonuses and discounts on wholesale products in order to influence the packaging of services by SPs;
- Designing specific activities (such as in marketing) to influence SPs' strategies;
- Limiting the availability of unbranded and unstructured airtime;
- Restricting or denial of access to intelligent network features and/or databases;
- Bundling of services;
- Requiring up front investments as bond or for making adaptations to the network;
- Controlling mobile portals and
- In cooperation with the providers of terminals, making the proprietary portal on new handsets the preferred portal for end users.

These strategies were the source for the regulatory dossiers on the theme that deals with the relationship between the SPs that needed special access to mobile networks for the delivery of value added services and the MNOs. We discern the following issues within this theme:

- preferential treatment of proprietary services that led to complaints by the independent SPs on anti-competitive behavior of the mobile networks;
- the introduction of new services by MNOs themselves and
- the introduction of new forms of special access facilitated by means of a regulatory decision.

In the following paragraphs, we present the summarized description of the issues.

Preferential treatment for proprietary services

The issue of preferential treatment for proprietary services consists of several cases in which the MNOs were accused of making an allegedly unfair distinction between the services they themselves offered due to vertical integration and the conditions for wholesale access they offered to independent SPs wishing to offer the same services via special access to their networks.

Charge card operators complained that network operator Orange was informing their callers that when they wished to dial via an alternative charge card operator, they would be charged at premium rate. The charge card operators saw it as misleading and detrimental for their services, but OFTEL saw no reason to intervene as the message was correct.

Mobile information services require special access to network intelligence. When MNOs were having SMP, they had to make these functionalities in their network available on non-discriminatory terms. Although no regulator actually intervened, they did monitor and provide guidelines towards this crucial type of access for independent SPs to offer innovative services to their end users.

In the case of the refusal of MNOs to connect an SP's platform for management of SMS (the Short Message Service Centre (SMSC) that stores and forwards SMSs), OFTEL did take a decision by proclaiming that SMS conveyance fell under the *Interconnection Directive*. This entailed that the

MNOs with market power had to offer sufficiently unbundled interconnection services for this type of special access.

As for the French case of portal control, the proprietary portals of MNOs were in competition with portals set up by third parties. The network operators had the advantage of being able to install their portal as the front-page once the end users activated their mobile telephone. The complaint of the independent SP was that changing the portal by the end user was a long and costly procedure. A simple procedure for reprogramming by SMS was not supported by the mobile phones sold with subscription by the network operators. Moreover, it was not possible to memorize favorite pages via the Internet, contrary to their own services. The ART concluded that operators had to refrain from discrimination between SPs by using their ability to privilege specific SPs, either by means of technical or economic measures.

Value added services

The introduction of content services was the first type of value added services in the development of mobile services. The MNOs with SMP were by licence or by *Interconnection Directive* obliged to grant all reasonable requests for access to the network by SPs. Especially in the case they already offered the content service themselves, MNOs with SMP had to make it available to third parties too. Still the revenue share arrangement and the SMS termination charges led to complaints for OFTEL to deal with.

Introduction of new services by the Mobile Network Operators

In the United Kingdom, BT's Genie Service was subject to allegations of cross-subsidization and price squeezing. BT offered

"a Web-to-mobile SMS messaging service to any subscriber with a digital mobile phone. It offers two types of service: tailored news-flashes according to previously stated personal preferences (financial, sports or news) and a website that allows individuals to send text messages from a PC to another's phone. Genie is also a WAP portal and ISP, offering a range of associated services" (OfTel, 2000b).

Independent SPs objected to the fact that the service was offered for free, claiming that BT as a dominant market party was not allowed to cross-subsidize such a service. However, OFTEL investigations showed that the service was open to all independent SPs on BT's Cellnet network. Also, the allegation that BT Cellnet Genie was offering retails services that led to margin squeeze because of the low retail price, was not sustained. All SPs had equal access to the package on equal terms as BT Cellnet Genie and the so called OFTEL formula indicated the retail package did not indicate a licence breach by BT (see the Glossary for an explanation of the OFTEL formula).

In contrast, the way in which BT Cellnet and Vodafone (then dominant market parties) priced their own personal numbering services to their clients did provoke regulatory intervention. They offered personal numbering services at a lower retail price by claiming they were of a different status than the personal numbering services offered by the independent SPs. After many complaints were filed, OFTEL performed a market analysis and concluded that the services involved were in the same market and consequently issued a retail tariff regulation to eliminate all discriminatory price settings between proprietary versus third party personal numbering services.

Introduction of new forms of special access

Both concepts of indirect access and access for MVNOs were subject to market consultations and elaborate studies by the NRAs. The NRAs were cautious to take regulatory measures to support the market entry on the basis of the two concepts as they realized that supporting new types of providers' access would lead to significant changes in market structure and thus impact the competitiveness in the market. The fact that commercial negotiations already led to new providers entering the market and the foresight of new 3G entrants (in the United Kingdom) led to regulatory cautiousness. For OFTEL the two concepts also meant a breach with the policy to encourage investments in new networks. The authority of the NRA to take a decision on obliging MNOs to grant requests for indirect access was also questioned. Ultimately all three NRAs issued a regulatory decision that obliged MNOs with SMP to grant indirect access on their networks. The NRAs did not enforce the same directions for the MVNOs (services based on roaming) but continued to monitor this concept.

Synthesis on service providers and special access

The relationship between MNOs and SPs that requested special access to their network to provide value added services led to tensions because of the interests of the network operators to provide beneficial added value services themselves. Only if the network operators could gain from the added value services by an independent SP, would they grant access on acceptable terms and conditions.

Regulatory activities were motivated by the wish to create a level playing field to enhance competition on the services level. However, this theme is also illustrative of the uncertainties caused by technological advance that led to new types of services. These innovations led to intense regulatory dossiers in which the interests of MNOs, value added SPs and end users had to be taken into account. These interests had to be assessed in the context of the overall competitiveness in the market not only at the moment in time but also in the long term. The ex post dispute settlement dossiers had the character of checking with compliance to the telecommunications law or to the operators' licences. These ex post dossiers required limited regulatory activities. In contrast the dossiers that had the character of ex ante regulation that aimed at the facilitation of new types of services provision led to extended regulatory activities before a decision was made. The decisions taken in these latter, very intense dossiers required a balanced deliberation between service innovation and the effect on the competitiveness in the market in the longer term.

In the next section, we address the last type of relationship that was found in the regulatory dossiers, the one between MNOs and retailers.

4.6. Economic rationale: mobile network operators and retailers

A retailer is a vending organization that sells a mobile station (with or without a subscription) without any after sales services to the end user. Retailers buy telephones from hardware suppliers or from network operators with subscriptions or pre-paid packages for wholesale tariffs and cash their profits on the difference between the wholesale and retail tariffs. In the period of our research focus this was mainly done by large warehouses and music stores who considered the sale of mobile

phones as part of their product portfolio. A special class of retailers only sold their phones through websites and had no physical shops.

The relationship between MNOs and retailers (see number 3 in Figure 1) only appeared on OFTEL's agenda, with two issues: the claw back clauses and the issue of resale price maintenance.

Claw back clauses

One retailer filed a complaint with OFTEL on the allegedly unfair trading terms of claw back clauses. These clauses implied that retailers had to indemnify the MNO in case that pre-pay handsets were sold but not activated or not used by the end user.

Resale price maintenance

The other complaint was on the anticompetitive effects of MNOs for resale price maintenance. The operators fixed the retail prices for pre-pay phone packages by means of labeling the packages with a fixed price and subsequently lowering their resale prices, which led to a margin squeeze for the retailers.

Synthesis on mobile network operators and retailers

The role of retailers in the mobile telecommunications market is to provide end users with the end user devices (mobile phones) with which they can access basic and value added services. Only two regulatory dossiers related to the relationship between retailers and MNOs. These cases were about the situation that retailers sold pre-pay phones that are linked to a specific network operator. The retailers specifically had complaints on unfair terms and margin squeezes, but neither case led to regulatory intervention. The limited number of cases shows that this relationship between MNOs and retailers required a limited number of regulatory activities and can thus be labelled as the least cumbersome of all relationships.

4.7. Creating the dimension market issues

In Chapter 1 we introduced the potentially conflicting business and regulatory objectives in the mobile telecommunications market. The NRAs were installed to safeguard public values and to enhance fair market competition. These regulatory objectives compare to the distinction made by Prosser (Prosser, 1997, section 2.3.4) and Eckert (Eckert, 2018) between the social versus economic rationale for regulation. In Figure 1 we labelled the social rationale as public values and the economic rationale as fair competition.

We can now fill in these rationales on a more specific level by means of the market issues that we presented in this chapter. We use the term properties for the lowest level of market issues, which can be grouped into a sub category of similar properties and then into the categories of social rationale and economic rationale, see Table 25. The arguments for this are as follows:

In the synthesis on the mobile services provision and end users, we concluded that some issues are approached on an ex post basis and others on an ex ante basis. In the case of ex post regulation, the issues are triggered by requests for dispute settlements by an individual end user. Ex ante regulation addresses public interests before a market issue can arise.

This *ex ante* versus *ex post* distinction can also be discerned in the category of economic rationale for regulation, which is aimed at regulating the strategic behavior of the market parties with their economic interests. These are the dossiers on the relationships between the MNOs mutually and with the SPs and retailers. *Ex post economic regulation* refers to either compliance management, a request for dispute settlement or a complaint by a market party. This category is characterized by a reactive regulatory approach and deals with the regulation of one market party or one set of market parties such as the ones with dominant market power. *Ex ante economic regulation* is aimed at the clarification of market conditions on the infrastructure level (such as interconnection and interoperability) and supporting technological or services innovation on the services level. The main objective of *ex ante* economic regulation is to create transparent conditions for competition for all market parties; consequently, the NRA decisions address all market parties. See Table 24 for an overview of the category and sub categories for the economic rationale for regulation.

Table 24 Category economic rationale for regulation

Category	Sub categories		Properties
Economic rationale: fair competition	ex post	Compliance	n.a.
	ex post	Dispute settlements between market parties	Market party complaint handling or request for dispute settlement
	ex ante	Developing the institutional context	Developing market conditions on the infrastructure level
			Supporting services innovation

Based on these distinctions we create the dimension *Market Issues*, which consists of:

1. the category *social rationale* aimed at public values that consists of the sub categories 'ex post consumer interests' (based on the property complaint handling) and 'ex ante public interests' (based on the properties terms of usage, tariffs, quality of service and jamming) (see Table 22)

and

2. the category *economic rationale* aimed at fair competition that consists of the sub categories ex post compliance and ex post dispute settlements (based on the properties *market party complaint handling or request for dispute settlement*) and ex ante developing the institutional context (based on the properties *developing market conditions on the infrastructure level* and *supporting services innovation*) (see Table 24).

Thus, we created the dimension *Market Issues*, which is presented in Table 25. This is the first dimension for the development of the conceptual framework of regulatory practice.

Table 25 Dimension *Market Issues* that OFTEL, OPTA and ART dealt with in the mobile telecommunications market, over the period 1997-2002.

**PD (Primary Doc) number refers to the dossier numbers as listed in Appendix C*

DIMENSION MARKET ISSUES				
Categories	Sub categories		Properties	PD*
Social rationale: public values	ex post	Consumer interests	Complaint handling	1
	ex ante	Public interests	Terms of usage	2, 3, 5, 16, 17, 50
			Mobile retail tariffs	4, 18, 21, 22, 60
			Quality of Service	15, 19, 20, 51
			Jamming	55
Economic rationale: fair competition	ex post	Compliance	n.a.	11
	ex post	Dispute settlements between market parties	Market party complaint handling or request for dispute settlement	14, 26, 27, 28, 31, 32, 34, 35, 38, 41, 42, 43, 46, 48, 49, 52, 53, 58, 59
	ex ante	Developing the institutional context	Developing market conditions on the infrastructure level	6, 7, 8, 23, 24, 25, 29, 30, 54, 61
			Supporting services innovation	9, 10, 12, 13, 33, 36, 37, 39, 40, 44, 45, 47, 56, 57

4.8. Dimension: market issues in the mobile telecommunications system

To develop a conceptual framework of regulatory practice in mobile telecommunications systems, we first need to know which market issues led to interventions by NRAs. The first dimension for our conceptual framework is based on the overview of market issues that we presented in this chapter. We used this overview to create the dimension to answer the sub research question:

1. How to conceptualize the market issues that a national regulatory authority in the mobile telecommunications system deals with?

We reconstructed 61 regulatory dossiers in the mobile telecommunications market in the United Kingdom, the Netherlands and France in the period 1997-2002 and coded them in Atlas.ti. The dossiers represent the market issues that led to regulatory practice. In this thesis a market issue is any reason for an NRA to perform activities in order to develop a regulatory arrangement. The dimension consists of the sub categories social and economic rationale.

The social rationale is aimed at the end users having access to mobile services at reasonable and affordable terms and consists of the sub categories

- consumer interests and
- public interests

The economic rationale for regulation consists of the sub categories

- compliance;
- dispute settlements between the MNOs, SPs, retailers in the wholesale market;
- developing the institutional context

In both rationales we found evidence for ex ante and ex post regulation. The full overview of the dimension *Market Issues* is presented in Table 25.

In the next chapter, we explore how the NRAs dealt with these market issues in practice.

5. Dimension: Regulatory Activities in Mobile Telecommunications Systems¹⁵

“[t]o understand fully the ‘governance of regulation’, it is necessary to go beyond description and analysis of the formal structures and institutions of public management; we must also examine the characteristics of the public policy process. This means looking behind the institutional façade to grasp the ‘real world’ of public action” (Minoque, 2002, p. 12)

5.1. Introduction to the regulatory activities

The dimension *Market Issues* is a conceptualization of the regulatory dossiers that the NRAs dealt with. Our next aim for the development of a conceptual framework of regulatory practice is to explore how the NRAs dealt with these market issues. We therefore look at the activities that the NRAs deployed to develop regulatory arrangements for dealing with the market issues. This will answer our second sub question:

2. How to conceptualize the activities that a national regulatory authority in the mobile telecommunications system performs to deal with market issues?

We used chronological reconstructions of the 61 regulatory dossiers in Atlas.ti. In the phase of open coding we coded every single activity by means of line by line coding, following our definition of regulatory practice as “the activities of a sector-specific national regulatory authority in the process of regulating the mobile telecommunications market”¹⁶. This coding procedure yielded a list of 525

¹⁵ We presented preliminary outcomes of chapter 5 in: (Ubacht, 2004, 2006, 2016).

¹⁶ During later phases of coding and analysis, we discovered activities that third parties perform during the process in which the regulator addresses a market issue. We come back to this in the sections 5.2 and 5.5.

activities. The terminology of the properties closely resembles how the NRAs presented their activities in the official documents in which they report on the market issue at hand.

For an example of the line by line coding, see Box 1. These activities are the properties which are organized into sub categories and categories to form the dimension of *Regulatory Activities* in the selective coding phase. This dimension is the conceptualization of the way in which NRAs deal with the market issues that we presented in chapter 4 and is presented in full in the conclusion of this chapter (section 5.6).

After the introduction of mobile number portability OFTEL received a customer complaint on number portability. This case ran from January 20th 2000 to May 30th 2001. The customer alleged SP Intercity Mobile Communications (a Vodafone SP) of not willing to provide number portability on reasonable terms (OfTel, no. 17). At first OFTEL did not see a legal basis to enforce reasonable terms on the SP as neither a licence condition, nor the ONP Regulation 1998, nor the Unfair Terms in Consumer Contracts Regulations 1999 offered a basis for enforcement. However Intercity Mobile Communications was referred to the Industry Process Manual, in which the refusal to provide mobile NP because of non-payment of outstanding charges was prohibited (OfTel, no. 17). In October 2000 OFTEL started a new investigation and concluded in May 2001 that licence condition 68 of Vodafone’s licence did provide a ground for intervention. By this licence condition mobile network operators are obliged to make sure their SPs adhere to the directions on mobile number portability. After discussing the case with Vodafone, OFTEL concluded that “Vodafone attempted to influence Intercity Mobile Communications in all proportionate and practical ways” (OfTel, no. 21). Subsequently, OFTEL closed its investigation without further formal intervention.

Box 1 The open coding phase: an example of line by line coding of regulatory activities.

Legend: this textbox contains part of the case on mobile number portability by OFTEL (PD16). The underlined text elements indicate the properties that we coded.

We applied an iterative cycle of open and selective coding of all activities within the reconstructed regulatory dossiers. When reaching saturation we grouped the activities into four categories, see Table 26 for the number and percentage of occurrences in each of these categories. These four categories constitute the dimension *Regulatory Activities*.

Table 26 Dimension *Regulatory Activities*

DIMENSION REGULATORY ACTIVITIES			
	Categories	No of occurrences	Percentage of occurrences
Section 5.2	Procedural Activities	302	58 %
Section 5.3	Enforcement Activities	120	23 %
Section 5.4	Strategic Activities	46	9%
Section 5.5	Networking Activities	57	11%
	Total	525	100%

We describe the categories in short and elaborate on them in the next sections. For each category a full overview of the sub categories and their properties in numbers is provided in Table 27-

Table 30:

- *Procedural activities*: the procedural activities are the activities of (mainly but not exclusively) the regulatory authority to support the process of dealing with a market issue, see Table 27 and section 5.2;
- *Enforcement activities*: the enforcement activities represent the decisions that the NRA takes to solve a market issue. They are preceded by the procedural activities to analyze the issue at hand and to explore the choice for a type of enforcement activity that needs to fit with the character of the relevant issue and the possible effect of the enforcement on the market, see Table 28 and section 5.3;
- *Strategic activities*: the strategic activities represent the options that a regulatory authority has to refrain from a top-down regulatory approach in solving a market issue. Instead, a solution is found by relying on market forces or on communal actions with or by the market parties: the market parties are expected to take their own responsibility to develop a solution to the market issue. The NRA thus chooses not to intervene by means of enforcement, see Table 29 and section 5.4;
- *Networking activities*: the networking activities are those activities that either another national or international regulatory authority performs within an NRA dossier, or the other way around: the activities that an NRA performs for other regulatory organizations, see Table 30 and section 5.5 (Ubacht, 2016).

In the subsequent sections 5.2-5.5, the four categories and sub categories of regulatory activities are described in-depth and illustrated by means of examples from the reconstructed regulatory dossiers.

Table 27 Properties and sub categories of the category *Procedural Activities*

Selective coding: CATEGORY & sub categories	Open coding: properties	No of occurrences	Total per sub category
PROCEDURAL ACTIVITIES			
<i>Investigation</i>	Investigation into technical details	1	
	Self-initiated investigation	7	
	Investigation with National Competition Authority	2	
	<i>Investigation following:</i>		
	Request for dispute settlement	3	
	Market party complaint	27	
	End user complaint	4	
	Request from third party	3	
	Reuest European Commission	3	
Sub total		50	
<i>Information gathering & sharing</i>	Private communications (e.g. letter)	9	
	Complaint hotline	1	
	Private hearing with separate market parties	4	
	Disucssion with other NRAs	2	
	Performance reports	3	
	Preliminary inquiry	1	
	Discussion with European Commission	1	
	Asking for consent to license modification	1	
	Search of premises	1	
	Accreditation scheme for websites	1	
	Affirmation of NRA authority	2	
	Publications of reports or notices	7	
	Public hearing in dispute settlement case	4	
	Round table with market parties	5	
	Request to market parties for information	6	
	Mystery shopping tour	2	
	End user campaigns	2	
	Forum consultation	4	
	Informing or reporting to third parties (e.g. consumers council or EC)	4	
	Market consultation	28	
Commissioning of studies by others	5		
Sub total		93	
<i>Analysis</i>	Price index research	1	
	Pre-implementation analysis	3	
	Benchmarking study	1	
	Price review & analysis	2	
	End user survey	2	
	Market survey	3	
	Evaluation of regulatory regime	1	
	Market review	8	
	Analysis of end user complaint	1	
Sub total		22	
<i>Third party procedural step</i>	Asking for postponement of implementation of direction	2	
	Disputing the NRA authority	1	
	Market party complaint	36	
	Request for investigation from third party	5	
	Request for clarification from third party	5	

Selective coding: CATEGORY & sub categories	Open coding: properties	No of occurrences	Total per sub category
	Dispute settlement request	18	
	End user complaint	7	
	Lodging an objection to an NRA decision	8	
	Sub total		82
<i>Referral to other organization</i>	Referral to European Commission	1	
	Referral to National Competition Authority	3	
	Referral to European Regulators Group (ERG)	1	
	Sub total		5
<i>Close case</i>	Withdrawal of dispute settlement request	5	
	Transfer of the issue into another dossier	4	
	Close case after intervention	10	
	Close case without intervention	31	
	Sub total		50
	Total Procedural Activities		302

Table 28 Properties and sub categories of the category Enforcement Activities

Selective coding: CATEGORY & sub categories	Open coding: properties	No of occurrences	Total per sub category
ENFORCEMENT ACTIVITIES			
<i>Persuasion</i>	Conversation with market party	2	
	Reminder of license obligations or industry manual	4	
	Proposal for central information system	1	
	Mediation	1	
	Sub total		8
<i>Control/monitoring</i>	Threat of final order	2	
	Monitoring	11	
	Provisional order	3	
	Quantitative measure for compliance	1	
	Sub total		17
<i>Behavioral directions</i>	SPM/MI designation	10	
	Policy guidelines or statement	16	
	Directive for market parties	26	
	Decision on NRA procedure	6	
	Sub total		58
<i>Financial regulation</i>	Wholesale tariff regulation	17	
	Retail tariff regulation	8	
	Sub total		25
<i>Penalties</i>	Fine	3	
	Penalty on a daily basis	2	
	Sub total		5
<i>License adaptation</i>	License modification	7	
	Sub total		7
	Total Enforcement Activities		120

Table 29 Properties and sub categories of the category Strategic Activities

Selective coding: CATEGORY & sub categories	Open coding: properties	No of occurrences	Total per sub category
STRATEGIC ACTIVITIES			
<i>Enforced co-regulation</i>	Agreement amongst market parties	4	
	Installation of an industry wide policy group	4	
	Co-regulatory approach to reach full coverage	6	
	Implementation of an industry wide technical system	1	
	Implementation of an industry procedure	3	
	Sub total		
<i>Market forces</i>	Lifting regulatory obligations	3	
	Forbearance of regulatory intervention	10	
	Sub total		
<i>Self-regulation</i>	Code of conduct	2	
	Memorandum of understanding	1	
	Cross-industry standard contract	2	
	Industry-wide consumer awareness campaign	1	
	Cross-industry protocol	2	
	Encouragement by NRA to reach a self-regulatory arrangement	7	
	Sub total		
Total Strategic Activities			46

Table 30 Properties and sub categories of the category Networking Activities

Selective coding: CATEGORY & sub categories	Open coding: properties	No of occurrences	Total per sub category
NETWORKING ACTIVITIES			
<i>Activity of other national regulatory player in an NRA dossier</i>	Joint publication	3	
	Approval of Minister	1	
	Ministerial decree	6	
	NCA report	3	
	Decision by another regulatory player	8	
	Investigation by other regulatory player	5	
	Joint market consultation	2	
	Passing motion	1	
	Adaptation of primary legislation including transposition of EC directive	7	
	Sub total		
<i>Activity of international player in an NRA dossier</i>	<i>European Commission:</i>		
	Publication of a communication	2	
	Publication of a new directive	3	
	Accusation of market party	1	
	Adaptation of a directive	2	
	Investigation by EC	1	
	Request for investigation	3	
	Search of premises by EC	1	
	Sub total		
<i>NRA activity for another national regulatory player</i>	Advice to Ministry	7	
	Advice to NCA	1	
	Sub total		
Total Networking Activities			57

5.2. Category: procedural activities

In the open coding phase, we found that a majority of the regulatory activities (302 out of 525 coded activities, 58%) are related to the processing of information on the one hand (these are the sub categories of *investigation, information gathering & sharing* and *analysis*). On the other hand, other players than the NRA play a role by either initiating to put the issue on the regulatory agenda (the market party or end user complaints and the requests for dispute settlement that are put forward to the NRA) or by sending in requests during the process of the dealing with the issue. These are coded as the sub category *third party procedural step*.

The other way around, an NRA can also refer a case to another regulatory authority (such as the EC, the ERG, or the NCA) when the case is beyond its own authority to deal with. This is the sub category *referral to other organizations*.

Additionally, towards the end of processing a market issue, the NRA performs a last activity: that of closing the case with or without an intervention. In a limited number of dispute settlement cases, the case is closed because the complainant withdraws the case before the NRA takes a decision. This is the sub category *closing the case*.

The common character of all these activities is that they represent/support the process of dealing with a market issue. These activities are either the reason that an issue enters the regulatory agenda (e.g. a complaint or dispute settlement request), or they are the supporting activities that are needed to assess the issue thoroughly (investigating, analyzing) or to close the case at the end of the regulatory process. Because of the nature of these activities within the regulatory process, we grouped them into the Category *Procedural Activities* (see Table 31) (Ubacht, 2016).

Table 31 The sub categories and their occurrences in numbers and % within the category *Procedural Activities*

Category: Procedural Activities	Sub Categories	No of occurrences	Percentage of occurrences
Section 5.2.1	Investigation	50	17%
Section 5.2.2	Information gathering & sharing	93	31%
Section 5.2.3	Analysis	22	7%
Section 5.2.4	Third party procedural step	82	27%
Section 5.2.5	Referral to other organizations	5	2%
Section 5.2.6	Closing the case	50	17%
	Total	302	100%

Procedural activities are also characterized by the fact that the NRA is not the only acting actor during the processing of an issue. Market parties often initiate the issue by submitting a complaint or by asking for a dispute settlement. Occasionally an end user complaint is the start of an issue. And other regulatory organizations can be involved in the process in case the issue does not fall under the jurisdiction or powers of the NRA itself (referral to EC, ERG or NCA).

Another role for third parties during the process is that of offering information and of discussing the analysis and interpretation of data that is presented by the NRA to market parties, end users, and other interested or involved actors. This characterizes the interactive character of the regulatory process: along the way, the NRA assesses the issue, presents and discusses a preliminary

intervention with third parties. The information exchange is done in a process that is interactive, in which the NRA gathers and analyses information, but also shares and checks interpretations with interested parties and explores the solution space for solving the issue. The aspect of interactivity illustrates the regulatory practice of a regulatory authority that operates in an actor network in which activities from a diversity of actors contribute to the regulatory agenda as well as to deciding upon market issues. An example of this interaction is given in Box 2.

The issue of number portability in fixed networks provided the leading principles for the introduction of mobile number portability in the United Kingdom. OFTEL started the process of this introduction in March 1996 with a market consultation to elicit responses from market parties on its intentions to extend number portability to the mobile market segment. This discussion was part of the process towards an adaptation of the National Numbering Scheme.

Box 2 Example of the interactive character of the regulatory process [PD16 UK Mobile Number Portability]

We clustered the procedural activities into six sub categories (see Table 27). In the following sections, we first describe the six sub categories and then offer a synthesis on the *Procedural Activities*.

5.2.1. Investigation

The sub category *Investigation* contains activities that are often triggered by the request of a market or third party or an end user complaint, but self-initiated investigations by the NRA also occur. The *Investigation* activities are agenda setting and are usually followed by other procedural steps during the period of the investigation. *Investigation* is a first step to obtain a full insight into a new regulatory case, to explore and to be able to assess the request or complaint and its characteristics at the very start of a case. Although self-initiated investigations occur, the majority of the investigations follow requests for dispute settlements, market party complaints, end user complaints or requests from others (e.g. the EC).

5.2.2. Information gathering & sharing

In the sub category *Information gathering & sharing* the procedural NRA activities are characterized by interaction with interested parties or market parties involved. On the one hand, we discern face-to-face meetings to discuss the issues of a regulatory dossier such as the organization of a round table with market parties, organizing market consultations or a public or private hearing in a dispute settlement case. On the other hand, we found more repressive means of information gathering such as searching the premises of companies in order to obtain data. Also, included but rare is the mystery shopping tour that an NRA can perform for example to observe the way in which shop personnel advises customers on buying mobile telephones and services.

A separate sub category is the communication with the end users in which we discern information services such as an accreditation scheme for web sites for the comparison of telephone tariffs, end user campaigns and a complaint hotline. These activities are targeted at end user empowerment to support them to make an informed choice of mobile operator and services (providers).

Some of the activities in this sub category of *Information gathering and sharing* have a repetitive character. Examples are the six-monthly reports by OFTEL or the annual reviews by the ART on the

quality of mobile services or the regular statistical analysis and reporting of end user complaints by OFTEL and OPTA.

5.2.3. Analysis

The procedural activities in the sub category *Analysis* are characterized by research that is performed or commissioned by the NRA. These activities aim at collecting data to enhance the understanding of the supply or demand side of the mobile telecommunications market. They include desk research kind of activities in which primary or secondary data analysis is at the core. These data are gathered from market research, end user or price surveys or reviews, benchmark studies or studies into end user complaints. In that sense, the *Analytical* activities differ from the *Information gathering & sharing* activities which are characterized by interaction with other parties. Activities in the sub category of *Analysis* refer to the NRA's own analytical activities to interpret data. The analytical activities are usually preceded by activities of the sub categories *Investigation* and *Information Gathering & Sharing*.

5.2.4. Third party procedural step

27% of the procedural activities within the regulatory dossiers are initiated by others than the NRA (82 out of total number of 302). We coded these properties into the sub category *Third party procedural step*. This sub category contains activities such as filing a complaint by end users and lodging a request for a dispute settlement or requesting an investigation, opinion or determination from the NRA by market parties in the mobile telecommunications sector or interest groups. Especially the number of requests for dispute settlements (18 occurrences) and complaints by market parties (36 occurrences) are prominent in this sub category¹⁷. We will come back to this in section 6.3.1.

5.2.5. Referral to other organizations

In some regulatory dossiers, the NRA was not able to execute a decision to close the dossier. In these cases, the NRA turned to another regulatory organization for *Referral of the case* (5 occurrences). This was done either because the NRA was not able or authorized to force a decision upon the market parties and subsequently had to refer the case to the NCA or because the case required an international approach and therefore was referred to the EC and/or the ERG.

5.2.6. Closing the case

Most regulatory dossiers are concluded by the NRA either by formulating an intervention (10 out of 50 cases) or by taking a decision **not** to intervene (31 out of 50 cases). In addition, sometimes a market issue is transferred into another dossier (4 out of 50 cases) (see Table 27). In 5 dispute settlement cases in the United Kingdom, the regulatory dossier was closed because the requesting market party withdrew the dispute settlement request before the NRA could come to a decision; see

¹⁷ Note that the activities by other regulatory actors are part of the category Networking Activities, see 5.5.

Box 3 for an example. This illustrates again that the activities by third parties matter, which turns the regulatory process into an interactive process amongst multiple actors involved. But it also points to the phenomenon that the regulatory process itself can be considered instrumental in solving an issue. In other words, during the regulatory process the involved parties gradually come to an agreement without the NRA having to intervene by means of enforcement.

OFTEL organized a market consultation in September 1999 on a draft direction and an explanatory document. In its draft direction, the Director General expressed his intention to apply the same tariffs as under the price cap regime, with some adjustments because of the differences in networks (GSM1800 as opposed to a GSM900 network) (OfTel, 1999g). However, before OFTEL could come to a final determination, BT, Orange and One2One came to an agreement. In December 1999 and January 2000 resp. BT accepted the terms of reduced termination charges from One2One and Orange and withdrew its requests for dispute settlements.

Box 3 Example of the withdrawal of a dispute settlement request by the initiator because the market parties come to an agreement during the regulatory process (PD27).

We coded this sub category as *Close Case*, which refers to a (provisional) closure of the market issue. We add 'provisional' because some issues re-appear on the agenda after a short or longer period of time either initiated by the NRA when new aspects emerge (see for an example Box 4) or because a market party does not agree with the closing of the case and puts it on the agenda again (which would be coded as a *third party procedural step*).

*On October 16th 1998, OFTEL received a complaint by Advanced Communications who alleged that BT Cellnet refused to supply Mobile Radio Telecommunications Services (MRTS) that are at the technical basis of supplying pre-pay services (OfTel, 1999p, case BX/663/140). OFTEL did not agree with BT's opinion and reminded BT of its licence condition to supply wholesale services to independent SPs (OfTel, 2000, point S4). BT Cellnet announced a new pre-pay wholesale product and thus OFTEL closed the dispute settlement case on September 23rd 1999 without further regulatory intervention (OfTel, 1999q). Still OFTEL continued to pursue the issue on the question of how far unbundling of the pre-pay functionality in the mobile network had to be implemented in order for independent SPs to offer pre-paid services and whether or not the costs of unbundling would outweigh the benefits of more choice for end users (OfTel, 1999q). Therefore OFTEL started a consultation process on July 27th 1999 with the publication of the document *Pre-paid mobile services and the regulatory framework* (OfTel, 1999p).*

Box 4 Example of an issue that is put on the regulatory agenda after an initial closing of the case (PD47)

5.2.7. Synthesis on procedural activities

We synthesize the previous paragraphs on the sub categories by providing the most prominent characteristics.

Procedural activities represent the majority of regulatory activities (58%) that we coded. This indicates that regulatory practice is foremost a procedural approach to dealing with market issues. The procedural activities are chosen case by case as the majority of the market issues do not fit with a standard approach. This does not apply to a limited number of rather straightforward dispute

settlement cases and continuous/repetitive activities such as market reviews and regular reports on the quality of services and end user complaints. During the process, the NRA applies a mix of consecutive procedural activities, in which repetition of activities from the same sub category may occur. The regulatory dossiers range from short (about one month of throughput time) to long duration (which can extend over several years).

The NRA is not the only actor that undertakes procedural activities, the dossiers show that end users, market parties (MNOs and SPs), interest groups and other regulatory authorities play a role too. This leads to an interactive, exploratory process in which information is shared and analyzed in interaction with other actors. Towards the end of the dossier, the NRA communicates its decision for an intervention or for refraining to intervene in the market (see the section on *Category: strategic activities*). However, the market parties themselves can also withdraw their request for dispute settlement or their complaint when they come to terms with one another amongst themselves before the NRA takes a decision. The latter indicates that the regulatory process can be instrumental itself in solving a market issue.

Furthermore, our open coding process of the empirical data shows that, although the regulatory practice is predominantly led by the NRA, the activities of third parties should also be taken into account. These third parties are market parties, end users, interest groups and other regulatory organizations such as the EC, the national Ministry, or the NCA. This shows that NRAs operate within a network of actors that are involved in the regulatory process. These actors can perform several roles, from being the initiator of a case, to a discussion partner or source of information during the regulatory process, to being the alternate authority and the challenger of NRA decisions or the NRA authority.

By means of open and selective coding we developed the category *Procedural Activities* (see Table 27). In the next section, we turn to the category of *Enforcement Activities* that are the result of the procedural activities.

5.3. Category: enforcement activities

The *Enforcement Activities* represent the decisions that the NRA takes to deal with a market issue. They are preceded by the *Procedural Activities* to analyze the issue at hand (see section 5.2) and to explore the choice for a type of enforcement activity that needs to fit with the character of the relevant market issue and the intended effect of enforcement (Ubacht, 2016).

In the open coding phase, the *Enforcement Activities* represent 121 of the 525 coded activities, which is 23% of all activities (in comparison: the procedural activities represent 58% of all activities, see section 5.2).

Table 32 The sub categories and their occurrences in numbers and % within the category *Enforcement Activities*

Category: Enforcement Activities	Sub Categories	No of occurrences	Percentage of occurrences
Section 5.3.1	Persuasion	8	7%
Section 5.3.2	Monitoring	17	15%
Section 5.3.3	Behavioral directions	58	44%
Section 5.3.4	Financial regulation	25	23%
Section 5.3.5	Penalties	5	5%
Section 5.3.6	Licence adaptation	7	6%
	Total	120	100%

In the following paragraphs the sub categories of the category *Enforcement Activities* are described: *persuasion, monitoring, behavioral directions, financial regulation, penalties* and *licence adaptation*, see Table 32. After the descriptions, we offer a synthesis on the *Enforcement Activities* in section 5.3.7.

5.3.1. Persuasion

The sub category *Persuasion* relates to the least intrusive type of enforcement: a conversation that an NRA has with market parties, or a reminder of licence obligations or a form of mediation within a dispute settlement case. An example of a case in which mediation as property of the sub category *Persuasion* is applied, is given in Box 5.

In numbers the sub category *Persuasion* ranks low as only eight occurrences were found and coded as such, this represents only 7% of all enforcement activities. We include them in awareness of the limitations of our research method of formal document analysis. We assume that persuasive activities are applied more often but are not consistently and formally reported upon in public documents, which prevents us from coding them.

In March 2001 Orange requested OFTEL for a determination on the routing of inbound international traffic via the BT network (Orange versus BT, case CW/00401/03/01). Orange claimed to have the ability to choose itself between the international Concert switch or BT's tandem exchange (the Digital Main Switching Unit, DMSU). After OFTEL mediation between the two operators, Orange withdrew the case in July 2001.

Box 5 Example of persuasion (UK, PD32 routing of inbound international traffic)

5.3.2. Monitoring

Under the sub category of *Monitoring* we coded and grouped the enforcement activities that the NRAs take to ensure compliance with the regulatory framework (such as adhering to rules in practice; performance indicators or quantitative measures) or to encourage the continuation of a process of the implementation of regulatory rules. We coded for 17 occurrences, which represents 14% of the sub category *Enforcement Activities*.

These monitoring activities are characterized by the presence of a regulatory framework that leaves room for interpretation in practice. The NRA chooses for monitoring activities to leave room to the

market parties to explore and/or to come up with their own interpretation of how to comply. The market parties do so with the knowledge that non-compliance or unsatisfactory compliance in the eyes of the NRA will lead to other enforcement activities (see Box 6 for an example)

In the July 2001 directive OPTA concluded that a heavy financial enforcement instrument like the penalty on a daily basis was no longer proportionate to guarantee a good number porting process and withdrew the penalty stipulation. However, OPTA also decided to continue to use the quality parameters for mobile number portability as set up earlier and stated that operators had to be able to report on the percentages of ported numbers per month in order to continue the monitoring of the pass rates.

Box 6 Example of *monitoring* activities by an NRA (NL, PD2 mobile number portability).

A specific kind of monitoring activity is issuing a provisional order or threatening to issue a final order. The NRA uses these orders to see whether a market party is able to come forward with their own interpretation to comply with rules. If not the consequence of a final order will be applied by the NRA.

5.3.3. Behavioral directions

Approximately 49% of the *Enforcement Activities* is formed by the sub category *Behavioral Directions* that the NRAs formulate in regulating the mobile market (58 occurrences were coded as such, see Table 32). *Behavioral Directions* are usually directives for market parties to directly comply with and contain clearly defined criteria. In addition, the more indicative policy guidelines fall within this sub category and a small number also refers to directions for own functioning of the NRA within a market issue. In summary, within sub category of *Behavioral Directions* we discern four types of directions that differ in their goal-orientation and their general or more specific applicability.

Within this sub category *Behavioral Directions*, directives for market parties (26 occurrences) and policy guidelines (16 occurrences) are the most important ones: they account for 45% and 28% of the *Behavioral Directions* respectively. Designation as having Significant Market Power (SMP) or Market Influence (MI) (10 occurrences) is 17% and the Decisions on NRA procedures (6 occurrences) rank lowest by 10% within the sub category of *Behavioral Directions* (see Table 28). In the following paragraphs these four properties are explained.

Directives for market parties

The property *directives for market parties* has 26 occurrences, which accounts for 45% of the *Behavioral Directions*. They represent the type of enforcement that is directive/prescriptive in nature towards market parties. The NRA interprets the regulatory framework and formulates the indicators to which the market parties have to adhere to. The source for directions to market parties is mainly EU directives that need to be transposed into the regulatory framework or the rise of a new technological or service innovation (e.g. providing unbundled interconnection or supporting the implementation of mobile number portability) that requires regulatory support to be accessible for all market parties and not the dominant ones only). The directives are meant to make the market parties adapt specific parts of their strategy. They include deadlines for compliance and in case of non-compliance, the market party/parties will be held accountable by the NRA. This is in contrast to the *Monitoring* type of enforcement activities, that allows room for the market parties to explore

and interpret formal rules themselves before putting them into practice (albeit with the possibility of regulatory enforcement if they do not (sufficiently) comply).

These *directives for market parties* can be fine-tuned to influence single market parties (e.g. only one MNO has to comply), a subset of market parties (e.g. only the MNOs with SMP or MI have to comply) or all market parties (e.g. all MNOs have to comply). In addition, directives range from relatively light weight interference in business models towards directives that have a potentially profound effect on the market structure. The directives with a profound effect are the type of behavioral directions that take long in the making; an example is given in Box 7.

Although OFTEL was inclined to put more faith in the ability of network competition for reducing the mobile retail prices than on the direct intervention of obligatory introduction of indirect access, it did choose for a mandatory arrangement in December 1999 (OfTel, 1999s). The two mobile networks with significant market power (at that time: BT Cellnet and Vodafone) became obliged to grant indirect access. The terms and conditions for indirect access had to be reached through commercial negotiations. In case the parties did not reach a satisfactory arrangement, OFTEL would take the retail-minus arrangement as leading principle in dispute settlement. This meant that the service was to be charged at retail prices, minus the elements of the retail service that the operator will substitute for those of the network operator. These are the costs for routing, marketing, billing, purchasing of conveyance and termination of calls. All so-called Annex II of the ICD-parties obtained the right to negotiate with the operators with significant market power to obtain this form of access. The decision did not require any modifications to the mobile licences but was implemented through a Directive under the Interconnection Regulations. So, for the time being OFTEL decided against mandatory indirect access for all mobile networks, but if mobile retail prices were not to go down (subject to yearly monitoring of the market), OFTEL would reconsider this statement on indirect access.

Box 7 Example of a directive with profound consequences as it changed the mobile market structure (OfTel, PD40, Introduction of indirect access)

Policy Guidelines

The property *policy guidelines* has 16 occurrences, which accounts for 28% of the *Behavioral Directions*. By formulating *policy guidelines* the NRAs offer their own interpretation of the legal framework in more general terms, along broader lines than the *Directives to market parties*. In the United Kingdom these are often called *statements*; in the Netherlands, they are called 'beleidsregels'. As such they offer guidance for later decisions in specific cases or for the way the NRA organizes its own regulatory process in dealing with upcoming cases. *Policy guidelines* differ from the *directives for market parties* in the fact that the latter are more specific and enforced in case of non-compliance (see above), whereas *policy guidelines* are more general in character. In Box 8 an example of the use of policy guidelines by ART is given.

On May 11th 2001 the ART issued policy guidelines on mobile interconnection for Mobile Network Operators with Significant Market Power on the national market of interconnection (ART, 2001d). On the basis of these guidelines, the ART started to examine the interconnection tariffs of these Mobile Network Operators with Significant Market Power.

Box 8 Example of the role of a policy guideline (ART, PD60, Fixed to MTTs)

Designation as Significant Market Power (SMP)/having Market Influence (MI)

The property *Designation as Significant Market Power (SMP)/having Market Influence (MI)* has 10 occurrences, which accounts for 17% of the *Behavioral Directions*. The *designation of a market party with Significant Market Power or as having MI* is a particular type of behavioral direction which influences the status of MNOs in the market. An MNO which is deemed to have SMP or MI will fall under a separate regime with detailed rules that aim at leveling its dominant market position in order to protect the position of the operators without SMP or MI and (independent) SPs. At the start of a newly competitive market, the latter ones are operators and SPs that have newly entered the mobile market that is already served by the operator(s) with SMP or MI. In a later phase when competition is growing, the SMP or MI designation is no longer preserved for formerly dominant operators; new entrants can also become dominant in a specific mobile services market segment.

In all three countries, the incumbent and first new entrants were at least once designated as having SMP or MI in the mobile services market or in a particular segment of that market. (Vodafone & BT Cellnet in the United Kingdom, KPN and Libertel in the Netherlands and France Telecom/Orange and SFR in France). In Box 9 the example of the designation of SMP in France is presented.

On September 15th 1999 the ART determined that France Télécom and SFR had SMP in the mobile retail market. Both operators had market shares between 35 and 45% (ART, 1999g). This obliged France Télécom and SFR "to meet all reasonable requests for access to the network including access at points other than the network termination points offered to the majority of end-users" (European Parliament and the Council of the European Union, 1997b).

Box 9 Example of the designation of a market party with SMP (ART, PD60, Fixed to MTTs).

Decision on NRA procedures

The property *Decision on NRA procedures* has 6 occurrences, which accounts for 10% of the *Behavioral Directions*. These decisions relate to the regulator's own functioning. The *decisions on NRA procedures* represent the interpretation of the regulatory framework on its own role or stance within a regulatory dossier. For example, a decision on NRA procedures explains how the NRA will deal with confidential information within dossiers (see Box 10), or about proclaiming a complaint to be not sustainable on the basis of the regulatory framework (see Box 11). This type of decisions actually determines the space for its own acting. They are communicated to the public by means of issuing a directive/decision, as illustrated by the example of the ART in Box 10 and the example of the OPTA in Box 11.

In May 2000, the ART published a decision explaining which guidelines it would apply in disclosing information from interconnection agreements to interested third parties, especially focusing on how it will deal with confidential material (ART, 2000e). If a party with SMP is involved in the interconnection agreement, then, according to directive 97/33/EC: “[i]n every case, details of interconnection charges, terms and conditions and any contributions to universal service obligations shall be made available on request to interested parties” (European Parliament and the Council of the European Union, 1997b, art. 6c). So the ART decided to communicate these details if one market party involved has SMP.

Box 10 Example of a Decision on NRA procedures (ART, PD53, Equality of MTTs for international and national calls)

On the basis of the Telecommunication Act, OPTA came to the conclusion that KPN Mobile was only obliged to negotiate for access to its network, but that the legal rules did not apply to the charges. In other words: the charges were not subject to any formal rules, but subject to commercial negotiations. Therefore, on October 24th 2000, the Commission of OPTA decided that the complaint was not sustainable (OPTA, 2000c).

Box 11 Example of a decision on NRA procedures on the unsustainability of a complaint (OPTA, PD14, Wholesale terms and conditions)

5.3.4. Financial regulation

The sub category *Financial Regulation* is created on the basis of the coding for instances of wholesale and retail tariff regulation in the regulatory dossiers (in total 25 occurrences were coded, which accounts for 21% of the category *Enforcement activities*). Within *Financial regulation*, we discern two properties:

- wholesale tariff regulation where the tariffs that market parties calculate for delivering services to each other are concerned, as well as
- retail tariff regulation, in which the prices that end users pay for services to their mobile providers are concerned.

In a sense, the *Financial regulation* activities are a special case of *Directives for market parties* (see paragraph 5.3.3), but because of their character in enforcing detailed measures for (wholesale and retail) tariffs and in the case of wholesale the intention to leverage the position of players in the market for an extended period of time, we decided to group them into a separate sub category.

Both types of regulation require an extended process for determining the issue, exploring an approach and, once a decision to use financial regulation is taken, discussions on the regulatory decision follow. Predominantly the regulation of tariffs is applied for at least one year, but often also to a more extended period of time, especially in the case of price cap regulation. In the next paragraphs, we take a closer look at these two properties of *Financial Activities*.

Wholesale tariff regulation

The NRAs use wholesale tariff regulation (17 occurrences, 14%) as a means to influence the (unequal) relationships between competitive market parties. More specifically it is used to leverage the position of new entrants as opposed to incumbent or dominant MNOs. This wholesale tariff regulation is mainly used within the dossiers in which the fixed to MTTs and mobile interconnection

were handled. The specific measures are addressed to the dominant operators in the market (see 5.3.3) to leverage their market dominance by putting limitations on their calculations for tariffing services to their competitors.

Occasionally all MNOs are addressed within the same regulatory intervention e.g. by means of an overall price cap regime to lower the mobile termination prices amongst all operators (see Box 12) or a communal raise in international termination tariffs with foreign operators (see Box 13).

The *wholesale tariff regulation* is applied to determine:

- the timing conditions for tariff changes by MNOs e.g. forcing to lower or allowing to surcharge quicker than previously stated (see example in Box 12);
- tariffs calculations for mobile national & international termination tariffs (see example in Box 13) and
- tariffs calculations for mobile interconnection (see Box 14).

As part of the EC investigation and responding to a request from the European Commission, OPTA started an investigation into the fixed to mobile retail tariffs in September 1998 (OPTA, 1998a) (OPTA, 1998a). In November 1998 OPTA issued a decision with a financial regulation, stating that KPN had to adjust its fixed to mobile end user tariffs if call termination tariffs were lowered, at any time (OPTA, 1999, section 1.1).

Box 12 Example of the application of wholesale tariff regulation, on the timing conditions for tariff changes by MNOs (OPTA, PD4, MTTs)

The ART not only applied the principle of cost orientation, it also introduced a subsequent mechanism of price cap regulation on the two MNOs with SMP, Orange and SFR (ART, 2001f)(ART, 2001g). For the principle of cost orientation, the ART concluded that the average termination tariffs of all calls from national fixed networks terminating on the Orange and SFR networks should not exceed 1.32 French francs per minute (0.20123 euro) by March 1st 2002. This maximum average termination tariff would only be applied as long as the two operators continued to be deemed operators with SMP for the year 2002. The tariff was valid until December 2002. Furthermore, the ART introduced a long-range price cap plan by setting the average termination tariffs for 2003 and 2004 in the same decisions(ART, 2001f, 2001g).The corresponding maximum average termination tariffs were 1.12 French francs (0.17074 euro) for 2003 and 0.98 French francs (0.14940 euro) for 2004. The ensuing price reductions would be 15% between 2001 and 2002, 15% between 2002 and 2003 and 12.5% between 2003 and 2004. Thus, a total reduction of 40% in three years' time. By introducing a long-term tariff regulation, the ART wanted to diminish the uncertainty about these tariffs in the market (ART, 2001f, 2001g).

Box 13 Example of the application of wholesale tariff regulation, on the tariff calculations for mobile national termination tariffs (in combination with the concept of SMP) (ART, PD60, Fixed to MTTs)

OFTEL chose for option 1, therewith stating that each mobile network operator is a monopolist in the market for mobile termination on their own network. In September 2001 OFTEL proposed a price cap regime on MTT for four years for all mobile network operators. The price cap was to be set at RPI-12% from March 2002 until March 2006. However, three of the mobile network operators publicly objected to the proposal, so OFTEL had to refer the case to the Competition Commission (the former MMC).

Box 14 Example of the application of wholesale tariff regulation, on the interconnection tariffs amongst MNOs (OfTel, PD18, MTTs).

In doing so the NRAs used the following wholesale tariff principles:

- formulating conditions for tariff changes (see example in Box 12).
- applying cost orientation & non-discrimination principles (e.g. maximum average tariff), usually this measure is linked to the designation of SMP or MI; (see example in Box 13)
- developing a price gap regime, entailing reductions in tariffs over time (see examples in Box 13 and Box 14);
- setting charges for administrative processes to support e.g. number conveyance in the technical and administrative process to support mobile number portability amongst operators (see example in Box 15).

Before the formal introduction of mobile number portability on the 1st of January 1999, OFTEL received the first requests for dispute settlement. These requests came from the smaller mobile network operators One2One and Orange in December 1998 and were both complaints against the well-established operators Cellnet and Vodafone. Main points of disagreement were the (sharing of) charges for Donor Conveyance, the Porting Administration and the Termination Rates for ported traffic. Subsequently, on November 25th 1999, OFTEL set the charges for Donor Conveyance at 1.6 pence per minute, to be shared equally between the donor and recipient operator (OfTel, 1999m, 1999o, 1999f).

Box 15 Example of using wholesale tariff principles for setting charges for administrative processes (OfTel, PD16, Mobile number portability)

Retail tariff regulation

By means of *retail tariff regulation*, the NRA focusses on the interests of the end users. *Retail tariff regulation* is not often used, as *wholesale tariff regulation* comes first in line when NRAs consider to intervene in tariffs. In cases in which wholesale tariff regulation does not sufficiently contribute to regulatory goals, regulation of the retail tariffs is considered an option¹⁸. Only in those instances in which the interest of the end user needs to be addressed in a more direct way, the NRAs turn to regulate (aspects of) the retail tariffs. This results in the observation that retail tariff regulation can be combined with wholesale tariff regulation within the same dossier, but this is not a precondition.

¹⁸ An example of this type of sequencing appeared in the fixed to MTTs case in the Netherlands (PD4). OPTA initially addressed the fixed to MTTs by means of wholesale regulation, but later issued a retail tariff regulation for all mobile (virtual) network operators (OPTA, 2002a).

If from the analysis of the dossier it turns out that wholesale regulation will not be sufficient, then retail regulation could also be applied directly, without a first phase of wholesale regulation.

In contrast to *wholesale tariff regulation* which is predominantly used for market parties with market dominance, *retail tariff regulation* is predominantly applied to all MNOs in the market alike.

We coded 7 occurrences of *retail tariff regulation*, which accounts for 6% of the *Enforcement Activities*. This indicates that this intervention is relatively limited in use. But once used they have a considerable impact on the business model of the market parties to which the regulation applies. An example of retail tariff regulation by the ART is presented in Box 16.

The facts made the ART formulate the following aims:

1. “[To] bring down prices charged for calls to mobiles, in the interests of consumers;
2. [To] combat international rerouting, which is artificial and economically unhealthy;
3. [To] safeguard mobile operators’ economic equilibrium, which is still fragile;
4. [To] take into account the differences, particularly in structure and life-span, between the three mobile operators, in order to maintain fair competition conditions” (ART, 1999j).

To reach these aims, the ART suggested a first reduction in retail prices of 20% by October 1st 1999. It was up to the mobile network operators to set a timescale and to make arrangements to do so. The ART was to evaluate their steps in March 2000 for a new reduction in the summer of 2000.

Box 16 Example of retail tariff regulation (ART, PD60, Fixed to MTTs)

In addition, retail tariffs in the mobile number portability process were addressed in order to limit the switching costs of end users when they wished to switch from one operator to another, see Box 17.

In its decision, the ART mentioned that: “L’Autorité a veillé à ce que le droit à la portabilité puisse être effectivement exercé par la consommateur, et donc à ce que la Portabilité des Numéros Mobiles soit accessible au plus grand nombre, dans le cadre de règles simples, précises et communes, à des tarifs non dissuasifs” (ART, 2002b, p. 5). Therefore, the ART stipulated that only administrative and technical costs that were directly evoked by the process of mobile number portability could be invoiced to the end user.

Box 17 Example of retail tariff regulation: setting a maximum on switching costs (ART, PD50, Mobile number portability)

5.3.5. Penalties

Penalties are used in the form of either a definite fine or as a preliminary fine under specific conditions: if a market party does not comply with a rule within a limited period of time, then the fine will be executed (this is a *penalty on a daily basis*). *Penalties* differ from the sub category *financial regulation* in its character of its one off application. Although during our research only the OPTA in the Netherlands applied it in one dossier only (PD2, the introduction of mobile number portability) we include it as a sub category of the *Enforcement Activities*. Our substantiation to do so is in order to indicate that a penalty or a penalty on a daily basis is also a means for enforcing compliance with regulation and as such can be part of regulatory practice. With only 5 instances

coded, the sub category *penalty (on a daily basis)* accounts for 4% of the category *Enforcement Activities*. An example is given in Box 18.

...The Steering Committee on number portability (in which the main Dutch operators KPN, Telfort, Libertel, A2000 and EnerTel participated) claimed by letter to OPTA on the 29th of December 1998 not to be able to have the inter-operator communications network for the transfer of numbers ready by that date. After some debate, OPTA allowed a postponement until April 1st 1999, but also imposed a penalty on a daily basis in case of non-compliance of Dutch guilders 10.000, which is approx. 4.500 Euro (with a maximum of Dutch guilders 250.000; approx. 113.500 Euro) (OPTA 1999m).

Box 18 Example of a penalty on a daily basis (OPTA, PD2, Mobile number portability)

5.3.6. Licence adaptation

Seven times a *licence adaptation* was used to change the conditions under which the MNOs were operating (6% of the *Enforcement Activities*). The use of the *licence adaptation* as a regulatory intervention is country-dependent. Whereas the OPTA uses decisions to change the conditions, especially OFTEL needed to use the route of licence adaptation to implement new rules such as the implementation of the EU Directive for *Interconnection & Interoperability*, or such as the introduction of mobile number portability or a price cap and price monitoring regime.

In the cases in which the transposition of an EU Directive into national legislation plays a role, the licence adaptation is done *indirectly* by means of a change in the national Telecommunications Act. Direct adaptations to licences (conditions) were subject to debate, as (in the case of OFTEL) the MNOs had to agree with the adaptation upfront. As licence adaptations were considered in the dossiers with a high impact on the market (players) such as the introduction of mobile number portability, a price cap regime or mandatory roaming obligations, they were subject to an extended period of regulatory activities before they could be introduced. This is illustrated by the example in Box 19. This example also shows that in these cases the authority of an NRA or the Ministry can be legally contested by the market parties. This makes the licence modification a rather inflexible intervention that requires a long process of implementation.

After the market consultation period on the introduction of a licence condition for mandatory roaming, OFTEL issued a Statement on National Roaming in July 1999 in which the final licence condition was presented (OfTel, 1999g, Annex A). Subsequently OFTEL asked the 2G operators for their consent to include this new national roaming condition into their licence on August 20th 1999 (OfTel, 1999f, point 1.2). Some minor changes to the text of the new licence conditions and to the guidelines led to a revised version of the Statement on National Roaming in October 1999 (OfTel, 1999k).

Also in August 1999 One2One took DTI to court on the precondition of mandatory national roaming as an entry requirement for bidding during the 3G auction, with Orange supporting this legal challenge (Clark, 1999b). One2One pledged that "OfTel's mandating a license change was not in accordance with the 1984 Telecommunications Act" (Clark, 1999a). On August 6th 1999, the High Court ruled that the enforcing character of the proposal to modification of the licences was indeed "unlawful as it ignored existing rights to appeal this decision" (Clark, 1999a). DTI went for appeal on the Court decision. In October 1999, the Court of Appeals ruled that DTI was in its right to make mandatory national roaming a precondition for the four existing mobile network operators to enter the 3G auction.

McMillan reports that Vodafone and BT Cellnet voluntarily accepted the proposed licence modification on national roaming in October 1999, but Orange and One2One refused (McMillan, 1999). As DTI was satisfied that the acceptance by two mobile network operators sufficed to guarantee national roaming to a new 3G entrant, it no longer pursued acceptance by the other two mobile network operators.

Box 19 Example of a direct licence modification for the introduction of licence conditions related to mandatory roaming, including an example of the contestation [OFTEL, PD30, national roaming/mobile coverage)

On the other hand, the licence adaptation can also be used to lift detailed regulation, e.g. by making a licence condition dormant, which can be part of the intention of a regulator to scale down detailed regulation as can be seen in the example in Box 20.

In April 1998, in a general trend to withdraw detailed regulation of the mobile networks, the DGT modified the Orange and Mercury One2One licences (OfTel, 1998c). The licence modification meant that these two operators were no longer obliged to provide for resale, as long as they were not considered to have market power. A transitional period secured the already established position of the SPs on these networks for one more year.

So, from May 1999 onwards Orange and Mercury One2One were allowed to show preference for their own services and to discriminate between SPs requesting for resale airtime. However, if the DGT were to appoint Orange and/or Mercury One2One as Well Established Operator or, after September 1999, as having Market Influence in a relevant market, these dormant licence conditions could again be applied (OfTel, 1997e). By making the licence conditions dormant instead of removing them from the licences, DGT remained authorized to investigate cross subsidies, also in the case of mobile network operators who were not considered to have market dominance.

Box 20 Example of the use of a direct licence modification aimed at lifting a regulatory condition (OFTEL, PD39, administrative access for SPs)

5.3.7. Synthesis on enforcement activities

We synthesize the previous paragraphs on the sub categories of the category *Enforcement Activities* by providing the most prominent characteristics.

Coding of the regulatory dossiers shows that *Enforcement Activities* are far from solitary actions. In most dossiers, the enforcement is not limited to one action, but rather the result of an exploratory approach which entails a sequence of *Procedural Activities* before the decision to choose and use an *Enforcement Activity* is taken. The exploratory approach is an interactive process in which market parties are consulted before a final decision is taken. Especially in the case of tariff regulation and licence adaptations (but not exclusively so), the process can take an extended period of time.

Also, a dossier can be prolonged because there is uncertainty on the authority of the regulator to act. In those cases, its authority is questioned or decisions are contested, and even legal means to prevent application are used by market parties that take the regulator to court (for an example: see Box 19).

The dossiers show that the NRA has room to explore and interpret laws and regulation and can allow the initiative to the market parties to fill in before taking the lead. Sometimes the NRA will limit its own room for interpretation or decisions by issuing a *decision on NRA procedures* to create clarity or transparency in its own envisaged actions.

From the coded dossiers, it becomes clear that enforcement is not only done at or towards the closure of a regulatory dossier. In practice, procedural and enforcement activities alternate during the entire lifespan of a regulatory dossier.

Regularly a dossier that seems to be closed is reopened again, either because the NRA decision is challenged or because the enforcement does not fully solve the issue or because new information arises. The consequence is that the NRA reinitiates procedural activities that will lead to an enforcement activity or the NRA continues to search for an alternative enforcement activity, or decides to refer the case to another regulatory player.

By means of open and selective coding we developed the category *Enforcement Activities* (see Table 28). In the next section, we turn to the category of *Strategic Activities*.

5.4. Category: strategic activities

In the category of *Strategic Activities*, three sub categories can be discerned that present the options for a regulatory authority to refrain from a top-down regulatory approach in solving market issues. Instead the regulator can consider one of the following three alternative options (Ubacht, 2016):

First, in the case of *enforced co-regulation*, the regulator urges the industry to collaborate towards a solution under the threat of a possible top-down regulatory intervention if the envisaged results or objectives are not attained by a co-regulatory approach amongst the market parties themselves. 18 Occurrences of enforced co-regulation were found in the empirical data.

Second, the regulator can refrain from intervention by choosing to *rely on market forces* to solve the issue at hand. We found 13 occurrences of this property *reliance on market forces*, which means that

the NRA expects that the dynamics of the regulated market itself will provide a market-based solution to deal with the issue.

Third, *self-regulation* refers to those cases in which the market parties themselves pro-actively offer a solution and take their responsibility to develop the solution to the market issue. A form of self-regulation was found 15 times in the dossiers.

Table 33 The sub categories and their occurrences in numbers and % within the category *Strategic Activities*

Category: Strategic Activities	Sub Categories	No of occurrences	Percentage of occurrences
Section 5.4.1	Enforced co-regulation	18	39%
Section 5.4.2	Reliance on market forces	13	28%
Section 5.4.3	Self-regulation	15	33%
	Total	46	100%

In total, we coded 46 occurrences of the category *Strategic Activities*, which accounts for 9% of all regulatory activities (see Table 26). In Table 33 the sub categories of *Strategic Activities* are presented. In the following sections, we describe the three sub categories that emerged from the empirical data.

5.4.1. Enforced co-regulation

An *enforced co-regulatory approach* entails that the NRA can collaborate with market players and other organizations such as consumer organizations to formulate a solution to deal with an issue. The NRA takes the lead and is actively involved in the process towards a co-regulatory arrangement and uses the threat of legal action (see Box 21) or financial consequences if goals are not met by means of co-regulation (see Box 22). We coded 18 occurrences of a co-regulatory approach in the empirical data, which accounts for 39% of the Category *Strategic Activities* (see Table 33).

The form in which the co-regulatory approach materializes can be a code of practice (in e.g. the case of interoperability issues), a so-called common approach (in e.g. the case of removal of the SIM lock policy), or an industry wide (technical) protocol for implementation (in cases such as enabling mobile number portability and carrier pre-selection). Often an industry wide policy group or working groups of different actors are set up to work out the co-regulatory approach (see Box 23 for an example of the implementation of an industry policy group developing an industry wide procedure).

The data show that this way of working is done in cases in which communal action is required to potentially increase the overall telecommunications system performance and/or to raise the degree of competitiveness in the market. For example:

- technical issues need to be taken care of in the case of interconnection & interoperability (e.g. for the implementation of carrier pre-selection);
- mobile number portability needs to be implemented which requires cooperation amongst MNOs (e.g. for the conveyance of numbers);
- or the implementation issues of applications like the jamming of mobile signals in locations of public performances need to be explored.

In addition, a common approach can also be required when a single operator cannot take the first step without having the confidence that competitors will follow. This was the case in France in which the NRA wanted the MNOs to cooperate in covering the unexploited GSM-areas to extend the availability of mobile services, and in the United Kingdom in which the NRA wanted the MNOs to remove the SIM lock on telephones. These are examples of situations that require common action to remove the risks of a singular market player to be the only one taking action, or of being the first (and potentially the only one) taking action and consequently experiencing a negative impact on its competitiveness in the market. This may result in an impasse, which an enforced co-regulatory approach can solve.

From May 2001, onwards mobile network operators started to lower handset subsidies. This strategy was inspired by the higher penetration of mobile telephony as the battle for new users was shifting to the battle for existing users. With lower subsidies, the rationale for SIM locking was gradually vanishing. In that period, OFTEL proposed a co-regulatory approach to remove SIM locking altogether. Part of this was securing a common approach, because a solitary action by a single mobile network operator was not an option. In the meantime, OFTEL was still concerned that mobile network operators did not adequately adhere to the 1998 Guidelines on SIM locking. Whereas OFTEL proposed a co-regulatory approach, it did not preclude legal action if the mobile network operators persisted to disregard the Guidelines (OfTel, 2001, annex 3).

Box 21 Example of an NRA working towards a co-regulatory approach with the threat of legal action if goals are not met (OFTEL, PD17 SIM Lock)

*In October 1997, the ART issued a *Décision* in which it was mentioned that the MNOs had agreed to cover the unexploited GSM areas (ART, 1997a). In order to do so they would enter into an agreement with a satellite operator as soon as this was technically possible. Their end users would then be able to roam on satellite networks in the uncovered areas. Also, the MNOs together would work out the conditions for sharing infrastructure in order to limit the costs of roll out. The ART supervised this process of enforced co-regulation. As long as the MNOs kept to their mission of roll out, they would be exempted from paying additional interconnection tariffs during the period of tariff rebalancing (ART, 1997a).*

Box 22 Example of an NRA working towards a co-regulatory approach with the threat of financial consequences if goals are not met (ART, PD61, Infrastructure sharing 2G)

The three mobile network operators (GSM Bouygues Télécom, Orange France and SFR) formed the Groupe Portabilité Mobile to develop an industry wide procedure for the implementation of mobile number portability.

Box 23 Example of the implementation of an industry wide policy group developing an industry wide procedure (ART, PD50, Mobile number portability)

5.4.2. Reliance on market forces

Not in all regulatory dossiers, the regulatory authority will choose for an enforcement activity as a means of intervention or solving an issue. The NRA can also explicitly *rely on market forces* to solve the market issue at hand. We coded 13 occurrences of this option, which accounts for 28% of the category *Strategic Activities* (see Table 33).

One property of *Reliance on market forces* is the *lifting of regulatory obligations* for compliance. This is done at the moment that the market is deemed sufficiently mature to be acting competitively and no special safeguards are necessary anymore for the market players to comply with in accordance to regulatory objectives. Although only 3 occurrences were found, we deem these coded instances as important as they hint towards the fact that regulatory practice goes through phases that requires different regulatory approaches. These occurrences of *lifting regulatory obligations* can be an indicator of a new phase in which top-down regulation is gradually being replaced by reliance on market forces. An example can be found in Box 24 in which OFTEL decided to lift the designation of MI.

The DGT considered all four mobile operators as well established now and did not expect that removing the MI determinations would lead to less competition at the retail level. Neither did the DGT foresee a full vertical integration in the mobile sector. If, after lifting the MI determinations, Vodafone and BT Cellnet would engage in anti-competitive practices again, the DGT expected to be able to use other regulatory mechanisms to deal with this, either by using licence conditions or by applying the Competition Act 1998 (OfTel, 2002, point 5.44). Moreover, the licence conditions 56-58 that contained the dormant MI trigger remained in the licences. So the DGT could always reapply them. Subsequently, the MI designations on Vodafone and Cellnet were lifted on April 5th 2002.

Box 24 Example of reliance on market forces by lifting regulatory obligations (OfTel, PD39, General framework for mobile service provision)

Another property of reliance on market forces is *forbearance of regulatory intervention*, which stands for those cases in which a regulator, for the moment, refrains to intervene. From the empirical data it appears that this takes place in two types of cases:

- especially in cases with a high level of uncertainty because of lacking insight into technical details or uncertain demand for services, the regulator is hesitant to formulate formal/general regulation and chooses to await the behaviour of the market parties before taking position (see example in Box 25);
- but also in dispute settlement cases in which no evidence of the breach of a licence or anti-competitive behaviour can be determined, the regulator can choose to forbear from regulatory intervention, sometimes with the expectation that the market competition will increase and/or with the foresight that regulation will be enforced once this is not the case (an example is given in Box 26).

As far as carrier pre-selection (choice of carrier per call) was concerned, OPTA indicated in the same consultation document that it needed more technical details and more insight into the demand for this kind of service (OPTA, 2001, point 134). Therefore, OPTA for the time being refrained from regulatory intervention. OPTA expressed doubts on the impact of carrier pre-selection on a mobile market in which five MNOs were already active. At the end of our period of data collection, mobile carrier select was still not offered in the Netherlands.

Box 25 Example of forbearance of regulatory intervention in case of uncertainty (OPTA, PD10, Introduction of indirect access)

In the discussion on special access to mobile networks, OPTA basically limited the category of services based on roaming to the concept of Mobile Virtual Network Operators (MVNO). The fact that prior to the consultation document an MVNO entered the mobile market following commercial negotiations (Tele2 became an MVNO on the Telfort network on August 24th 2001) made OPTA reluctant to install any formal policy guidelines on this type of special access networks, as expressed in its consultation document of November 2001 (OPTA, 2001, point 140). Therefore, OPTA refrained from regulation, however, if any dispute settlement was needed, OPTA would use the criteria for reasonableness as used in the case of value added services.

Box 26 Example of forbearance of regulatory intervention with foresight of future enforcement (OPTA, PD12, Services based on roaming)

5.4.3. Self-regulation

The sub category *Self-regulation* differs from *Enforced Co-regulation* mainly in the role of the NRA in the development of the regulatory arrangement. Although the NRA encourages market parties to choose for a form of self-regulation, it does not actively play a role in the formation of the self-regulatory arrangement such as in the case of co-regulation. Still, the route towards self-regulation is taken after the NRA has formed an opinion on a case and encourages the market parties to turn to self-regulation. Sometimes this is grounded in the fact that the NRA is not able or authorized to apply a formal regulatory intervention or it is grounded in a common interest in taking up a shared responsibility amongst the market parties in order to avoid detailed regulatory intervention in business processes or prices.

We found 15 occurrences of self-regulation, which accounts for 33% of the category of *Strategic Activities*, see Table 33. The dossiers in which self-regulation is encouraged range from the issues on infrastructure sharing (antenna & site sharing), number portability (see Box 27) to the pricing strategies (such as the one minute start-up fee in France) and to consumer oriented interests (such as improving the transparency of mobile retail prices, or a code of conduct on sending commercial SMS messages, see Box 28).

The telecommunications providers by that time had already, without any OPTA intervention, drawn up a standard contract for number portability (OPTA, 2001b). All fixed and mobile telecommunications operators signed this standard contract ('Standaardovereenkomst Nummerportabiliteit') which was also the juridical basis for their joint infrastructure for number porting, called COIN (COMmon INFrastructure) (OPTA, 2003).

Box 27 Example of self-regulation: a cross-industry contract (OPTA, PD2, Mobile number portability)

The primary goal of the OPTA investigation was to judge which procedure should be applicable to SMS-spam (OPTA, 2001i). During the investigation, the market players started an initiative to design a Code of Conduct for the sending of commercial SMS messages.

Box 28 Example of self-regulation: Code of Conduct (OPTA, PD1, Consumer complaint handling)

5.4.4. Synthesis on strategic activities

We synthesize the previous paragraphs on the sub categories by providing the most prominent characteristics.

The category of *Strategic Activities* is characterised by an active role for the market players in carrying out a decision or in solving an issue in mutual cooperation on the one hand. On the other hand they are characterised by initial trust in the market to acknowledge that a shared understanding amongst market players for a communal approach to defining rules or formulating solutions is preferred to a top-down formal regulatory intervention by the regulatory authority.

Self-regulatory arrangements occur in different types of dossiers (pricing, infrastructure sharing, interconnection & interoperability, consumer interests) and take the form of a Memorandum of Understanding, Code of Conduct, Industry-wide protocols or contracts or a communal action such as a consumer awareness campaign supported by all MNOs.

In the dossiers that we analysed it looks as if the NRA always has an initiating role towards the formation of self-regulatory arrangements. However, self-initiated initiatives of market parties without involvement of the NRA are beyond our empirical data because of our choice to select formal regulatory documents that may not report on the stand alone business initiatives towards self-regulation.

By means of open and selective coding we developed the category *Procedural Activities* (see Table 29). In the next section, we turn to the category of *Networking Activities*.

5.5. Category: networking activities

In creating a separate category of *Networking Activities*, we reflect the empirical data that show that a regulatory authority does not operate on its own. The networking activities are those activities that either another national or international regulatory authority performs within an NRA dossier, or the other way around: the activities that an NRA performs for other regulatory organizations. As such they are examples of collective regulatory practice in cooperation with other regulatory organizations (Ubacht, 2016).

In total, we coded 57 of such instances, which represent 11% of the total number of regulatory activities that we coded (see Table 26). For a division of the sub categories within this category: see Table 34, they are described in more detail in the following paragraphs.

Table 34 The sub categories and their occurrences in % within the category Networking Activities

Category: Networking Activities	Sub Categories	No of occurrences	Percentage of occurrences
Section 5.5.1	Other national regulatory authority	36	63%
Section 5.5.2	International authority	13	23%
Section 5.5.3	NRA activity for other regulatory authority	8	14%
	Total	57	100%

5.5.1. Activity of other national regulatory authority

Within a regulatory dossier, sometimes another *national regulatory authority* than the sector-specific telecommunications authority will influence the process and content of the dossier. Most prominent are the properties of the ministerial decrees and the adaptation of primary legislation by which the relevant Ministry of a country enforces changes in law or policy that need to be taken into account by the NRA. In the case of adaptation of primary legislation, this was often triggered by a new European Directive that needed to be transposed into national laws. Examples of these other national regulatory players are the Department of Trade and Industry (DTI) in the United Kingdom, the Ministry of Public Works, Transport & Water in the Netherlands and the Ministère de l'économie, des finances et de l'industrie in France, under whose authorities the national telecommunications law resided. An example of such activity is given in Box 29.

On October 27th 1999, the Ministère de l'économie, des finances et de l'industrie modified the Code des postes et télécommunications, article D99-16 to introduce carrier (pre)select into the telecommunications sector (Ministère de l'économie des finances et de l'industrie, 1999). In the decree the Ministry followed the ART advice and states that it is the responsibility of the ART to determine the services to which carrier (pre)selection is applied and that the ART needs to work out the conditions and timetables for the implementation (Ministère de l'économie des finances et de l'industrie, 1999, art. 1er).

Box 29 Example of an activity by another national regulatory player (ART, PD57, Introduction of indirect access).

Other important national regulatory players are the National Competition Authorities (NCAs): (in the United Kingdom the Monopolies & Mergers Commission (MMC), in the Netherlands the Nederlandse Mededingings Autoriteit (NMa) and in France the Conseil de la Concurrence¹⁹). Occasionally the NCA will influence the regulatory dossiers by means of the publication of reports or decisions and investigations into the relevant markets. But the NCA and NRA also work together within a market issue, which is often the case in joint market consultations, joint publications and joint policy guidelines. This was especially the case in infrastructure sharing/network coverage issues and the determination of the reasonableness of wholesale terms & tariffs. These cases required a sector-specific approach as well as an approach based on generic competition law. An example of such cooperation is presented in Box 30.

¹⁹ Names of the authorities in the period in which we collected the empirical data.

In May 1998 OFTEL referred the case of the retail prices for calls from fixed to national mobile networks to the Monopolies and Mergers Commission (MMC) because OFTEL and the parties concerned could not agree on the analysis of the problem and because of the public interest involved. OFTEL asked the MMC to investigate the following aspects:

I. The charges made by Vodafone and by Cellnet to operators of fixed public telecommunications systems:

a. for the delivery of calls from fixed public telecommunications systems to telephone handsets connected to Vodafone's respectively Cellnet's mobile public telecommunications system;

b. for unanswered calls to such handsets; and

c. for the diversion of such unanswered calls.

and:

II. The charges made by BT to users of its fixed public telecommunication system for calls to subscribers to the mobile public telecommunication system operated by Vodafone and Cellnet.

In both cases the DGT wanted to know whether possible negative effects of these charges could be cancelled by a modification in the licences concerned.

Box 30 Example of the cooperation between the NCA and the NRA (OFTEL, PD18, MTTs)

The third set of players that influence the regulatory dossiers are the Courts, such as the High Court in the United Kingdom, the District Court in the Netherlands and the Cour d'appel in France. The courts take decisions in court cases that market players put forward in which decisions of the regulatory authority are challenged (see Box 31 for an example of the Dutch regulator OPTA)

KPN also lodged an appeal with the District Court in Rotterdam against the OPTA decision, on April 29th 1999 with the request to suspend some of the OPTA rules. On June 3rd 1999 the President of the District Court accepted the appeal on the aspects of the publication of the coordinates and the courtesy requests but disallowed the appeal in the case of site sharing (however, the President of the District Court allowed a preparation period of 10 weeks before KPN had to comply with the new directions). The president adapted the direction on reservation for own use for the roll out of KPN's DCS1800 network. As soon as KPN designed its DCS1800 network, it had to publish the availability of rest capacity on its antennas.

Box 31 Example of the role of a Court in a regulatory dossier (OPTA, PD6, Infrastructure sharing 2G period)

5.5.2. Activity of international regulatory authority

The main international regulatory authority that influences the regulatory practice of the NRAs in this study is the EC (see Table 30). By means of the publication of a Communication, a new Directive or an adaptation to an existing Directive, the EC influences the regulatory framework in which an NRA operates (see Box 32). Additionally, the EC can investigate issues of international/transnational importance (such as the MTTs, see Box 33) or can put forward a request for investigation amongst the European NRAs (see Box 34).

On September 24th 1998 the European Parliament and the European Council issued a Directive to introduce carrier (pre)selection for the telecommunications markets (European Parliament and the Council of the European Union, 1998b). The Directive stated that carrier (pre)selection had to be introduced in the Member States by January 1st 2000. Carrier (pre)selection refers to the possibility of callers to determine the operator for each separate call by means of dialing a prefix ("appel par appel"), or by setting a preferred operator for all of their calls.

Box 32 Example of an activity by an international organization: the EC issues a new Directive (ART, PD57, Introduction of indirect access)

In February 1998, the European Commission started an official investigation into mobile and fixed telephony prices (European Commission, 1999). The Commission investigated three categories of prices by means of cases:

- 1. the mobile to fixed termination charges,*
- 2. the fixed operators' retention rate on fixed to mobile calls and*
- 3. the mobile termination rates.*

This investigation was closed in May 1999 "after substantial price reductions of more than 80% in some cases, which have taken place in response to the investigation" (European Commission, 1999).

Box 33 Example of an activity by an international organization: an investigation by the EC (OPTA, PD4, MTTs)

In September 1998, the European Commission suspected unfair use of the SIM lock functionality and asked all European regulators to study the use of SIM lock in their countries. The director of DG IV Competition, Mr. John Tempel Lang, advised the NRAs to take measures to prevent anti-competitive behavior by means of the SIM lock and "to align any action [they] may take on the basis of sector specific legislation with the Commission's position on SIM Lock" (European Commission, 1998a).

Box 34 Example of an activity by an international organization: a request for investigation by the EC to all European regulators (OFTEL, PD17, SIM Lock)

5.5.3. NRA activity for other regulatory player

In the empirical data, several references to the advisory role of an NRA occur (see Table 30). These are NRA advices to the Ministry or the NCA. These advices are either invited by the other party (primarily in France) or un-invited (such as in the Netherlands). In both cases the advice can be either followed up or not by the receiving organization, in other words: they are not binding (see for an example of the latter case Box 35).

In the case of the ART we find that the Ministry/the Secrétariat d'Etat à l'Industrie can ask the ART to explore regulatory options and as such to contribute to the formulation of legal rules. Whereas in the United Kingdom and the Netherlands, the joint market consultations and publications are more common, as can be seen in the paragraph on "Activity of other national regulatory".

During the design of the 3G licences, OPTA advised the Ministry to include similar national roaming rights into the licences for new entrant 3G operators in a letter of May 7th 1999 (OPTA, 1999d). However, the Ministry ignored this opinion and did not include national roaming rights in the 3G licences (Jansen, Ros & Van der Windt, 2002).

Box 35 Example of an NRA advice to the Ministry (OPTA, PD8, National roaming/mobile coverage)

5.5.4. Synthesis on networking activities

We synthesize the previous paragraphs on the sub categories of the category *networking activities* by providing the most prominent characteristics.

The Ministry, the NCA and the EC have a dialectic relationship with the NRA. From both sides activities can be taken such as giving and asking for advice or performing a procedural activity within each other's dossiers. The relationship can also have a principal-agent character in the situation in which higher level authorities determine the regulatory framework in which the NRA operates. In the case of the NCA and the NRA, a relationship of cooperation within a market issue also occurs, which we term as collective regulatory practice.

By means of open and selective coding we developed the category *Networking Activities* (see Table 30). In the next section we present our conclusion on the categories of regulatory activities.

5.6. Conclusion on the dimension regulatory activities in mobile telecommunications systems

Going through the phases of open and selective coding of the 61 reconstructed dossiers, we identified four categories of regulatory activities. These four categories constitute the Dimension *Regulatory Activities* that will be used for the development of the conceptual framework of regulatory practice in the mobile telecommunications system. This dimension is the answer to the sub question:

2. How to conceptualize the activities that a national regulatory authority in the mobile telecommunications system performs to deal with market issues?

The dimension *Regulatory Activities* consists of the following categories (Ubacht, 2016):

- *Procedural activities*: the actions of (mainly but not exclusively) the NRA to support the process of dealing with a market issue;
- *Enforcement activities*: the decisions that the NRA takes to solve a market issue. They are preceded by the procedural activities to analyze the issue at hand and to explore the choice for a type of enforcement activity that needs to fit with the character of the relevant issue, taking the possible effect of the enforcement on the market into account;
- *Strategic activities*: the options that a regulatory authority has to refrain from a top-down regulatory approach in solving a market issue. Instead, a solution is found by using co-regulation, relying on market forces or self-regulation. In all three options the market parties are expected to take responsibility to develop a solution for a market issue;

- *Networking activities*: those activities that either another national or international regulatory authority performs within an NRA dossier, or the other way around: the activities that an NRA performs for other regulatory organizations.

Although the creation of the dimension *Regulatory Activities* is an answer to our sub question, the empirical data analysis leads to other observations on the way in which the regulatory authorities deal with market issues:

First, regulatory practice is foremost a procedural approach during which the activities are chosen on a case by case basis along the way.

Second, a sequence of (different types of) activities reveals the degree of intensity of the process. Only a few market issues are solved straight away in a more standardized way. Other market issues require a sequence of activities over a long(er) period of time.

Third, the process is characterized by interactivity and exploration in a dialectical process for discussion and evaluation of options with multiple actors before a regulatory arrangement is decided upon.

Finally, new policies, technical innovations, difficulties to assess the effect of regulatory arrangements on the market and the unpredictability of mobile services demand lead to uncertainties in the regulatory process. In addition challenges to the formal authority of a regulator influences their regulatory activities.

In the next chapter we elaborate on these observations as input for the conceptual framework of regulatory practice in the theoretical coding phase.

6. Conceptualization of Regulatory Practice²⁰

"From an interpretive perspective, constant comparison is not sufficient. Until the results can be displayed in a descriptive graphic, illustration, or table or until the results can be stated in no more than a paragraph, neither the degree of empirical grounding has been established .., nor has meaning been constructed... from constant comparison" (O'Connor, Netting and Thomas, 2008, p. 42).

6.1. Introduction to conceptualization

After the phases of open and selective coding which yielded the dimensions *Market Issues* and the *Regulatory Activities*, the next phase in our research design is the theoretical coding phase. This phase of the CGT approach is an integration phase that aims at establishing the relationship between the dimensions that are developed. Therefore, in this chapter our central sub question is:

3. Which are the dimensions and their relationships for the conceptual framework for regulatory practice in the mobile telecommunications system?

To define conceptualization, we refer to Glaser who states that:

"For GT, a concept is the naming of an emergent social pattern grounded in research data. For GT, a concept (category) denotes a pattern that is carefully discovered by constant comparing of theoretically sampled data until conceptual saturation of interchangeable indices. It is discovered by comparing many incidents, and incidents to generated concept, which shows the pattern named by the category and the sub patterns which are the properties of the category" (Glaser, 2002a, p. 24).

²⁰ We presented preliminary outcomes of chapter 6 in: (Ubacht, 2016).

Our objective is to conceptualize regulatory practice by means of a conceptual framework to explain how regulators deal with the tensions and uncertainties in the mobile telecommunications system. The central element in this framework will be the so-called core category. Holton refers to Glaser for the function of the core category:

“Glaser ... states that the core category merits its relevance and prominence by accounting for most of the variation in processing the concern or issue that has emerged as the focus of the study and by conceptually explaining the latent pattern of social behavior that accounts for its continual resolution” (Holton, 2007, p. 279).

In their 2017 article Holton and Wash specify the concept of the main concern a bit more by stating that it is “the issue or problem that occupies much of the action and attention in the research setting, whereas the core [variable] explains how that concern or problem is managed, processed, or resolved” (Holton and Walsh, 2017, p. 88).

Applied to our research, this entails we want to understand the main concern of the regulatory authorities and to conceptualize the pattern(s) by which they deal with the market issues. In consecutive steps we develop the dimensions for the conceptual framework of regulatory practice:

First, we establish the relationship between the two dimensions *Market Issues* and *Regulatory Activities* that we presented in chapters 0 and 5. At this end we compare all market issues with the characteristics of the regulatory activities performed in the process of developing a regulatory arrangement. In 5.2 we already concluded that the exploration of the solution space and the formulation of the regulatory arrangement is foremost a process. During this process a regulator explores the specifics of the market issue along the way. In section 6.2 we substantiate our earlier impression that the type of issue influences the duration and intensity of the process by means of the comparison of all 61 dossiers. This is the basis for the formulation of our *core category* of regulatory practice: *the process of matching the market issue by means of mixing regulatory activities* in section 6.2.

Second, the empirical data show that the matching between the type of issue and the regulatory activities to be taken towards the development of a regulatory arrangement is the central part of a prolonged *phased approach*. Therefore we include the dimension of *Phases* in the conceptual framework; this is discussed in full in section 6.3.

Third, the conceptual framework includes the dimension of the *Uncertainties* that influence the regulatory activities; these are described in section 6.4.

Fourth, choices need to be made within the formulation of the regulatory arrangement. We refer to this as the dimension of *Fine-tuning*. We present the categories for *Fine-tuning* in section 6.5.

Based on these dimensions we present the visualization of our conceptual framework in section 6.6.

6.2. Core category: process of matching and mixing

Through open and selective coding we discovered the four categories of the dimension *Regulatory Activities* that we presented in the sections 5.2-5.5: *procedural*, *enforcement*, *strategic* and

networking activities. These activities are alternated according to the state of affairs in a regulatory dossier. This means that at every step of the regulatory dossier an NRA considers which activity to perform to continue the development of the regulatory arrangement. We analyzed the empirical data on the way in which activities are alternated to derive patterns in the mixing of activities.

We first provide examples as illustration of the differences between the matching of market issues with regulatory activities and the consequences for the duration of the process:

- In relatively straightforward cases of ex post regulation such as compliance and dispute settlements or market party and end user complaints, the procedural activities are limited in numbers and the case is mostly dealt with within several months;
- In contrast the types of cases that are subject to ex ante regulation are very intense. In ex ante cases many actors with diverging interests are involved. In addition, these cases include technological uncertainties and require a thorough exploration of the effects that a regulatory intervention may have on the market. The consequence is that dealing with these intensive cases can take years before they are solved. The example in Figure 9 shows the case of implementing mobile number portability in the United Kingdom. This case started with a market consultation in March 1996 and ran up to September 2001 with a dispute settlement between market parties. Many procedural activities were performed towards developing the regulatory arrangement;
- Yet other market issues can be of low intensity and may not require many activities to be solved, but do extend over a longer period of time. This is illustrated in Figure 10 by the example of lifting the SIM lock on mobile phones in the Netherlands. In the example the extended duration is caused by the consumer complaints that followed after the intervention by the Dutch NRA.

We analyzed all 61 dossiers in this way to derive patterns in the ways in which NRAs dealt with the market issues, to explain how the NRAs combined the type of market issue with regulatory activities. We analyzed the dossiers for duration and intensity to discern these patterns which we present in the following paragraphs. The synthesis of this comparison is presented in Table 35.

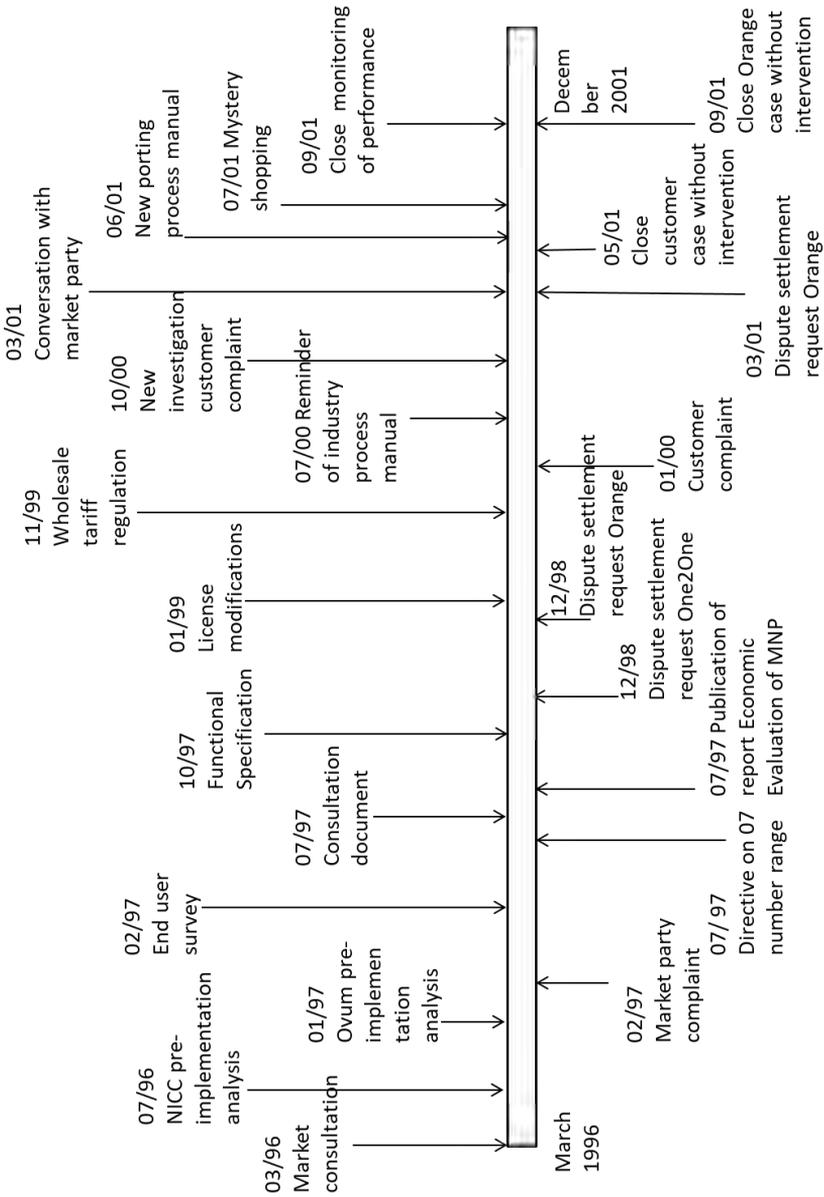


Figure 9 Example of a regulatory dossier with high intensity, with a high number of different activities, and an extended timeframe: Mobile Number Portability in the United Kingdom (PD16)

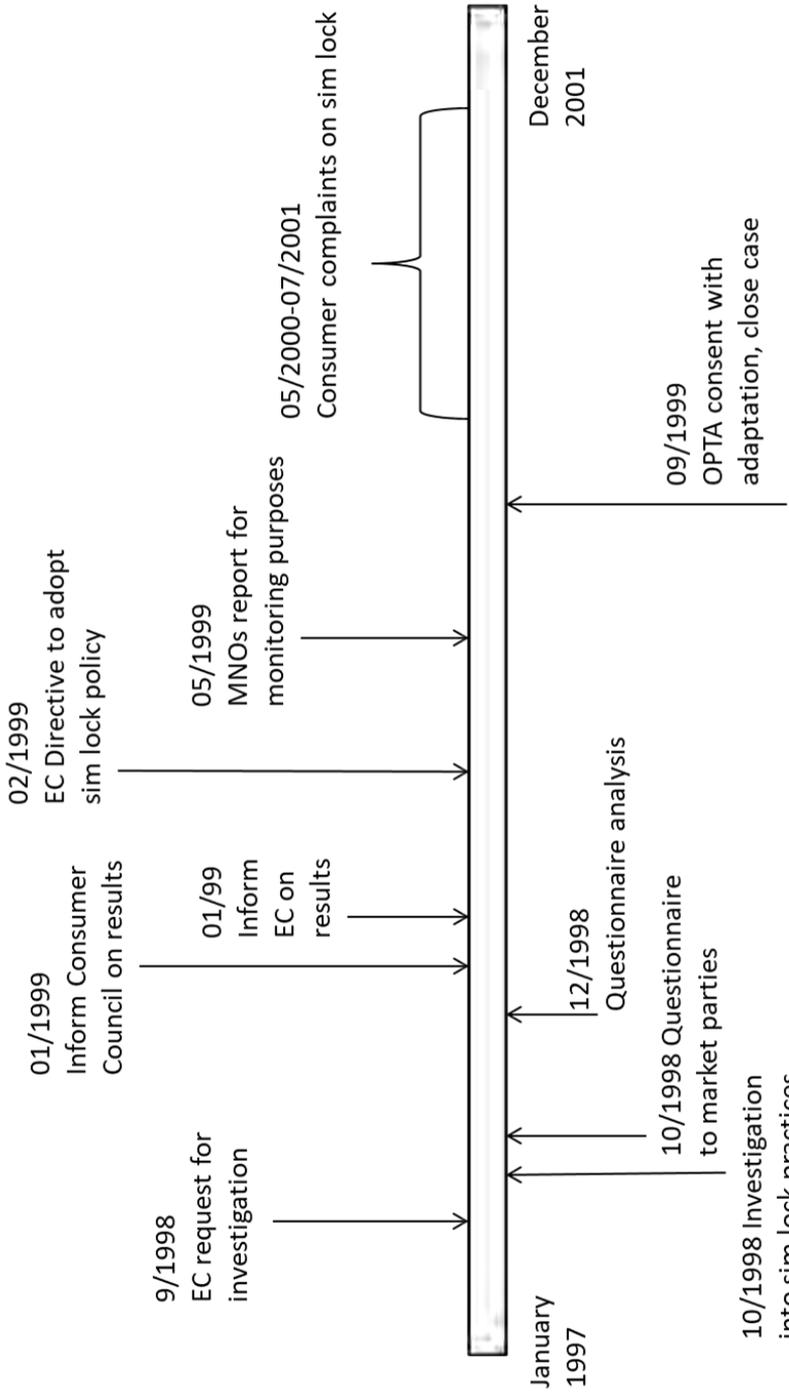


Figure 10 Example of a regulatory dossier with relatively low intensity, with few activities, but an extended timeframe: lifting the SIM lock on mobile phones in the Netherlands (PD3) (Ubacht, 2016).

6.2.1. Intensity of activities

Our first observation is on the mix of activities that can show a low or high level of variance (defined as the alternation of different types of activities) for each market issue apart. The level of variance is related to the type of market issue:

1. **Low variance:** in the dossiers in which a dispute settlement is central (ex post), the process of dealing with it can be rather straightforward. The dispute settlement request is received by the NRA, explored and investigated by collecting information and possibly hearing the parties involved and a decision is presented.

2. **High variance:** in contrast, regulatory practice in dossiers in the realm of ex ante economic regulation is characterized by a high level of variance in the types of regulatory activities.

The second observation is on the number of activities that are performed in order to develop the regulatory arrangement:

1. **Limited number of regulatory activities:** only a few activities are required to develop the regulatory arrangement;

2. **High number of regulatory activities:** these are the cases in which a long(er) series of activities are executed along the way.

We combine the variance and number of regulatory activities into the aspect ‘intensity’ in the dossiers:

Straightforward intensity: the market issue requires a limited number and limited variance in regulatory activities to come to a closure;

Exploratory intensity: the market issue is characterized by numerous and different types of regulatory activities to come to a closure.

6.2.2. Duration of the process

Our second observation relates to the duration of the process to develop the regulatory arrangement. The duration can either be:

1. **condensed:** shorter than 1 year or

2. **extended:** longer than 1 year or

3. **continuous:** some market issues receive continuous attention. These are mainly in the realm of consumer interests issues such as end user complaints handling (PD15) and in the realm of public interests such as monitoring the quality of service (PD19; PD51) and the transparency of end user terms (PD20). They lead to regular reports (e.g. quarterly or annual) such as annual market reviews, surveys on the quality of service or analyses of end user complaints (see 5.2.2 and 5.2.3).

6.2.3. Classification of market issues

For determining the patterns we use the categories of the regulatory dossiers (see 4.8) and analyze them on the intensity (in number and variance) of the regulatory activities and the duration of the regulatory process. The patterns are presented in Table 35; a more elaborate overview of the table is presented in Appendix D.

The patterns show that the extended dossiers that were most intense relate to market issues that were initiated by the NRA, national policy or EC policy. They aimed at:

- a. **regulation with a social rationale:** terms of usage and tariffs for end users and jamming of mobile signals;
- b. **regulation with an economic rationale:** infrastructure sharing²¹, interconnection, interoperability, national roaming and indirect or special access to mobile networks of competitors.

In contrast, the majority of the condensed and straightforward dossiers are complaints in the social-oriented domain and dispute settlement cases in the domain of economic regulation. Looking at the number of dossiers Table 36 shows a comparison of 32 condensed and 25 extended dossiers, and between 26 straightforward versus 35 exploratory dossiers. Omission of the four “continuous dossiers” leads to 22 straightforward versus 35 exploratory dossiers.

We conclude that the duration of the cases ranges between a regulatory process that can be condensed and straightforward (e.g. in the case of compliance or dispute settlement requests that are solved within a couple of weeks or months) or extended and exploratory (e.g. in cases of ex ante economic regulation which can require many different types of activities during an extended process, even several years). Only a few market issues required a continuous process with a straightforward intensity of regulatory activities. No market issues fit into the extended/straightforward or continuous/exploratory combinations.

In the next paragraph we synthesize these findings to develop the core category of our conceptual framework.

²¹ The infrastructure sharing in 3G dossiers were condensed and straightforward, in contrast to the 2G dossiers on infrastructure sharing.

Table 35 Patterns in duration and intensity

**PD (Primary Doc) number refers to the dossier numbers as listed in Appendix C*

Categories	Sub categories		Properties	PD*	Duration	Intensity
Social rationale: public values	ex post	Consumer interests	Complaint handling	1	condensed	straightforward
	ex ante	Public interests	Terms of usage	2, 3, 5, 16, 17, 50	extended	exploratory
			Mobile retail tariffs	4, 18, 21, 22, 60	extended	exploratory
			Quality of Service	15, 19, 20, 51	continuous	straightforward
			Jamming	55	extended	exploratory
Economic rationale: fair competition	ex post	Compliance	n.a.	11	condensed	straightforward
	ex post	Dispute settlements between market parties	Market party complaint handling or request for dispute settlement	26, 28, 31, 32, 34, 35, 38, 42, 43, 46, 48, 49, 52, 58, 59	condensed	straightforward
				14, 27, 41, 53	condensed	exploratory
	ex ante	Developing the institutional context	Developing market conditions on the infrastructure level	7, 8, 25, 54	condensed	straightforward
				6, 23, 24, 29, 30, 61	extended	exploratory
			Supporting services innovation	9, 10, 37, 39, 40, 47, 57	extended	exploratory
				36	condensed	straightforward
				12, 13, 33, 44, 45, 56	condensed	exploratory

Table 36 Duration of the regulatory process combined with the intensity of regulatory activities

Legend: the PD (Primary Doc) numbers refers to the dossier number as listed in Appendix C

		Intensity of regulatory activities		
		Straightforward	Exploratory	
Duration of the decision-making process	Condensed	PD1, PD7, PD8, PD11, PD25, PD26, PD28, PD31, PD32, PD34, PD35, PD36, PD38, PD42, PD43, PD46, PD48, PD49, PD52, PD54, PD58, PD59 (22x)	PD12, PD13, PD14, PD27, PD33, PD41, PD44, PD45, PD53, PD56 (10x)	32
	Extended		PD2, PD3, PD4, PD5, PD6, PD9, PD10, PD16, PD17, PD18, PD21, PD22, PD23, PD24, PD29, PD30, PD39, PD37, PD40, PD47, PD50, PD55, PD57, PD60, PD61 (25x)	25
	Continuous	PD15, PD19, PD20, PD51 (4x)		4
	Total no of PD	26	35	61

6.2.4. Conceptualization of core category

Based on the findings on duration and intensity of the regulatory process we formulate the following synthesis:

The characteristics of duration and intensity contribute to the conceptualization of regulatory practice as a process of exploration to develop a regulatory arrangement. During this process the issue at hand needs to be addressed by the appropriate activity or activities. The nature of the market issue (ex-ante/ex post; social rationale/economic rationale) influences the way in which the NRA explores the development of the regulatory arrangement along the way. This can turn out to be a rather straightforward or an exploratory process. This process of matching the market issue with a mix of regulatory activities along the way is the main concern of the NRAs. We therefore label our core category as a Process of Matching and Mixing. The conceptual framework needs to include this core category as a combination of the dimensions Market Issues and Regulatory Activities. In addition the Process of Matching and Mixing influences the duration and intensity of the development of the regulatory arrangement. This is visualized in Figure 11.

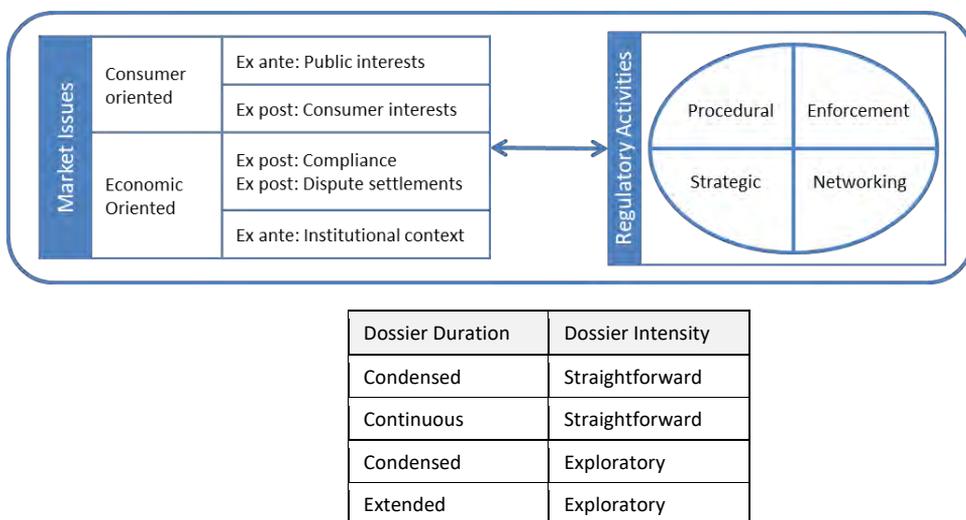


Figure 11 Visualization of the core category *Matching and Mixing*

6.3. Dimension: phases

The next dimension for our conceptual framework is the phased approach. In section 4.8 we concluded that regulatory practice is primarily a procedural practice (see Table 27 and section 5.2 that show that 58% of all regulatory activities are procedural activities). In the previous section we presented that dealing with a market issue is an exploratory approach towards developing the regulatory process as well as the regulatory arrangement along the way.

As such the processing of a regulatory dossier takes place ‘along the way’ with alternating stages of information gathering and analysis and pre-testing of regulatory options, actors challenging the decision, reformulation of the market issue, etc. On the basis of the empirical data we heuristically and for conceptual reasons (following Glaser, 1978, pp. 97-100) discern five phases for the development of a regulatory arrangement: initiation, analysis, exploration, formulation and closure.

These phases support the notion of regulatory practice as a process. The duration of the phases is influenced by the type of market issue and the required intensity, as presented in the previous section 6.2. We elaborate on each phase in the following paragraphs.

6.3.1. Initiation

In the *Initiation* phase the market issue at hand is put on the agenda of the NRA. Most of the market issues are put forward by the market parties or initiated by the NRA (resp. 38% and 31% of the cases, see Table 37 & 5.2.4). The regulatory framework that is formed by the EC (with 15%) and the national Ministry (with 10%) represent 25% of the dossiers. For the EC, the sources are mainly EC communications, directives and requests for investigation. For the national Ministry, these are decrees that are issued, policies that are formulated or requests for an opinion from the NRA. Only in a limited number of cases the source is an end user who submits a complaint (6%).

Table 37 Sources of the market issues in numbers and % of occurrences

Initiators	Description	Numbers	Percentage
Market parties	Submitting a complaint or request for dispute settlement or investigation	23	38%
Regulatory authority	Own initiative or own investigation	19	31%
European Commission	EC communications, directives, requests for investigation	9	15%
National Ministry	Issue of decrees, policies, request for an NRA opinion	6	10%
End user	Submitting a complaint	4	6%
	Total	61	100%

6.3.2. Analysis

After the market issue enters the regulatory agenda, it is analyzed: an (initial) inventory of the actors involved is made, if applicable the technological artifact that is central to the issue is assessed and the market context is investigated. To this end, the NRA undertakes a series of activities in information gathering. Partly the information is already available through the market reviews, surveys, benchmarking and other types of continuous data gathering that are part of the NRA's market monitoring role. Partly the information is gathered through desk research and communication with market parties. The goal of this *Analysis* phase is to have an initial analysis of the market issue that needs to be decided upon. This phase is mainly characterized by the procedural activities of *Investigation* and *Analysis* as presented in sections 5.2.1 and 5.2.3 respectively. In Table 36 we presented the taxonomy of ex post and ex ante social regulation and ex post and ex ante economic regulation. This phase of *Analysis* will yield a better understanding of the type of issue as a starting point for the next phase.

6.3.3. Exploration

In the phase of *Exploration* the market issue is further assessed in a multi-actor dialectical process with other actors by means of information gathering & sharing activities (as presented in 5.2.2). The obtained data and own interpretations are discussed with market parties (e.g. in the form of market consultations, round tables and workshops or public/private hearings) and with other governmental organizations such as other NRAs and the EC. The solution space for solving the issue is explored, in order for the NRA to be able to develop and substantiate a regulatory arrangement.

6.3.4. Formulation of the regulatory arrangement

Once the market issue is analyzed, and the solution space is explored, the next phase is the *Formulation* phase in which the regulatory arrangement to address the market issue is actually developed. This regulatory arrangement can consist of a process design for future decision making (e.g. in case of questions on the authority of the regulator to intervene, see 6.4.3 and Box 19 or if the NRA refers the case to another regulatory player (see 5.3.7). But the arrangement can also consist of an intervention that aims at solving the market issue (see 5.3.7) or the NRA chooses for enforced co-regulation, self-regulation or relies on market forces (see 5.4). Like the *Exploration phase*, the phase of *Formulation* is characterized by a dialectical process with market parties and other regulatory authorities in which the draft arrangement is discussed and evaluated before it is finalized. In 6.5 we present the dimension of fine-tuning which is part of this phase of *Formulation*.

6.3.5. Closure

Once the regulatory arrangement is finalized, the NRA communicates the arrangement to the market parties and governmental organizations that are involved in the issue. This is the phase of *Closure* which can take several forms.

First of all, the NRA can present the regulatory arrangement to deal with the issue or chooses for a non-intervention strategy (see 5.2.6).

Second, the issue can be transferred into another dossier (e.g. PD58, see Table 27).

Third, the NRA can refer the dossier to another regulator such as the EC or the ERG for an international approach on the issue, or to the NCA for market issues in which the NRA was not able or authorized to force a decision upon the market parties (e.g. PD14 and PD18, see 5.2.5).

Fourth, the market party that initiated the issue by submitting a complaint or a request for dispute settlement can withdraw the case before a decision is taken. In this specific case the exploratory character of the regulatory process can be instrumental in itself in solving an issue. Because of the interactivity in information gathering and sharing with market parties to investigate and analyze the issues, involved parties can gradually come to an agreement without the NRA having to intervene in a formal way (see 5.2.6 and Box 3). In these cases, the actor that first put the issue on the agenda withdraws the case before the NRA takes a decision.

After the closure of a dossier, the NRA can continue to *Monitor* and *Evaluate* the market issue and its intervention (see 5.3.2 and Box 6), can be challenged on the decision by market parties making an *Appeal* (see examples in Box 19 and Box 31), or may receive *New Information* which leads to reopening of the case (see 5.2.6 and Box 4). Finally, within a single market issue a *Sequence* of the regulatory cycle can take place, e.g. in case that complaints are consecutively received on the same topic (see 5.3.7) or in case of an appeal after which the NRA needs to reopen the dossier (see Box 19 and Box 31).

This phased approach seems to represent a rather well-defined and consecutive process, but this is certainly not always evident in the empirical data. The process is less predefined as it seems, the phases can be overlapping and previous phases can be revisited, going back and forward, as illustrated by the case of Mobile Number Portability in the UK in Figure 9. In addition, the duration of

the consecutive phases of regulatory practice is influenced by the type of market issue at hand, as noted in paragraph 6.2.2.

6.3.6. Conceptualization of phases

For the conceptualization of regulatory practice, we formulate the following synthesis:

The distinction in phases contributes to the conceptualization of regulatory practice as a phased process to develop a regulatory arrangement. The phases are characterized by their nature of initiation, analysis, exploration, formulation and closure. After closure of the case the phases can be repeated when continued monitoring & evaluation takes place, when an appeal is made against the decision, or when new information is received. Also sequencing can lead to a repeated regulatory cycle. The conceptual framework needs to include the dimension Phases and the options after closure of the case. This is visualized in Figure 12.



Figure 12 Dimension *Phases* and its categories

6.4. Dimension: uncertainties

So far, the dimensions that we developed in chapters 0 and 5 primarily explain how the NRAs dealt with the tensions in the mobile telecommunications market as the physical or virtual area where transactions between suppliers and buyers of telecommunication services and end user equipment take place. However, in section 1.5 we formulated our research objective to develop a conceptual framework that explains the way in which regulatory authorities deal with the tensions and uncertainties in the complex mobile telecommunications system in their aim to develop regulatory arrangements. Therefore, in our open and selective coding phases we also coded for instances of factors that an NRA cannot directly influence or are hard to phantom due to external developments. In the theoretical coding phase we conceptualize them as the dimension *Uncertainties*. These uncertainties influence the regulatory activities of the NRAs and as such can subsequently lead to a more exploratory process (intensity, see 6.2.1) or a prolonged process for development of a regulatory arrangement (duration, see 6.2.2).

Through the coding process we discovered that these uncertainties are rooted in

- the difficulty to assess the effect of a regulatory arrangement on the market;
- awaiting the implementation of new policies;
- debates on the authority of NRAs;
- technological innovations and
- unpredictable services demand.

In the following paragraphs we present these uncertainties in more detail to show how they influence regulatory practice. We use examples from the empirical data to substantiate our coding.

6.4.1. Effect on market

An important consideration of the NRAs in developing regulatory arrangements to enhance competition in the mobile telecommunications market relates to the effect of their decisions on the current but also the future market situation. This is particularly evident in the realm of economic regulation, in which the rise of alternative service concepts such as indirect and special access for SPs to mobile networks was debated. In these cases a balanced deliberation between service innovation, the effect on the competitiveness in the market in the longer term and customer benefits is required.

An example is the introduction of indirect access, which led to intricate deliberations on the pro's and con's in all three countries. We illustrate the deliberations in the case of OFTEL in Table 38 which provides an overview of the considerations in favor and against the introduction of indirect access in the mobile telecommunications market in the United Kingdom.

Table 38 Overview of OFTEL considerations on the introduction of indirect access on mobile networks on a cost plus basis [PD40, based on (OfTel, 1999c)].

In favor of Indirect Access	Against Indirect Access
Leads to more competition on the service level	Strategic behavior of MNOs: regaining loss of income by raising subscription fees and lowering retail prices (price squeeze)
Wider range of innovative services for end users	IA is a short term solution with a long term risk of cream skimming by IA providers without investments in network facilities and new services and subsequent exit of the market
New price packages for end users	Break with regulatory tradition of stimulating investments in alternative networks
End user in control of routing and thus of tariffs of single calls (call-to-call basis)	Compulsory IA access has negative influence on present and future network investor confidence, particularly in 3G (which was planned for 1999)
Lower retail prices because of more efficiency in routing, marketing, billing, purchasing of conveyance and termination of calls	Market competition is too premature to intervene, rather make competition drive down retail prices
For mobile service providers: more choice for purchasing services, more independence from predetermined packages of MNOs	Uncertainty in development of IA in the market
Removal of barrier of entry for new type of provider	MNOs have not taken IA into account when setting up their business cases
Variation in call prices is larger than variation in tariff packages	There are technical and commercial alternatives (the MVNO-concept was at the time of discussion object of an OFTEL consultation of the market)

Additionally, the case of the introduction of MVNOs in the UK market is another illustration of the deliberation between the effects on the market and the added value for consumers (PD44). This case was highly debated between new entry market parties and established network operators. The following statement is exemplary for the decision of an NRA to refrain from regulating the market entry of new entrants/new concepts and how the balance between the economic effects versus the added benefits for consumers was explored. In this Statement on the entry of MVNOs of October 1999, OFTEL summarized its decision to refrain from regulating the market entry of MVNOs in favour of relying on market forces:

“Of tel has considered, among other factors, the potential economic costs and benefits associated with intervention to require the provision of services to MVNOs, including the potential impact on competition and the potential benefits to consumers. Of tel’s conclusion is that there is not enough evidence to justify intervention by Of tel at present. With the prospect of effective competition in the mobile market, Of tel is reluctant to take the significant regulatory step of requiring that services be provided to MVNOs, particularly since the impact of competition of Indirect Access (IA) from mobile networks has yet to be gauged, and there is the prospect of increased competition from the entry of one or more new entrants from the Third Generation spectrum auction” ((Of tel, 1999k): section on ‘The basis for regulatory intervention’). [PD44]

These two examples illustrate that a source of uncertainty is the difficulty to assess the effect of a regulatory arrangement on the market in the short and the long term and whether or not the customers will benefit. Therefore we consider *Effect on Market* as a category in the dimension *Uncertainties*.

6.4.2. New policies

Another category of uncertainty is due to policy making at the national or international level in which new rules and regulations are prepared. Policy making is on a different timescale than the regulatory process and as such can lead to delays in regulatory practice. The regulatory authority may have to wait until the new rules and regulations are formally implemented before being able to formulate a regulatory arrangement.

An example is the OPTA dossier in which end user complaints on SMS messages were received (PD1). OPTA wanted to investigate which procedure (opt-in or opt-out) should be applicable to SMS-spam. However, during the investigation the EC was preparing an adaptation of the *Privacy Directive 97/66/EG* (European Parliament and the Council of the European Union, 1997c). Therefore OPTA refrained from intervention in commercial SMS messages awaiting the new Directive.

Another example is the discussion on special access to mobile networks (PD12) in which OPTA took an awaiting attitude towards the new European common regulatory framework for electronic communications networks and services that was introduced in 2002 (European Parliament and the Council of the European Union, 2002). In most types of special access to mobile networks OPTA chose to wait for dispute settlement requests in order to formulate a formal opinion and refrained from ex ante regulation.

These two examples demonstrate that lag in regulatory practice can occur due to the different timescales of policymaking versus regulatory practice to deal with issues that require a shorter term decision. Therefore we label *New policies* as a category within the dimension *Uncertainties*.

6.4.3. Authority issues

Newly liberalized, infrastructural markets are in a dynamic stage of change in which new entrants enter the market, former monopolists have to reposition themselves and new rules and regulations are put to practice. Subsequently, the regulatory arena is characterized by new parties that explore

their grounds and a regulatory authority that has competition engineering tasks to stimulate competition in the market, but who can also be questioned on its authority.

In its regulatory activities, the NRA is bound by the formal law and regulation as formulated by the relevant national Ministry. These laws and regulations are influenced by an international framework for regulation. In our study, the main international regulatory authority that influenced the regulatory practice of the NRAs is the EC. By means of the publication of a Communication, a Directive or an adaptation to an existing Directive, the EC influences the regulatory framework in which an NRA operates (see Box 32). The national Ministry transposes the European rules into the national law and regulation. Still, the NRA has room for interpretation when applying the rules to the market issues. This interpretation takes place in several parts of regulatory practice.

First of all, the NRAs can publish interpretation guidelines for their own future decision making. These can be formulated in policy guidelines that are a guidance for later decisions or reference (“if this issue appears, then we will act as follows...”). The guidelines are the basic principles that inform later decision making and can be informative for market parties in a period of uncertainty regarding legal interpretations. In addition, the NRA can issue decisions to explain its role perception or its interpretation of the legal framework, by which it explains or puts boundaries to its own space of acting.

Second, the interpretation of regulatory directions takes place in the analysis and exploration phases of a market issue. In these phases the NRA explores their own understanding of the legal framework by means of interaction with other actors in the regulatory arena. Likewise, the market parties also explore the space of an NRA and can dispute its authority to act in the way the NRA intends to do. This disputing of authority especially takes place in the intensive cases such as a licence adaptation (see 5.3.6, 4.5.2, PD6, PD30, Box 19 & Box 31).

In several market issues the authority of the NRA was challenged by the market parties, such as the case of Infrastructure Sharing in the Netherlands (PD6). The sequence of enforcement of antenna sharing, appeals against the decision with the NRA (OPTA), and an appeal with the District Court in Rotterdam led to the inclusion of a new article 3.12 in the Telecommunications Act 1998 in 2000 (*Telecommunicatiecawet. (Telecommunications Act), 1998*). This article was meant to clarify OPTA’s authority to issue directives on the publication of information on antenna sites, antenna reservations for own use, the time period for judging a request for antenna sharing from a competitive MNO and the charges for sharing. Several judgements by civil judges deemed OPTA not authorized to issue directives, but the new article in the Telecommunications Act clarified OPTA’s authority to do so.

Another example of questions on the authority of an NRA is from France where the incumbent operator France Telecom questioned the authority of the ART to deal with a dispute on termination tariffs for international call termination charges (PD53).

Challenging the authority of the regulators to deal with market issues leads to uncertainty and, subsequently, to delays. Therefore we coded *Authority Issues* as a category in the dimension *Uncertainties*.

6.4.4. Technological innovation

Because of digitization of the (mobile and fixed) telecommunications systems, innovations in service concepts, tariffing, call routing etc. can be implemented without having to change the hardware of the infrastructure such as cables, antenna's and end user equipment. For the regulator these innovations can present a problem of information asymmetry due to lacking insight into the related technical details. A dialectical relationship can be discerned in that a technological innovation itself can raise market issues and a regulatory intervention can affect the adoption of technological innovations, e.g. hampering or advancing it. Therefore the dynamics in telecommunications technology requires a thorough assessment of the role of technological innovation in the regulatory dossiers.

The cases on mobile number portability, indirect access, carrier (pre)select, special access and network intelligence are examples of technical innovations that required the development of a regulatory arrangement. In some of these cases the regulatory process was an extended one because of uncertainties in the development of the technology or because of the regulator not having sufficient insight into the technical details. For example, in the case of access to network intelligence, the Dutch regulator OPTA declared not to have enough insight into the technical specifications in order to set up general policy guidelines for requests for access to the signaling system (OPTA, 2001f). Therefore OPTA refrained from formal regulation regarding access to network intelligence (PD9).

Based on these cases we coded *Technological Innovation* as a category within the dimension *Uncertainties*.

6.4.5. Unpredictable services demand

Part of regulatory practice is the assessment of whether or not the user demand for new services justifies a regulatory intervention at all.

An example is in the case of carrier pre selection (CPS: choice of carrier per call) by OPTA. This case was linked to the introduction of new forms of special access such as indirect access and access for MVNOs, see the example in section 6.4.1. The debate was on whether the concept of mobile carrier (pre)select should be introduced in the Dutch market in which five MNOs were already active. The discussion centered on the question of the added value in view of market competition on the services level and consumer interests in the short and the long term (PD10, see Box 25). These effects were hard to assess and predict which led to a prolonged regulatory process and occasionally to (temporary) forbearance of regulatory intervention. In the Dutch case the NRA used temporary guidelines for mobile carrier selection to further explore before formulating definite policy guidelines.

We coded *Unpredictable Services Demand* as a category within the dimension *Uncertainties*.

6.4.6. Conceptualization of uncertainties

For the conceptualization of regulatory practice we formulate the following synthesis:

Five categories of uncertainties in the regulatory process can be defined:

1. the uncertainty of the effects of regulatory arrangements on the market;
2. the development of new policies for rules and regulations;
3. discussions on the authority of regulators to deal with market issues,
4. difficulties to assess technological innovations and
5. unpredictable services demand by end users.

These uncertainties influence the regulatory activities and as such can lead to an extended or more intense process for the development of regulatory arrangements. The conceptual framework needs to include the dimension *Uncertainties*. This is visualized in Figure 13.

Uncertainties	Effect on market
	New policies
	Authority issues
	Technological innovation
	Unpredictable services demand

Figure 13 Dimension *Uncertainties* and its categories

6.5. Dimension: fine-tuning

Through the coding of the empirical data, a special feature of developing a regulatory arrangement emerged: the fine-tuning of the regulatory arrangement. The NRA has several means for fine-tuning by formulating the details of the arrangement or matching it to the state of affairs in the market. The NRA can formulate details such as

- to which selection of relevant market parties the arrangement applies;
- by determining for which specific period of time the arrangement will be applicable by including a sunset clause;
- including details on the frequency and timing of evaluations of the arrangement;

In addition, the lead time to implement an arrangement is assessed to see whether the arrangement will still match with the state of affairs in the market once it becomes fully implemented.

We elaborate on the categories for the dimension *Fine-tuning* below.

6.5.1. Choice of applicable actors

In the configuration of a regulatory arrangement an NRA can enforce the regulatory arrangement on all market parties, a specific subset of market parties or a single market party. In the ex post cases of compliance and dispute settlements, the arrangements are foremost aimed at a single market party or a specific number of market parties involved in the case. In all other cases the arrangement can be applicable to all MNOs or e.g. only to the ones with SMP/MI.

6.5.2. Duration/sunset clause

The NRA can include a sunset clause for a regulatory arrangement. Sunset clauses were always included in case of enforcement activities. A regulatory arrangement can be prolonged or re-applied after the applicable period of time has elapsed. In addition, regulatory rules can be put dormant, with the option of re-awakening if the market situation requires doing so. In the fine-tuning these options for the duration of a regulatory arrangement are taken into account.

6.5.3. Regular evaluations

The NRA can regularly evaluate the effects of a regulatory arrangement and consider adaptations or even lifting regulatory obligations once the market is deemed sufficiently competitive. Or when special safeguards are no longer necessary for the market players to comply with (see 5.4.2). The NRA can also allow space for interpretation to market parties to carry out a decision within the boundaries of the legal framework and the interpretation thereof (see 5.4.3). This option is matched with monitoring on whether or not the market parties comply with the guidelines and stay within the regulatory space that is assigned to them. We therefore include 'regular evaluations' as part of fine-tuning: the NRA will include a condition in the regulatory arrangement to specify them.

6.5.4. Lead time

In the formulation phase the NRA may need to assess the time it will take to fully implement the finalized regulatory arrangement and to reach the envisaged effect. As shown in sections 6.2.1 and 6.2.2 some market issues require an extended process with many regulatory activities. These are the most complicated market issues, especially ex ante retail and wholesale tariff regulation require a long time in the making. Still the tariff regulations are formulated because they contribute to regulatory objectives and have an important influence on the market conditions for fair competition. Often this type of arrangement is enforced for at least one year, but regularly remains applicable for several consecutive years before the NRA concludes that the regulatory objective is fulfilled and sustainable without regulatory enforcement. However, occasionally the development and implementation of a regulatory arrangement takes too long to still be effective due to changing market developments that took place in the meantime. By assessing the lead time, the NRA can fine-tune the regulatory arrangement or can refrain from implementing it as it may no longer match with the state of affairs in the market.

6.5.5. Conceptualization of fine-tuning

For the conceptualization of regulatory practice we formulate the following synthesis:

We found four categories of fine-tuning that take place in the formulation phase of the regulatory arrangement: choosing the actors to which a regulatory arrangement applies, determine the duration of the regulatory arrangement, whether regular evaluations should be applied and considering the lead time to implement an arrangement.

The conceptual framework needs to include the dimension Fine-tuning in the Exploration and Formulation phase. The fine-tuning options are Explored and then finalized in the Formulation phase. This is visualized in Figure 14.

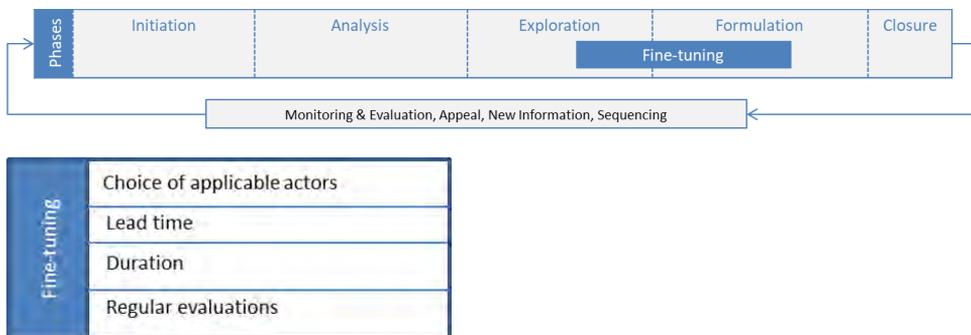


Figure 14 Dimension *Fine-tuning* and its categories

6.6. Conclusion on conceptualization of regulatory practice

In this chapter we conceptualized regulatory practice in the mobile telecommunications system, for which we formulated the sub question:

3. Which are the dimensions and their relationships for the conceptual framework for regulatory practice in the mobile telecommunications system?

In our study, we show that the complexity of the mobile telecommunications system leads to a challenging regulatory context with many *uncertainties* that have their roots in hard to predict effects of regulatory arrangements on the dynamic market, the difficulties to predict technological advance and uncertainty in estimating the demand for new services by end users. In addition the empirical data shows that the policy framework in which the regulators operate is subject to changes. Changing policies and regulations led to uncertainty on the formal authority of a regulator or caused delays in the configuration of a regulatory arrangement while awaiting the implementation of new EU directives or national laws. In our study, we show how these characteristics of the CSTS require an exploratory process in which regulatory arrangements are developed along the way. We therefore label our core category of regulatory practice as an exploratory *Process of Matching & Mixing*, for which we present the following description.

The core category *Process of Matching & Mixing* represents that regulatory practice is foremost a process of developing regulatory arrangements. This core category is grounded in matching of the market issue with a mix of the regulatory activities in order to developed the regulatory arrangement. As such the core category represents the main concern of the regulators: how to deal with market issues in the complex socio-technical mobile telecommunications system.

This process of regulatory practice is characterized by an alternation of procedural activities with the use of enforcement activities, the consideration of alternatives to formal top-down regulation (such as self-and co-regulation) and networking with other regulatory organizations. Only in some types of issues (such as dispute resolutions between two market parties, see 6.2) this is a straightforward process with clear consecutive steps. In other market issues, it is an extended process that unfolds along the way in which the regulatory options are explored. Only a few specific cases require continuous regulatory activities. In the process of regulatory practice several phases can be discerned: initiation, analysis, exploration, formulation and closure. Although the phases seem consecutive, iteration is taking place during the process.

In Figure 15 we integrate the core category with the other dimensions into one conceptual framework. The framework consists of:

- the core category *Process of Matching & Mixing*, which is a combination of the Dimensions *Market Issues* and *Regulatory Activities*. The matching & mixing influences whether a market issue requires a condensed, continuous or extended regulatory process (*duration*) with either straightforward or exploratory intensity in regulatory activities (*intensity*) (section 6.2);
- the dimension *Phases*, including the aftermath phase of a regulatory arrangement (section 6.3);
- the dimension *Uncertainties* that influences the regulatory activities (section 6.4) and
- the dimension *Fine-tuning* of the regulatory arrangement (section 6.5).

This visualisation is the first version of our conceptual framework. In the next chapter we use concepts from extant academic literature on regulatory practice to evaluate our conceptualization in a theoretical way and we present the contribution of our conceptualization to these extant conceptualizations.

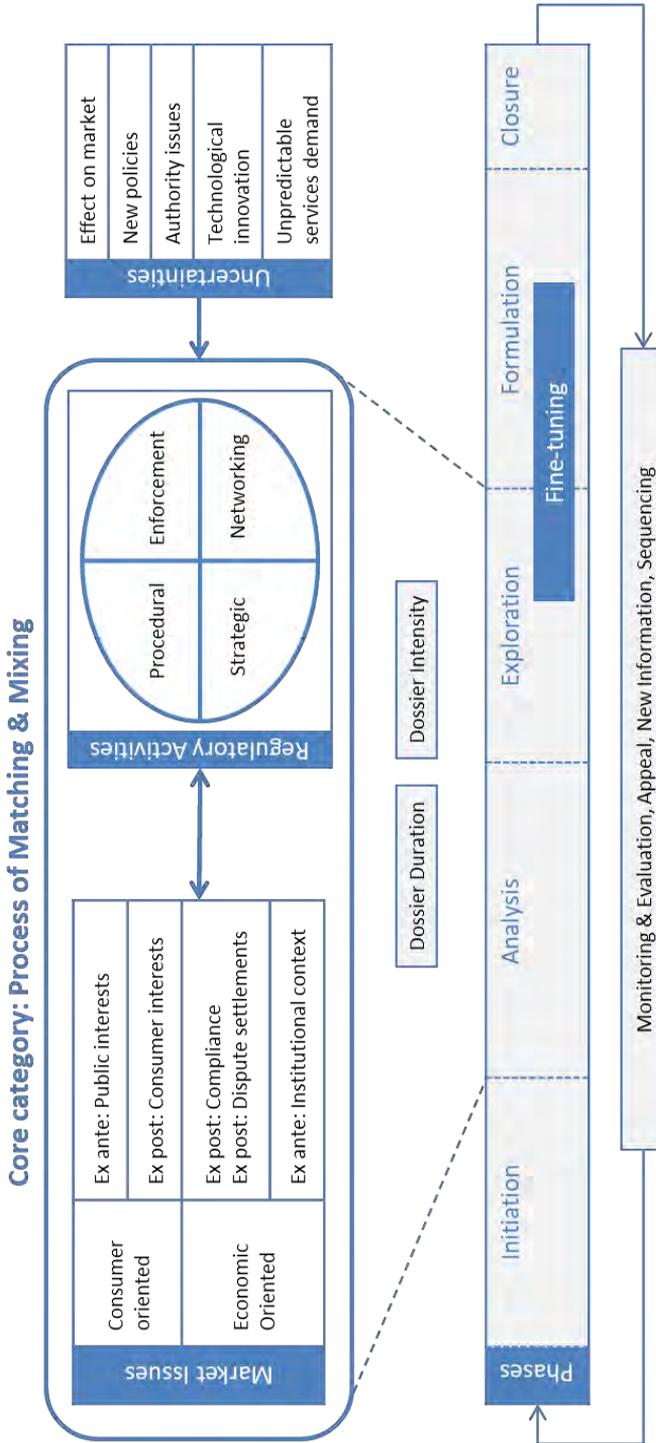
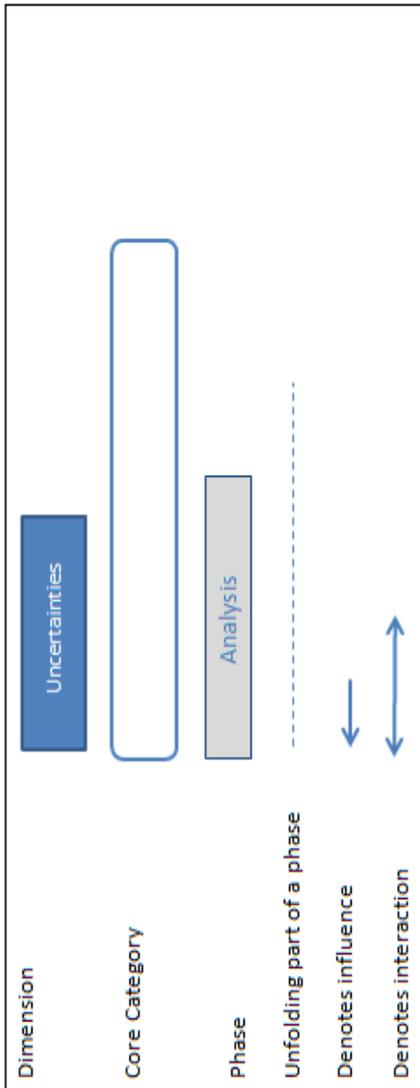


Figure 15 The first version of the conceptual framework of regulatory practice in the mobile telecommunications system



Legend to Figure 15

7. Conceptual Comparison

“All that [Grounded Theory] is, is the generation of emergent conceptualizations into integrated patterns, which are denoted by categories and their properties (Glaser, 2002a, p. 23).

7.1. Introduction to the conceptual comparison

The core category in our conceptual framework represents regulatory practice as a *Process of Matching and Mixing*. This core category explains the main concern of the regulatory authorities in their regulatory practice: to assess the type of market issue in order to find a suitable mix of regulatory activities towards the development of a regulatory arrangement. The additional dimensions show the *Phases* of the exploratory process and the dimension of *Fine-tuning* of the arrangement towards the end of the process. The conceptual framework also includes the dimension *Uncertainties* that NRAs are confronted with.

In this chapter we continue the development of our conceptualization of regulatory practice in mobile telecommunications systems by comparing our conceptual framework with extant theoretical concepts in the field of regulation. In the CGT approach this is the conceptual comparison phase, for which we formulated the following sub question:

4. How does the conceptual framework of regulatory practice in the mobile telecommunications system compare and relate to extant theoretical concepts of regulatory practice?

After an introduction on the two functions of a conceptual comparison in a CGT approach in section 7.2, we present the selection of the literature for the conceptual comparison in section 7.3. In section 7.4 we compare the concepts from the selected literature with ours to explore any additions they entail for the development of our conceptual framework and we critically assess our contribution to the extant literature. This leads to a synthesis of our findings in section 7.5. The

synthesis is used to refine our core category in 7.6 based on which we present the substantive concept of exploratory regulatory practice in section 7.7. We conclude this chapter in section 7.8 by answering sub question 4.

7.2. The two functions of conceptual comparison

In a CGT approach a literature review is performed towards the end of the study to serve two functions (Glaser, 2001, p. 145).

First, the literature review is considered to be an integral part of the CGT method of constant comparison of data (Scott, 2007, p. 95). The literature is considered as data that is used to further develop the core category into a substantive concept, just like the empirical data has been used in the previous phases. Charmaz explains this function of the literature review in GT by stating that “[t]hrough comparing other scholars’ evidence and ideas with your grounded theory, you may show where and how their ideas illuminate your theoretical categories and how your theory extends, transcends, or challenges dominant ideas in your field” (Charmaz, 2006, p. 165).

As such, the literature review serves to continue the development of the conceptualization towards the formulation of the substantive concept and, ultimately, the theoretical concept. Glaser formulates this function as follows:

“Once a fundamental process is generated then a particular literature becomes apparent to review. The literature is discovered just as the theory is. Once discovered, the literature is compared as simply more data” (Glaser, 1998, p. 69).

This use of the literature review after the development of the core category prevents the researcher from entering the domain of research with firm preconceived ideas of looking for the main concern, which would hamper having an open mind towards the object of study (Glaser, 1998, p. 69). Such preconception is at odds with the aim to let the concepts emerge from the empirical data, in order to stay as closely as possible to the way in which the main concern of the subjects is explained.

A second function of the conceptual literature review is making the connection between our conceptualization and extant theoretical concepts. When extant theoretical concepts can contribute to the further development of the concepts in our study, likewise our concept can be used to critically assess and contribute to extant theoretical concepts of regulatory practice. Thus, by means of a conceptual comparison we can position our conceptualization within a broader domain of relevant academic literature.

Referring to the character of the literature review in a CGT study, Christiansen (2011) states that it requires the selection of literature with which a conceptual link can be established which will allow for a ‘comparison of concepts’ (Christiansen, 2011, p. 21). Christiansen typifies this function of the literature review in a CGT study as follows:

“The place and purpose of the literature review in a Classic (Glaserian) Grounded Theory (CGT) study is to situate the research outcome within the body of previous knowledge, and thus to assess its position and place within the main body of relevant literature. The literature comparison is conceptual, i.e. the focus is on the comparison of concepts. The

literature comparison is not contextual, i.e., it is not based on the origin of the data."(Christiansen, 2011, p. 21).

Wolfswinkel et al. (Wolfswinkel, Furtmueller and Wilderom, 2013, p. 52) and Webster and Watson (Webster and Watson, 2002, p. xvi) use the term "concept-centric" literature review to distinguish this type of literature review from a contextual literature review, like the one we presented on regulation of the mobile telecommunications markets in section 2.4.3. We shortly reflect on the distinction between the contextual and conceptual literature review in our study.

In section 2.4.3 we presented a contextual literature review in which we explored which themes in the domain of regulation in mobile telecommunications systems are addressed by academic researchers. We concluded that the majority of the studies are focused on the use of a specific single regulatory instrument and the regulatory process itself is not an object of study. This observation led us to formulate our objective of creating a conceptual framework that explains the challenges that regulatory authorities are confronted with in the execution of their regulatory practice in the complex socio-technical mobile telecommunications system. This contextual literature review was aimed at completeness, with the aim to obtain a fairly complete overview of academic studies into regulation in the context of the mobile telecommunications system. In order to remain open to the empirical data which is inherent to following a CGT approach, we did not use any preliminary codes or sensitizing concepts from this contextual literature review for the coding of the empirical data in our study (Andrews, 2006).

In contrast, a conceptual literature review does not aim for being complete, but for being conceptually relevant. This has consequences for the selection of the literature with which the comparison with our core category is executed. The literature needs to address concepts instead of context to continue the constant comparison in order to advance the development of our core category. We present our selection of literature in the following section.

7.3. Selection for conceptual literature comparison

For our purpose of comparing our conceptual framework with its core category of the *Process of Matching and Mixing* we followed a phased approach to select relevant extant conceptualizations of regulatory practice. First, we used the search term 'regulatory practice' in the reference database Scopus to select the literature. Second, we reviewed these articles by looking for concept-oriented articles on 'regulatory practice'. Third, we used snowballing on these articles which led to a list of eleven articles for our conceptual comparison. In the following paragraphs we elaborate on this selection process in more detail, before presenting the conceptual comparison in section 7.4.

7.3.1. Searching for conceptual literature

We performed a literature search in the reference database Scopus with the key term "regulatory practice", which yielded 2.326 articles (October 23rd 2018). In Figure 16 the scoping towards the final selection is presented. We searched for literature that addresses how regulators resolve market issues as this is their main concern in their role as regulator. The key search term is "regulatory practice", which we defined as "the activities of a sector-specific national regulatory authority in the process of regulating the mobile telecommunications system". For the conceptual literature search

we extended this definition towards a more generic interpretation as “the activities of a national regulatory authority in the process of regulation” because from our contextual literature review we already knew that concepts in the more delineated market of mobile telecommunications were not available (see section 2.4.3).

First, we only selected references with the term ‘regulatory practice’ in title, abstract and key words which reduced the initial result of 2.326 articles to 306 articles.

In the second exclusion round we deselected the document types of ‘reviews’ and ‘notes’ towards 281 articles.

In the third exclusion round we only kept the articles that were written in Dutch, English, German and French as these are the articles we can read in their original language (271 articles remaining).

In the fourth round we excluded trade publications (269 articles remaining).

In the fifth round we deselected articles based on key terms that do not refer to a procedural perspective on regulatory practice; this led to a set of 138 articles.

Next, we manually assessed this list of 138 publications by using the following criteria for exclusion:

1. *Actor perspective*: The actor perspective in the article is not the regulatory authority, but e.g. the market parties that are regulated and thus presents a business perspective on regulation. Most of these articles take the perspective of the regulated organizations to e.g. explore their motivations for compliance with laws and regulations and how to enhance compliance. An example is the article by May “Compliance motivations: perspectives of farmers, homebuilders, and marine facilities” that studies compliance motivations of the regulated actors (May, 2005) .

2. *Conceptualization*: The article is not aimed at conceptualization, which makes it not suitable for our concept-centric comparison. Therefore articles that do not follow a research design towards conceptualization were excluded, such as evaluation studies that look into the effects of regulatory arrangements. An example is the study by Kaestner & Kahn on the effect of regulation on the pricing behavior of a telecommunications company (Kaestner & Kahn, 1990), or comparative studies, for example the study by Lahusen “The good government: Cooperative environmental regulation in a comparative perspective” (Lahusen, 2000).

3. *National level of regulation*: The research reported in the article is not on a national level of regulation, but e.g. on an international or local level which does not compare to the practice of NRAs. An example is the article on ‘good regulatory practice’ related to the Trans-Pacific Partnership (TPP) by Sheargold and Mitchell on “The TPP and Good Regulatory Practices: An Opportunity for Regulatory Coherence to Promote Regulatory Autonomy” (Sheargold & Mitchell, 2016).

4. *Lacking an integral approach*: we did not select articles that focused on a single dimension of our core category. As such we excluded articles in which research into single regulatory instruments or arrangements is presented such as e.g. an article solely on the instrument of access regulation (such as (De Bijl & Peitz, 2009)) or the role of co-production (such as (McDermont, 2018)).

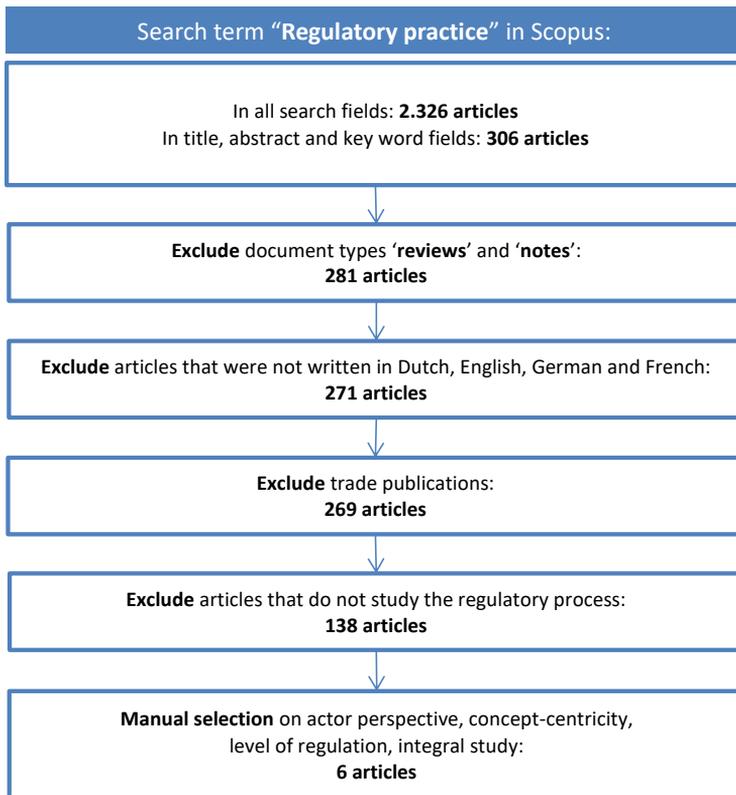


Figure 16 Search strategy on conceptualization of 'regulatory practice'

The manual selection process led to a final set of six references, published between 2002 and 2018, which are presented in Table 39. This set contains theoretically-oriented academic works in the field of regulatory practice in general. These works are selected for the concepts they present which make them fit to compare them with our own conceptualization of the *Process of Matching and Mixing*.

Table 39 Selected references from the literature search on regulatory practice

Minoque, M. (2002). "Governance-Based Analysis of Regulation". In: <i>Annals of Public and Cooperative Economics</i> , 73(4), pp. 649-666. (Minoque, 2002)
Picciotti, S. (2007). "Constructing Compliance: Game playing, tax law and the regulatory state. In: <i>Law and Policy</i> , 29 (1), January 2007, pp. 11-30. (Picciotti, 2007)
Georgosouli, A. (2009). "Regulatory interpretation: conversational or constructive". In: <i>Oxford Journal of Legal Studies</i> , vol. 30, issue 2, 29 October 2009, article no. 27, pp. 261-384. (Georgosouli, 2009)
Finger, M. and F. Varone. (2009). "Regulatory Practices and the role of technology in network industries: The case of Europe". In: <i>The Governance of Network Industries: Institutions, Technology and Policy in Reregulated Infrastructures</i> , pp. 87-101. (Finger & Varone, 2009)
Lentz, R.G. (2011). "Regulation as Linguistic Engineering". In: <i>The Handbook of Global Media and Communication Policy</i> , 19 April 2011, pp. 432-448. (Lentz, 2001)
Eccles, T. & J. Pointing. (2013). "Smart regulation, shifting architectures and changes in governance". In: <i>International Journal of Law in the Built Environment</i> , 5(1), pp. 71-88. (Eccles & Pointing, 2013)

Next, we applied snowballing to these six references, which led to five additional references in which the paradigms of (really) responsive, smart, and dialectical regulation are presented. These paradigms are often referred to in the domain of regulatory studies; they are listed in Table 40.

Table 40 Conceptual literature in regulatory studies, retrieved via snowballing

Ayres, I. & J. Braithwaite. (1992). <i>Responsive Regulation: Transcending the Deregulation Debate</i> . New York: Oxford University Press, Oxford Socio-Legal Studies. (Ayres & Braithwaite, 1992)
Gunningham, Neil, Grabosky, Peter and Sinclair, Darren. (1998). <i>Smart Regulation: Designing Environmental Policy</i> . Oxford, UK: Oxford University Press. (Gunningham, Grabosky & Sinclair, 1998)
Black, J. (2002). "Regulatory Conversations". In: <i>Journal of Law and Society</i> , vol. 29 (1), March 2002, pp. 163-196. (Black, 2002)
Adhieh, R. (2013). "Dialectical Regulation". In: <i>Connecticut Law Review</i> , issue 38, pp. 863-927. (Adhieh, 2013)
Baldwin, R. & J. Black. (2008). "Really responsive regulation". In: <i>The Modern Law Review</i> , 71: 59-94. (Baldwin & Black, 2008)

In the following section we use the total set of eleven academic works to compare our conceptualization with the extant theoretical conceptualizations of regulatory practice.

7.4. Conceptual comparison

For the conceptual comparison we first introduce the concepts that have been developed in previous literature by describing the authors' perspective and the main characteristics of the conceptualization they developed to represent regulatory practice. Next, we compare these concepts with our core category the *Process of Matching and Mixing* in order to include new aspects or to delineate our core category. At the same time we consider how our study can contribute to the conceptualizations in the extant literature by providing new ways of thinking on regulatory practice.

Our way of working was to code the literature in Atlas.ti by means of close reading. During this coding process two major types of conceptualizations emerged. The first type represents *regulatory practice as a process of conversation*. The second type conceptualizes the ways in which *regulators adapt their regulatory practice to the behavior of the regulated actors or to the status of the market*. Based on the coding and following (Webster & Watson, 2002) and (Wolfswinkel, Furtmueller &

Wilderom, 2013) we compiled a concept matrix to compare the literature. In Table 41 the authors and their contributions to the conceptual comparison are presented, in the following sections we elaborate on their perspectives and the concepts they developed.

Table 41 Concept matrix for Regulatory Practice

Authors	Concepts for Regulatory Practice				
	Regulatory practice as conversation			Regulatory practice as an adaptive process	
	Knowledge exchange	Building trust	Rule interpretation	Regulated firms	Coevolution
Adhieh (2006)	x				
Ayres & Braithwaite (1992)				x	
Black (2002)	x	x	x		
Baldwin & Black (2008)				x	
Eccles & Pointing (2013)		x		x	
Finger & Varone (2009)	x				x
Georgosouli (2009)			x		
Gunningham, Grabosky & Sinclair (1998)				x	x
Lentz (2011)			x		
Minoque (2002)	x	x			
Piciotti (2007)			x		

7.4.1. Regulatory practice as conversation

The concept of *regulatory practice as conversation* is taken from Black's article *Regulatory Conversations*, in which she states that "[r]egulatory conversations, the communicative interactions that occur between all involved in the regulatory 'space', are an important part of most regulatory systems" (Black, 2002, p. 163). Several authors in our conceptual literature review address these communicative aspects of the regulatory process, but they present different functionalities. In comparing the selected articles, we discern three main conceptualizations of regulatory practice as conversation:

1. for knowledge exchange;
2. for building trust;
3. for rule interpretation.

In the following paragraphs we discuss the way in which these conceptualizations of regulatory practice as conversation compare to our conceptualization.

Regulatory conversation for knowledge exchange

Minoque considers the conversation between regulators and market parties as an essential source of knowledge for regulators, who are at a disadvantage due to "their own lack of expertise, resources, information or power" (Minoque, 2002, p. 656). Such disadvantage can lead to regulatory capture in which the regulator "depend[s] too much on the regulated interests in the process of rulemaking and application" (Minoque, 2002, p. 656). Black also stresses the role of conversation in the dissemination and acquisition of knowledge and she signals an additional effect in the role of conversation: to come to shared meanings. It can lead to shared normative commitments from the regulatees' side, when regulation becomes institutionalized and consequently can lead to compliant actions (Black, 2002, p. 182).

In the mobile telecommunications system the regulatory authorities use several strategies to cope with this knowledge gap, as shown by the inventory of regulatory activities (see section 5.2). These activities do not only aim at information gathering, but through sharing intermediate results and analyses via e.g. round table sessions and public hearings the reactions and feedback from third parties are invited. Minoque (2002) also addresses the growing complexity of regulation that goes beyond the inequalities of expertise, resources, and information between the regulator and the regulatees. This complexity can no longer be addressed by the rational perspective on regulation in which formality and legal rules dominate: political discourse and multiple interests and resources influence the decision making process (Minoque, 2002, p. 658).

Whereas this may not be a distinctive element for regulation of a CSTS, the coevolutionary aspect as presented by Finger & Varone adds the issue that technological developments are hard to assess by both regulatory authorities and market parties alike (Finger & Varone, 2009). The coevolution that Finger & Varone present refers to the fact that in CSTS the technological, market and regulatory developments are interwoven and interdependent. Finger & Varone add the dimension of uncertainties that all actors in the CSTS are confronted with, not the regulatory authority alone. In our research we refined these uncertainties by their sources: technological innovation, new policies, authority issues, the difficulty to assess the effect of regulation on the market and the uncertainties in services demand.

In our conceptual framework the role of regulatory conversations is represented in the procedural and networking activities that the regulatory authorities perform towards the configuration of a regulatory arrangement. These activities are performed in different communicative settings, such as round tables, market consultations, public and private hearings, discussions with other regulatory authorities etc. (see sections 5.2 and 5.5) and in several phases of the process. These activities aim at gathering and sharing of information and inviting feedback on concept proposals in the regulatory arena. Thus our research provides a detailed picture of the conversational activities that take place in regulatory practice on a practical level.

In his article *Dialectical Regulation* Adhieh (2006) addresses another type of regulatory conversation by looking at the cross-jurisdictional interactions amongst regulatory authorities. He makes a distinction into three levels of such interactions: voluntary (regulators that voluntarily exchange information in the execution of their mandate), jurisdictional overlap (regulators that have a legal mandate to regulate the same regulatees or the same issues) and regulatory dependence (in addition to jurisdictional overlap, one regulatory authority is dependent on the activities of another regulatory authority) (Adhieh, 2013, pp. 863-865). In the latter case, the ultimate outcome can be joint regulatory activities of the regulatory authorities, which Adhieh denotes as “intersystemic regulation” (p. 866). This is the form in which *dialectical regulation* takes place, which he describes as “the consummate – and consequently most controversial - form of intersystemic regulation, in which significant overlap and interdependence combine to produce a degree of regulatory integration” (p. 870). Adhieh mentions the role of overlapping regulation as a bearer for dialogue, which can lead to innovation in regulatory practice and a combination of different perspectives to improve decision making: “[b]y pooling the/resources and capacities needed for information collection and analysis ... regulatory engagement can improve decision-making” (pp. 892-893). Baldwin & Black (2008) also mention the importance of conversation in an intersystemic regulatory context, amongst other purposes for assessing and, if necessary, adjusting the regulatory strategies

to raise performance (Baldwin and Black, 2008, p. 75). For the telecommunications market, Finger and Varone (2009) mention such overlap between the functions of market regulation by the independent regulatory authorities for the telecommunications industry and the national competition authorities in the EU Member States. The solution for tensions in this intersystemic regulation was found by making the two report to different Ministries, “thus balancing the power and raising conflicts among these two to the level of a political debate” (Finger and Varone, 2009, p. 92).

In our study several examples of intersystemic regulation are present. For example, the development of the mobile telecommunications market from a formerly monopolistic towards a competitive market and the anticipation towards the application of principles based on generic competition law (in contrast to sector-specific principles) in the new EU regulatory framework from 2002 onwards led to the joint regulatory arrangements and a Memorandum of Understanding between the Dutch sector-specific regulatory authority OPTA and the NCA NMa on e.g. the case of infrastructure sharing/networking coverage issues and the determination of the reasonableness of wholesale terms & tariffs (see section 5.5.1). The intersystemic regulation was driven by the rapid market developments in which principles from generic competition law and sector-specific regulations needed to be combined (see an example in the United Kingdom in Box 30). In Adhieh’s terms this type of intersystemic regulation is a collaborative one: it is a strong bilateral interaction, in which the regulatory authorities depend on each other to arrive at a common approach (Adhieh, 2013, p. 907). In our conceptual framework this cooperative way of working between regulators is captured in the networking activities (see section 5.5). Adhieh’s concept of *dialectical regulation* and his conceptual model to analyze the intersystemic regulation over an extended period of time in which repeated interactions between the sector-specific and competition authorities evolve complements our conceptual framework. His conceptualization can be used for analyzing the way in which intersystemic regulation plays a role in regulatory practice over an extended period of analysis. The lens of *dialectical regulation* combines well with the concept of coevolution of technological, market and regulatory developments as presented by Finger & Varone (Finger & Varone, 2009). We return to this aspect of coevolution in section 7.4.2. In Table 42 we summarize our findings on regulatory practice as conversation for knowledge exchange.

Table 42 Regulatory practice as conversation for knowledge exchange

Regulatory practice as conversation for knowledge exchange	Compares to our conceptual framework	We add to their conceptualization
Minoque (2002)	Minoque presents regulatory process as interaction, which is overlapping with our core category of Matching and Mixing during an interactive process to develop a regulatory arrangement	In the regulation of a CSTS, knowledge uncertainty is not only an issue for the regulator but also for the regulated organizations. Technological developments are a source of information asymmetry. Our research provides a more detailed picture of the conversational activities that take place in regulatory practice
Black (2002)	Conversation in the regulatory context can lead to shared meanings and consequently to compliant actions and in an intersystemic regulatory context to assess the performance of regulatory strategies from a diverse number of regulatory authorities	Our research provides a detailed picture of the conversational activities that take place in regulatory practice
Finger & Varone (2009)	Finger & Varone state that regulatory practice is complicated by the coevolution of policy, market & technology. This overlaps with our notion of regulatory practice for the mobile telecommunications market as a CSTS	We present a refinement of the uncertainties by our inventory of their sources: technological innovation, new policies, authority issues, the difficulty to assess the effect of regulation on the market and the uncertainties in services demand. These uncertainties require a process of information exchange between regulators and regulatees and amongst themselves.
Adhieh (2006)	Adhieh offers a conceptual model for intersystemic regulation. Regulatory overlap/conversations with other regulatory authorities is reflected in the networking activities of our research and thus an integral part of the <i>Process of Matching and Mixing</i> . The development of the intersystemic regulation by e.g. the NRA and NCA is touched upon but continued dialectical regulation is beyond our period analysis, this requires analysis over an extended period of time for further research	The overlap or joint activities between independent regulatory authorities can be temporary, dependent on the empirical domain at hand (in our case the mobile telecommunications market). Intersystemic regulation can be temporarily used on an ad hoc basis, but it can also be more permanent (e.g. if the NRA merges with the NCA once the market is deemed sufficiently competitive).

Regulatory conversation for building trust

A second objective of regulatory conversations that is presented in the references is the building of trust amongst the actors involved in the regulatory process.

Minoque sees the building of trust between the regulator and the regulatees as the basis for corporate governance, in which “self-regulation, co-regulation and voluntary regulation” (Minoque, 2002, p. 659) are the main strategies of regulation. Despite the potential risks of these regulatory strategies such as private interests taking over and lower transparency, Minoque considers them as attractive forms of regulation as it saves on institutional costs and puts the execution closer to the actors that have the in-house expertise to be compliant (p. 660). Minoque states that “[r]egulators must be seen as competent, reasonable, and credible while at the same time trusting regulatory targets to exercise self-restraint and to accept public interest values” (Minoque, 2002, p. 660). Eccles and Pointing (2013) also consider the establishment of trust between the regulatory and regulated firms as a basic requirement for the transfer of the regulatory burden towards the firms (Eccles and

Pointing, 2013, p. 79). Black adds to this that regulatory conversations can lead to characterizations of actors involved: the role of discourse for the formation of the identity of not only the regulatee (see the section on adaptivity below), but also of the regulatory authority. Perceptions of the regulatory authority can determine the willingness to comply (Black, 2002).

In our research the authority of the regulators to deal with a case was contested in several regulatory dossiers. Whereas this was based on a legal interpretation of the authority of the regulators, the conceptualization of conversation for building trust in the regulatory authority adds another aspect. When looking at the alternative forms of regulation such as self- and co-regulation in our empirical data, we can add the role of technological complexity to Minoque's idea on corporate governance. In the mobile telecommunications market, the form of co-regulation was mainly chosen to deal with issues that require a common approach from the market actors. Examples are a code of practice in the case of interoperability issues or a (technical) protocol for implementation of mobile number portability (see section 5.4.1). This can save on institutional costs and the execution is done by the network operators that have the expertise to do so, as Minoque states. In addition, the forms of self-regulation that we found in the empirical data was predominantly driven by the regulatory authorities themselves, either because they were not able or authorized to use a top-down intervention or the market parties preferred self-regulation over detailed regulatory intervention in the market. Whereas this seems less a matter of trust, but rather a matter of strategic considerations from the market players' perspective, the building of trust relationships is an underlying element in the *Process of Matching and Mixing*. However, demonstrating this requires a different type of analysis of the empirical data. Therefore, future research can address the role of trust in regulatory practice in the mobile telecommunications market and how this can lead to more strategies of self- and co-regulation. In Table 43 we summarize our findings on regulatory practice as conversation for building trust.

Table 43 Regulatory practice as conversation for building trust

Regulatory practice as conversation for building trust	Compares to our conceptual framework	We add to their conceptualization
Minoque (2002); Eccles & Pointing (2013)	Trust relationships need to be developed for alternative forms of regulation to be taken up by firms. Future research can study the role of building trust in preparation for self- and co-regulatory forms of regulation in the mobile telecommunications system.	In our study we found two variants of alternative strategies: the enforced and voluntary forms. The enforced form for a common strategy on e.g. technical implementation issues does not require trust but a sense of common interests, as the alternative is a top-down regulatory intervention. The role of technology and required common action for an interconnected mobile infrastructure can lead to self- and co-regulatory strategies.
Black (2002)	Building of trust is also dependent on regulatory conversations, which generate identities for regulatory authorities. This is a social aspect of regulatory practice and as such a refinement for our conceptual framework.	Our empirical data does not allow for this kind of analysis, but our domain of research can provide the context to study the role of identity formation by means of discourse analysis.

Regulatory conversation for rule interpretation

Several articles in our literature selection address the regulatory process as a vehicle for conversation in which the interpretation of rules is central. Georgosouli in her article *Regulatory*

interpretation: conversational or constructive (2010) defines interpretation as “an indispensable feature of rule-use, for it is through interpretation that the meaning of rules is clarified, disputes about how rules should be understood are resolved and their scope of application and consequences are crystallized” (Georgosouli, 2009, p. 362).

In her article *Regulatory Conversations*, Black (2002) studies the interaction between regulators and regulatees in the process of interpreting rules through the lens of discourse analysis. Discourse analysis in the context of regulation is rooted in linguistics and social sciences and addresses the micro-level of regulation: the linguistic interaction between regulators, regulatees and other parties involved in the regulatory arena either in spoken or written text (Black, 2002, p. 171). In our conceptual framework we see that the phases of the regulatory process all contain conversations between the regulatory authorities, market parties, other regulatory authorities and other actors in order to arrive at a shared meaning (which need not be the fully accepted meaning by all involved). As Black notes, especially in cases of uncertainty and ambiguous contexts, interactions are adamant in a regulatory context. In addition, she states that “conversations will also be important in the more general situation in which regulators are given broadly defined and conflicting objectives to fulfil or principles to follow, where they operate in a dynamic context in which problem definitions are complex and shifting, and the consequences of regulatory action uncertain” (Black, 2002, p. 172). This is where Black’s discourse analysis links to the dynamics of regulation that we found in our research. She considers a link between discourse analysis at the micro- and the macro-level as fruitful to not only study direct interactions but also to study the power relations that are based on them (this is studied more in depth by Georgosouli, which we present below).

Our research method and the sources we used do not allow us to draw any conclusions on this, but discourse analysis can contribute to revealing the micro-level of interactions between the regulatory authority, the regulated firms and others in the mobile telecommunications system. In this sense, the conceptualization of regulation as discourse is complementary to our conceptualization of the regulatory process. The *Process of Matching and Mixing* cannot be executed without regulatory conversations on the micro-level. Our conceptual framework offers the context in which discourse analysis can be performed. Black’s regulatory conversations approach fits well within the constructivist GT approach, that follows the tradition of symbolic interactionism in which understanding social processes is central (Hallberg, 2006, p. 146). Hallberg refers to Charmaz who works in the constructivist GT approach to “discover what is important from the viewpoints of people and what things really mean to them” (Hallberg, 2006, p. 146).

Picciotto (2007) takes the concept of regulatory conversations as a starting point in his article *Constructing Compliance: Game playing, tax law and the regulatory state*, in which he explores the role of interpretation of rules in the regulatory process (Picciotto, 2007). Like Black and Georgosouli he presents this interpretation as an interactive process between the actors in the regulated domain, stating that “a regulatory regime may be “created” through the interactions of those involved, mediated by contestations about the validity and legitimacy of different interpretations of rules” (Picciotto, 2007, p. 15). He distinguishes three levels of indeterminacy of rules. First, the linguistic level that allows for social groups to attach different meanings to the same words: language as social construction. Second, the difference between formulating very precise rules versus the formulation of general principles that allow for interpretation by individuals. Third, even for precise rules different interpretations can arise, depending on the value judgments or shared

views of its purpose of those involved in its interpretation. Within the regulatory domain the indeterminacy of rules is lowered through interactions between those involved in the interpretation of the rules towards the construction of a shared understanding (Picciotto, 2007, p. 18). Picciotto adds that participants in that process of interpretation should not be limited to experts only; contributions from the political and societal debate should be included in order to create transparency and trust (Picciotto, 2007, p. 26).

In our conceptual framework this way of working is represented by the exploratory process in which the regulatory authority interacts with a diversity of stakeholders (market parties, consumer associations, other national and international regulatory authorities, see sections 5.2 and 5.5) to interpret the rules and to explore the regulatory solution space. The most important principles and rules for the mobile telecommunications market are formulated in the EU regulatory framework, which is transpositioned into national law and regulation. The mobile licences are aligned but also contain more precise requirements for the MNOs. However, due to the dynamics of the market and the regulations, precise rules cannot be formulated upfront in order not to limit future market developments or to restrict technological developments. Therefore the interpretation of rules has a prominent role in the regulatory practice of the mobile telecommunications system (and thus in our conceptual framework), which is sustained by the procedural and networking activities of the regulators in which interaction in the multi-actor context is organized.

The format in which this can take place is discussed by Georgosouli (2010) who also addresses the interpretation of rules in the regulatory process, which she characterizes as “[a] perpetual interpretive process [that] underlies the process of rule-use” (Georgosouli, 2009, p. 361). She compares the conversational with the constructive approach to the process of interpretation. Whereas the conversational approach sees the interpretation process as a dialectical interaction to come to a shared understanding (similar to Picciotto’s perception), the constructivist approach aims for the higher goal of “new and better interpretations in accordance with the public standards that best justify regulatory practice” (Georgosouli, 2009, p. 363). The latter approach entails that not only the ones that are directly involved determine the interpretation because such a closed expert group entails the risk of regulatory capture. The extension of the regulatory community that Georgosouli argues for resembles Picciotto’s call to include political and societal voices as well.

Within the conversational approach, Georgosouli discusses the role of an interpretive community (pp. 366-367, also mentioned by (Black, 2002, p. 165): a community of interpreters who discuss and communicate about their interpretation of rules and “work(.) towards cultivating a shared understanding of regulatory requirements and ultimately towards interpretive convergence” (Georgosouli, 2009, p. 368). The basic idea is that those who are affected by the regulatory process have a voice in the interpretation of the rules that will be applied. This will also contribute to efficiency of the regulatory process as the rule is based on consensus and will not be contested in the subsequent application phase. However, Georgosouli objects to this conversational approach. She argues that the interpretation of the rules at hand can be based on group thinking, intentions can be quite different amongst the members of the community and not aligned with the meaning of the rule, and can lead to rent seeking and regulatory capture (pp. 369-270). By means of a discourse on interpretation in literary studies (a case study into the interpretation of three directors of the Shakespeare play *Hamlet*), Georgosouli proposes that interpretation of rules is subject to a constructive approach in which not only former decisions inform the interpretation (whether they

are correct, wrong or obsolete), but in which the regulatory authority also strives for “the working out of the public standard(s) that best justify regulatory practice” (Georgosouli, 2009, p. 377). The constructive approach does not strive for consensus like in the conversational approach, but for the best argument to choose for a specific intervention at a specific moment in time. Subsequently, the interpretation of the rule evolves due to “a recurring interaction between one’s understanding of the rule and one’s appreciation of its overall point and purpose” (p. 379). The overall point and purpose can be formed by the principles that the regulatory authority is bound by in practice. Georgosouli coins this as a “principles-based approach to regulation” (p. 381). An example from our study can be the introduction to the report *Dealing with anti-competitive behavior- an Oftel Guide* which the UK regulator OFTEL published in December 1997. It starts with the text on Oftel’s principles:

“Oftel’s goal is to provide the best possible deal for the customer in the telecoms market in terms of quality, choice and value for money. We believe that a fully competitive market in telecoms networks and services will deliver this goal by spurring innovation, offering choice, delivering improvements in quality and driving prices down” (Oftel, 1997a).

Within the empirical data of our study we discern both the conversational as well as the constructivist approach that Georgosouli presents. The conversational approach is visible in various forms of self- and co-regulatory arrangements, such as developing a code of practice (in e.g. the case of interoperability issues), a so-called common approach (in e.g. the case of removal of the SIM lock policy), or an industry wide (technical) protocol for implementation (in cases such as enabling mobile number portability and carrier pre-selection). Also industry wide policy or working groups of different actors are set up to work out the co-regulatory approach (see 5.4.1 and 5.4.3). The driver behind the conversational approach is that common action is required for the benefit of the entire mobile telecommunications system. Common action is also required when being the first in the market to apply a new strategy that is wished for by all market parties, but will be detrimental for the competitive position of the first mover.

On the other hand, the constructivist approach is also present in the regulatory practice in the mobile telecommunications system. This approach is visible in the subsequent phases of analysis, exploration and formulation in our conceptual framework. In all these phases a form of constructive discussion takes place with the market parties as well as with other regulatory authorities on the interpretation of rules to be applied. In cases of compliance these are of short duration as rules for compliance are more defined and precise upfront (ex post regulation), in contrast to the cases of ex ante regulation which require extensive discussions on the interpretation of rules.

Our synthesis is that the conversational as well as the constructive approach play a role within the regulatory process of a regulator, depending on the market issue at hand or when required along the way. The conversational approach as conceptualized by Georgosouli is particularly visible in the category of strategic activities in which the regulatees play a role in developing an arrangement that requires their common action. The constructivist approach as conceptualized by Georgosouli is at the base of regulatory practice as a process of matching and mixing and is particularly illustrated by procedural and networking activities. Therefore we consider that the conversational and constructive

approach are already represented in our conceptual framework through the dimension of *regulatory activities*.

For a deeper understanding of the regulatory process as conversation, Lentz turns to critical discourse analysis (CDA) to study “how regulatory texts act as carriers of institutional power in constituting telecommunication industries and infrastructures” (Lentz, 2001, p. 432). CDA is a specific form of discourse analysis that focuses on the linguistic representation of power relations and how to change them (Black, 2002, p. 169). Lentz dives deep into the role of linguistics in regulatory texts during the phase of technical/digital convergence of telecommunications, media and information technologies. In CDA language is not considered neutral, rather formulations can be used to exercise or challenge power and exclusion from a policy/regulatory process. Lentz illustrates this by analysing the *Computer Inquiries* in the USA over an extended period of time (1966-1989) and focuses on the changing definitions of the term ‘common carrier’. In the early years of her CDA study common carrier was an obligation for voice telephony services in the US. Due to digitization, data processing services and the rise of computers the term was redefined, and the concepts of basic versus enhanced services were introduced, with the consequence that less services (the basic ones) became subject to the common carrier obligations. By means of semantic maps, Lentz shows how ever more refined categories of services were created with the intention to deregulate the market (a.o. message-switching, hybrid communication service, remote access data processing service, etc.)(Lentz, 2001, p. 439). Lentz states that “[t]he gradual devolution of common carriage erodes part of the legal infrastructure for freedom of expression” (p. 443) and “FCC rulemaking linguistically marginalizes the social dimension of its regulatory mandate” (p. 443). This is an ongoing discussion, e.g. in the current debates on Net Neutrality and the role of ISPs and social media as Facebook. Lentz shows that in the regulatory practice as conversation, linguistics and textual engineering play a role that is not only important for rule interpretation but also for power relationships amongst actors in the regulatory arena (which fits with the ontological belief of criticism, see 3.2.1).

Although textual documents were the primary sources for the empirical data in our study, we did not apply CDA on these documents. We do see the added value of such an analysis in the interpretation of rules during the regulatory process. However, to uncover the linguistic engineering in the regulatory process requires a different type of analysis of the formal documents than we applied. It also requires additional sources in which the voices of the other actors in the regulatory process are recorded. Participatory observation of meetings between the regulatory authority, market parties and other regulatory bodies can add to the CDA. As we analysed formal documents from the three NRAs, we did not have access to the sources that represent these other voices. Therefore, we do not explicitly include it in our conceptual framework as it is on a deeper level of understanding than our objective of explaining the main concerns of the regulatory authorities for the regulation of mobile telecommunications systems. See Table 44 for a synthesis of our findings on regulatory practice as conversations for rule interpretation.

Table 44 Regulatory practice as conversation for rule interpretation

Regulatory practice as conversation for rule interpretation	Compares to our conceptual framework	We add to their conceptualization
Black (2002)	The <i>Process of Matching and Mixing</i> cannot be done without regulatory conversations on the micro-level	Our conceptual framework offers the context in which discourse analysis can be performed
Picciotto (2007)	Procedural and networking activities of the regulators in which interaction for rule interpretation in the multi-actor arena is organized is part of our conceptual framework	Our conceptual framework represents several phases of rule interpretation. Rule interpretation is an inherent part of the regulatory process in the mobile telecommunications system. By performing procedural and networking activities, rule interpretation is developed and tested in several consecutive phases
Georgosouli (2010)	The conversational or constructivist approach is implicitly included in our dimension of <i>Regulatory Activities</i>	Both the conversational as the constructivist approach can be chosen within the regulatory process, depending on the issue at hand or when required along the way of developing a regulatory arrangement
Lentz (2011)	Critical Discourse Analysis (CDA) is at a deeper level of understanding than our objective of explaining the main concerns of regulatory authorities in the mobile telecommunications system	Our empirical data (documents over a five year period from three NRAs) complemented with documents in which the voices of other market players are reflected can serve as a case study of CDA

7.4.2. Regulatory practice as a process for adaptivity

In addition to the concept of regulatory practice as a process of conversation, another group of authors that we selected for the conceptual comparison presents concepts of regulatory practice as a process for adaptivity (see Table 41). Based on close reading and coding of their works we group their conceptualizations into two forms of adaptivity that occur in regulatory practice:

1. Adaptivity to the behavior of the regulatees;
2. Adaptivity to the coevolution of regulation, technology and markets

In the following paragraphs we discuss the ways in which these conceptualizations of adaptivity in regulatory practice compare to our conceptualization.

Regulatory practice for adaptivity to the regulated firms

The concept of *Responsive Regulation* was introduced by Ayres and Braithwaite in their book with the same title published in 1992 (Ayres & Braithwaite, 1992). This concept presents regulation as an approach in which regulators have a range of strategies at their disposal to apply when they discover non-compliance with rules and regulation. Once non-compliance is detected, the regulator will start with negotiations based on persuasion and dialogue with the non-compliant firm. When persuasion is not sufficient to have the firm comply, then more stringent strategies will be applied, escalating towards the most punitive strategy (Ayres and Braithwaite, 1992, pp. 35-38). This order of increasing stringent strategies is represented by the enforcement pyramid, about which Ayres and Braithwaite state that most regulatory activities should take place at the bottom of the pyramid. This entails that after going up the pyramid, de-escalation should also be applied. An example of an enforcement pyramid is illustrated in Figure 17.



Figure 17 Example of an enforcement pyramid from (Ayres and Braithwaite, 1992, p. 35)

The concept of responsive regulation and the enforcement pyramid gained wide acceptance in the domain of compliance and enforcement regulatory studies, and is also applied in practice by professionals in the domain of compliance. However, Baldwin and Black notice that the concept is critically assessed for the following reasons (Baldwin and Black, 2008, 62-64):

1. some circumstances demand immediate higher level strategies instead of gradual escalation;
2. de-escalation may be hindered as higher level strategies distort the relationship with the regulated firm which is necessary for lower level strategies such as persuasion;
3. the pyramid is not sensitive to the diversity of firms' culture or market characteristics;
4. responsive regulation assumes a binary relationship between the regulatory and the regulated firm, whereas a diversity of regulators can be active in the same domain;
5. enforcement takes place in a complex institutional environment that may restrict the regulator to escalate;
6. the concept can be at odds with principles of "fairness, proportionality and consistency" (Baldwin and Black, 2008, p. 64).

Over the years authors in the domain of compliance and enforcement have extended and refined the concept of responsive regulation by offering alternative approaches, such as *Really Responsive Regulation* (Baldwin & Black, 2008; Black & Baldwin, 2010) and *Smart Regulation* (Gunningham, Grabosky & Sinclair, 1998). Central to their work is the adaptivity to the regulatee's behavior, often framed in the context of the regulatory process as a game between the regulator and the regulated firm in which information asymmetry plays a central role.

This form of adaptivity to the regulated firms in regulatory practice is prominent in the work by Baldwin and Black on the concept of *Risk-based Regulation*, which "offers an evidence-based means of targeting the use of resources....emphasising analysis and targeting rather than a process of responsive escalation" (Baldwin and Black, 2008, p. 66). Risk-based regulation is a two sided sword: it targets regulatory activities at the most non-compliant types of firms and supports the regulator to guide its limited resources according to priorities towards the most pressing forms of non-

compliance (for a critical assessment of risk-based regulation, see (Baldwin and Black, 2008, pp. 66-67).

In the concept of *Responsive Regulation*, Ayres and Braithwaite indicate that the binary relationship between the regulator and the regulatee requires a correct assessment of the type of firm that is being dealt with in cases of (non-)compliance. If the firm is intrinsically motivated to comply there is no need to use punishment right away. In contrast, if the firm is only extrinsically motivated towards compliance, using punitive instruments are more effective (Ayres and Braithwaite, 1992, p. 50). Within the concept of *Smart Regulation* Gunningham illustrates the matching of the regulatory responses with the behavior of the regulated firms, as follows: “.good regulation means invoking different responsive enforcement strategies depending upon whether one is dealing with leaders, reluctant compliers, the recalcitrant, or the incompetent” (Gunningham, 2010, p. 126). These identities are constructed in the conversations between the regulator and the regulated firms, which “affect how the enforcement official interprets the actions of individual firms, and thus what enforcement response is considered appropriate” (Black, 2002, p. 183).

Eccles and Pointing also use the concept of *Smart Regulation* and add a dynamic aspect by proposing a model that addresses the “differences in the capacity of businesses or professional entities to engage with the regulatory process [which] is highly variable because of differences in the size, objects and complexity of businesses” (Eccles and Pointing, 2013, p. 82). They present three developmental stages for regulated firms with the link to the type of regulatory strategies that are most suitable in these stages:

1. *Neophyte*: these are firms that are new to the regulatory process and need to be assisted in taking up their legal responsibilities. The regulator best takes up the role of adviser on how to reach for the next stage;
2. *Self-improvers*: these firms are in a learning phase towards the next stage and the regulator should refrain from intrusive strategies;
3. *Champions*: in this stage the firms are fit for self-regulatory strategies, with the cost or regulation falling on their account and the regulator is more at a distance. Their contribution is to present the regulated firms as learning entities, not as static objects of regulation.

Baldwin and Black use another classification, based on the concept of 'motivational posture' which they describe as "the social signals that individuals send to the regulator and to themselves to communicate the degree to which they accept the regulatory agenda and the way in which the regulator functions and carries out its duties on a daily basis" (Baldwin and Black, 2008, p. 69). They discern five types: "commitment to or accommodation of the regulatory agenda; capitulation to the regulatory authority; resistance, game playing and disengagement" (Baldwin and Black, 2008, p. 69). However, Baldwin and Black (2008) object to taking the behavior of the regulated firms as the main determinant and broaden the concept of regulatory adaptivity by taking the following aspects into account (Baldwin and Black, 2008, pp. 69-73):

1. the *attitudinal* settings of the regulated firms, not only their behavior;
2. the institutional environment in which the regulator and the regulatees operate;
3. the coherence in combining different regulatory strategies;
4. the performance of the regulator: "to *assess* its performance in the light of its objectives and to *modify* its tools and strategies accordingly" (p. 72)
5. contextual changes in "regulatory priorities, circumstances and objectives" (p. 73)

In their conclusion Baldwin and Black summarize their concept of *really responsive regulation* as follows:

"Regulation is really responsive when it knows its regulatees and its institutional environments, when it is capable of deploying different and new regulatory logics coherently, when it is performance sensitive and when it grasps what its shifting challenges are. As regulators across the world have to operate within more complex networks of control and have to face up to increasing rates of change, the case for really responsive regulation can only be expected to grow" (Baldwin and Black, 2008, p. 94).

Based on the literature on adaptivity to the regulated firms we see that authors aim to characterize the relationship between the regulator and the regulated firms in order to explain how and why regulators choose for a specific regulatory strategy to respond to non-compliant behavior. It also shows that later studies offer more detailed analyses and consider the regulated firms not as static, one-dimensional subjects but as learning entities that can choose their response strategy on a case by case basis. Later studies also questioned the simplified picture of the regulator-regulatee relationship that is assumed in the original *responsive regulation* approach, as "[r]egulatory regimes can be highly complex, and inspection and enforcement activities can be spread across different regulators with respect to similar activities or regulations" (Baldwin and Black, 2007, p. 8).

The concept of *Responsive Regulation* addresses the fit between regulatory strategies and the non-compliant firm and in that sense is comparable to our concept of *Matching and Mixing*: to strive for a suitable combination to solve the issue of (in their case) non-compliance. However, in a CSTS the pyramid with strategies/instruments with increasing levels of stringency cannot logically be developed because the concept of *Responsive Regulation* shows a simple process of escalation and de-escalation in cases of compliance. This does not compare to the regulation of the mobile telecommunications system in which compliance cases represent only a small subset of all market issues. We coded for a wider range of available regulatory activities as well as uncertainties that influence the regulatory activities. This shows that regulation of CSTS is a highly interactive and exploratory process that does not fit with the ladder of escalation and de-escalation as presented by

the concept of *Responsive Regulation*. We add a wider range of regulatory activities that are combined to address market issues that go beyond compliance cases. These regulatory activities are influenced by uncertainties.

Whereas Baldwin and Black's empirical data is in the domain of enforcement and compliance, which is only a small element in the regulatory practice of the mobile telecommunications market (see Table 25, section 4.8), their objective compares to ours: to provide an integral overview of regulatory practice (Baldwin and Black, 2008, p. 77). However, Baldwin and Black focus more on the capacities of the regulatory authority instead of the regulatory process itself; they take characteristics of the regulatory authority into account such as "performance sensitivity", a term that they use to indicate a regulator's ability for self-reflection and adaptation (p. 84). They do include a form of matching and mixing in the context of compliance by developing categories of tools and by reflecting on how regulators need to assess the logic behind the use of tools in considering the attitudinal settings of the regulatees (Baldwin and Black, 2008, p. 83).

In our research the number of compliance cases among the regulatory dossiers is limited as these require clear upfront rules that need to be complied with. In the dynamic market of the mobile telecommunications system such ex ante formulated rules and regulations for compliance are limited. Even more so in an era of major institutional change in which the task of the regulator is broader and includes regulating the relationships between the firms, instead of regulating single firms. Although issues of compliance are present in our study, the majority of market issues go beyond a binary relationship between the regulator and the regulatee in which the regulator monitors compliance with the law and regulations. In all other market issues, the object of regulation is the relationships between the regulatees in the market: between MNOs mutually, or between MNOs and SPs. In addition, the relationship between the firms and the end users of their services is object of regulation. As a consequence, in our conceptualization we consider adaptivity on the level of the market dynamics to deal with the tensions in the mobile telecommunications market instead of dealing with the attitudinal settings of the regulated firms. However, we acknowledge that attitudinal settings can play a role in the process to develop a regulatory arrangement. We therefore include the influence of market party behavior in our conceptual framework as output from the conceptual comparison in the core category. Future research is needed to develop this new dimension in our conceptual framework. In Table 45 we summarize our findings on regulatory practice for adaptivity to the regulated firms.

Table 45 Regulatory practice for adaptivity to the regulated firms

Regulatory practice for adaptivity to the regulated firms	Compares to our conceptual framework	We add to their conceptualization
Ayres & Braithwaite (1992)	The concept of responsive regulation addresses the fit between regulatory strategies and the non-compliant firm and in that sense is comparable to our concept of <i>matching and mixing</i> : to strive for a suitable combination to solve the issue of (in their case) non-compliance.	A pyramid with an order of increasing impact of strategies is hard to establish in a CSTS. The concept of responsive regulation includes a simple process dimension of escalation and de-escalation that is not fitting with regulatory practice in CSTSs. We add a wider range of regulatory activities that are combined to address market issues that go beyond compliance cases. These regulatory activities are influenced by uncertainties.
Baldwin & Black (2008)	The concept of really responsive regulation is comparable to our concept in providing an integral approach to regulatory practice, but in the specific regulatory domain of compliance. This concept represents the matching of regulatory strategies to the type of non-compliance and the attitudinal setting of the regulated firms. Attitudinal settings can be a determinant in our Process of Matching and Mixing. This requires additional analysis of empirical data.	Our core category the <i>Process of Matching & Mixing</i> resembles the integral approach of <i>Really Responsive Regulation</i> but positions it in the context of complex socio-technical systems. We are more oriented towards the level of the market instead of the individual non-compliance cases that are central in the realm of <i>Really Responsive Regulation</i> .
Eccles and Pointing (2013)	The idea to see the regulated firms as learning entities, not as static objects of regulation shows the way in which regulated firms operate in a regulatory context. Our conceptual framework is developed from the perspective of the regulatory authorities, an extension to the perspective of the regulated firms requires another type of analysis.	We complement the perspective of the regulated firms with our conceptual framework that takes the perspective of the regulatory authorities. The <i>Process of Matching and Mixing</i> can also be seen as a learning process in an evolving market.

Regulatory practice for coevolution

The challenges to regulation that are presented by a CSTS are the core subject for authors that study the relationships between technology, market/economics and policy making/regulation. This is framed as a coevolution between these three subsystems (Finger & Varone, 2009). This coevolution must be seen as a staged process of learning for regulatory authorities and regulated firms alike. The authors in this category address the interactions between the subsystems that require an coevolutionary approach to regulation. We discuss the way in which Finger & Varone (2009); Ayres & Braithwaite (1992); Gunningham, Grabosky and Sinclair (1998) and Baldwin and Black (2008) discuss regulatory practice for coevolution.

Finger & Varone address the issue of coevolution in their chapter *Regulatory practices and the role of technology in network industries: the case of Europe*. They focus on the technological aspects of network industries and how the developments in the technical system need to be taken into account in regulatory practice. The authors explore alternative policy models in the context of EU Member States. Their view is that the dynamics of the telecommunications markets require revisiting of the regulatory paradigm that was developed for markets that were less dynamic and that a static view of market regulation needs to be replaced by a dynamic approach of an evolutionary market (Finger and Varone, 2009, p. 87).

They propose three possible alternatives to the model of a national independent sector-specific authority that regulates the telecommunications market in the EU:

1. “the top-down creation of sector-specific regulators at the European level”;
2. “the bottom-up emergence of differentiated regulations, either at a regional level or across customers’ categories”; and
3. “the evolution of new regulatory powers to major market players such as self-regulation by transnational multi-utilities” (Finger and Varone, 2009, p. 87)

Their core message is that institutionalization and technical innovation in network industries should play a role in the determination of future regulatory structures.

These future changes are also visible in Ayres and Braithwaite’s concept of *responsive regulation*. They applied the concept not only to the regulation of single firms (as introduced in the previous section), but also to the regulation of an entire industry. To this end they present the pyramid of enforcement strategies that represents that industry self-regulation is the preferred strategy, but when necessary the regulator will climb the pyramid towards a higher level of interventionism. Such higher levels are for example enforced self-regulation and command & control regulation (Ayres and Braithwaite, 1992, p. 38). Changes in the market can lead to either more self-regulation or to more stringent interventions in the entire market. The main concept is the match between the regulatory strategy with the characteristics of the industry and in that sense, they also address adaptivity to the coevolution of the market and regulation (although without the technical dimension that is included in the work by Finger & Varone (Ayres and Braithwaite, 1992, pp. 38-40). They speak of an “enforcement game [that] is of course dynamic rather than static” (Ayres and Braithwaite, 1992, p. 51). This requires an adaptive approach in regulatory practice.

Likewise, Gunningham, Grabosky and Sinclair consider adaptivity to coevolution in their concept of *smart regulation* (Gunningham, Grabosky & Sinclair, 1998). Gunningham and Grabosky coined the term “smart regulation” to indicate that “in the majority of circumstances, the use of multiple rather than single policy instruments and a broader range of regulatory actors, will produce better regulation” (Gunningham, 2010, p. 131). In this arena of regulatory actors, also businesses and third parties such as non-governmental organisations (NGOs) are involved in creating the suitable regulatory arrangement (Gunningham, 2010, p. 131). They present the idea of regulatory pluralism that goes beyond the bi-partite relationship of a regulator and the regulated firms. To this end they introduce a regulatory pyramid with explicit roles for regulated firms as self-regulatory and third (non-)commercial parties as co-regulators in addition to state regulators. This is an extension of the regulatory pyramid by Ayres and Braithwaite who, in their opinion, only looked at the state as regulator, whereas other parties can also contribute to the regulation of a market/industry (Gunningham, Grabosky & Sinclair, 1998, pp. 395-400). Gunningham (2010) states that “...the preferred role for government under Smart Regulation is to create the necessary preconditions for second or third parties to assume a greater share of the regulatory burden rather than engaging in direct intervention” (Gunningham, 2010, p. 134). In a competitive market like the mobile telecommunications market, regulatory pluralism is one of the strategic alternatives to top-down or co-regulation. In our research we provide examples in which common interests amongst competitors led to initiatives by the market parties themselves. These were mainly driven by technological innovations that required shared system elements. Both concepts of responsive and smart regulation take future developments of the market into account. If the market changes, then

regulatory practice needs to adapt by using alternative regulatory strategies and by reconsidering the dominance of the state as the only regulatory actor. This fits with conceptualizing regulatory practice as a process for adaptivity to coevolution.

To summarize, these authors address that regulatory practice is a process of adaptivity for coevolution. The type of adaptation to coevolution that Finger and Varone present relates to the institutionalization of the regulatory authorities and less to their regulatory practice. Therefore it complements our conceptual framework on the level of policy making and choices for the kind of institutional setting in which the regulatory activities are performed. As such it does not directly relate to the activities that are carried out in practice as represented by our core category.

The concept of intersystemic regulation that Adhieh (2006) presents also addresses adaptivity to the context in which regulators function. Adhieh mentions that “[a] rapidly changing marketplace also requires a capacity for regulatory reform. Modern regulatory regimes thus demand mechanisms of innovation and evolution” (Adhieh, 2013, p. 890). Finger and Varone propose such mechanism of “innovation and evolution” by contemplating alternative policy models. In the paragraph on adaptivity to the regulated firms, we already presented the view of Baldwin and Black (2008) who also address the adaptivity to include changes in the context of regulation that need to be translated into regulatory practice (Baldwin and Black, 2008, pp. 69-73). They mention that “shifts may be due to policy adjustments by the regulator or because of developments in such matters as attitudes and preferences, industrial practices and technologies, types of regulated actors, numbers of concerns regulated or governmental policies and legislation or other changes in the institutional environment” (Baldwin and Black, 2008, p. 73).

In our conceptual framework adaptivity in regulatory practice can be traced to several aspects of the regulatory process itself, as the regulatory arrangements are developed along the way. In this process the regulatory conversations provide for input from different voices: from the regulated market parties as well as other regulatory authorities and consumer representatives. Furthermore, the coevolution of the market, technology and regulation is visible in the exploratory way of working in which the uncertainties raised by new policies, technological innovation, unpredictable effects on the market and hard to assess services demand influence the process.

Our conceptual framework includes the uncertainties that are present in the coevolution of technology, market and regulation and how they influence the regulatory *Process of Matching and Mixing*. These uncertainties are equal to regulators and regulated firms alike. However, coevolution is not limited to the level of regulatory practice; it extends towards the level of policy making. Whereas we only studied the level of policy execution, the authors we discussed look into longer cycles of regulatory reform: they explore how coevolution over time will influence the institutional setting for regulatory practice. This is an additional concept to include in our conceptual framework. We summarize our synthesis on regulatory practice as a process for adaptivity in Table 46.

Table 46 Regulatory practice for coevolution

Regulatory practice for coevolution	Compares to our conceptual framework	We add to their conceptualization
Ayres & Braithwaite (1992)	The pyramid of regulatory strategies is linked to coevolution over time. Regulatory strategies are included in our conceptual framework labelled as the dimension of ‘strategic activities’	We explicitly include ‘reliance on market forces’ in our conceptual framework, which equals ‘doing nothing’. This is not explicitly visible in the concept of <i>Responsive Regulation</i> .
Baldwin & Black (2008)	The concept of <i>Really Responsive Regulation</i> is comparable to our core category of <i>Matching and Mixing</i> in its integrative approach as compared to <i>Responsive Regulation</i> and <i>Smart Regulation</i> , but focuses on cases of compliance.	Our core category of the <i>Process of Matching and Mixing</i> is a specification of <i>Really Responsive Regulation</i> towards a dynamic market in which compliance has a minor role and regulatory objectives of fair competition and safeguarding public values and consumer interests are more prominent.
Finger & Varone (2009)	The proposition of three alternative policy models for regulation refers to the type of actor(s) that can perform regulatory activities. As such it complements our conceptual framework on a different (longer) timescale with the concept of coevolution.	We include the influence of the uncertainties from the coevolution of technology, market and policy for regulatory practice.
Gunningham, Gabrovsky & Sinclair (1998)	The concept of <i>Smart Regulation</i> with its idea of regulatory pluralism that goes beyond the bi-partite relationship of a regulator and the regulated firms is captured in our category <i>strategic activities</i> within the dimension of <i>regulatory activities</i> .	In a competitive market like the mobile telecommunications market, regulatory pluralism is one of the strategic alternatives to top-down or co-regulation. We include regulatory pluralism in the category <i>strategic activities</i> and show how these can be combined with other available regulatory activities.

7.5. Synthesis of the conceptual literature review

In the previous sections we analysed concepts from extant literature on regulatory practice. This is the input for the synthesis in this section in which we reflect on how “[t]hrough comparing other scholars’ evidence and ideas with your grounded theory, you may show where and how their ideas illuminate your theoretical categories and how your theory extends, transcends, or challenges dominant ideas in your field” (Charmaz, 2006, p. 165).

For our conceptual literature comparison we selected literature in which concepts are presented that relate to how regulators deal with the tensions in the market, c.q. how they resolve market issues. Our core category is labelled the *Process of Matching and Mixing* as the main concern in their role as regulator is to select a suitable mix of regulatory activities that matches with the market issue at hand, along the way.

We now synthesize how extant theoretical literature presents the main concern of regulators. We grouped the literature into two major conceptualizations. The first way to conceptualize regulatory practice is to see it as a conversational process, either for knowledge exchange, for building trust or for rule interpretation (see section 7.4.1, Table 42, Table 43 and Table 44). This conceptualization refers to the way in which regulators solve knowledge gaps, trust issues and difficulties with rule interpretation. The second way to conceptualize regulatory practice is to see it as a process for adaptivity either to the regulated firms’ behavior or capabilities or to coevolutionary developments between technology, market and regulation (see section 7.4.2, Table 45 and Table 46).

How do these conceptualizations relate to our core category? How do they fit in with the conceptual framework and its dimensions that we developed? And how do we contribute to extant concepts or regulatory practice? We reflect on these issues for each concept separately before drawing our conclusions on the literature comparison.

The concept of *regulatory practice as conversation* is inherent in our conceptual framework in which the phases *Analysis*, *Exploration* and *Formulation* are characterized by interactions with market parties and other regulatory authorities. In the regulation of a CSTS, all parties involved (regulators as well as market parties) face uncertainties in developments in policy, technological innovation and market. These uncertainties require a process of information exchange between regulators and regulated firms. Intersystemic regulation can contribute to the information exchange when regulatory authorities cooperate either on an ad hoc basis or it can become permanent.

Our core category compared to regulatory practice as conversation for knowledge exchange:

- The extant concept of regulatory practice as conversation for knowledge exchange overlaps with our core category; conversations are inherent to the *Process of Matching & Mixing*;
- Our contribution to extant literature is the detailed picture of conversational activities that take place in regulatory practice and we present a refinement of the uncertainties that require conversations by our inventory of their sources;
- Future research can address the way in which intersystemic regulation evolves over time, this requires an analysis of cooperation between regulatory authorities and how it influences regulatory practice over an extended period of time. An increase in intersystemic regulation can lead to a new dimension in the conceptual framework, whereas it is now a sub category of the category *networking activities*.

The concept of *regulatory practice as conversation for creating trust* is also inherent in our conceptual framework due to the interactive nature of the regulatory process. The special function of developing trust relationships towards the creation of alternative regulatory strategies such as co- and self-regulation is a social aspect of regulatory practice.

Our core category compared to *regulatory practice as conversation for creating trust*:

- The extant concept of regulatory practice as conversation for creating trust refers to a social aspect of regulatory practice and is a refinement of our conceptual framework;
- Our contribution to extant literature is the distinction into two variants of alternative strategies: the enforced and the voluntary variant of co- and self-regulation. For the enforced variant the regulatees do not require trust, the threat of top-down regulation as alternative can be sufficient for a common strategy. We also show the role of technological innovation in reaching common action by the competing market parties. So the concept of trust does not apply to all situations, which is a refinement of the extant conceptualizations in literature;
- The extant literature uses discourse analysis to study trust building.

The concept of *regulatory practice as conversation for rule interpretation* is an inherent element of regulatory practice in mobile telecommunications markets. By performing procedural and networking activities rule interpretation is developed and tested in several consecutive phases of developing a regulatory arrangement. The *Process of Matching and Mixing* cannot be done without regulatory conversation on a micro-level.

Our core category compared to *regulatory practice as conversation for rule interpretation*:

- The extant concept of rule interpretation is an integral part of the *Process of Matching and Mixing* in our conceptual framework. The choice for a conversational or constructivist approach towards rule interpretation is implicitly part of the dimension *Regulatory Activities*. The CDA proposed by Lentz requires access to expressions by other actors involved such as the regulated firms. Whereas our empirical data related only to the regulatory authority;
- Our contribution to extant literature is that the choice for a conversational or constructivist approach is dependent on the issue at hand and can be chosen along the way during the development of a regulatory arrangement. Some rule interpretations may be better served by a conversational approach, some other interpretations may require a constructivist approach;
- The extant literature proposes CDA for a deeper level of understanding of regulatory practice.

The concept of *regulatory practice as a process for adaptivity* fits with our core category in which we explain how regulatory authorities develop the regulatory process along the way. However, the extant literature addresses two forms of adaptivity that are less apparent in our core category and our conceptual framework.

On the one hand adaptivity of regulatory strategies to be fitted to the non-compliant behavior or the attitudinal setting or the learning curve of the regulated firm is less apparent in the regulatory practice in the mobile telecommunications system in which compliance issues are limited. The matching for a regulatory strategy does occur but rather to the type of market issue at hand.

Our core category compared to *regulatory practice for adaptivity to the regulated firms*:

- Regulatory practice in the mobile telecommunications market is more challenging than an escalation or de-escalation in a clear order of increasingly stringent regulatory strategies. This is the main difference between concepts that are based on compliance versus concepts that fit with regulation of CSTS. In s CSTS regulatory practice is oriented towards the market level instead of the individual non-compliance cases of (really) responsive regulation and in addition, a mix of activities/interventions can be used. The approach of *really responsive regulation* resembles our conceptual framework of regulatory practice due to the application of the concept of matching. The extant literature also looks into the activities of the regulated firms, which was not the focus in our study;
- Our contribution to the extant literature is the influence of technological dynamics that needs to be taken into account in developing regulatory arrangements. These technological dynamics are hardly addressed in the extant literature;
- The extant literature also looks into the perspective of the regulated firms, whereas we chose for the perspective of the regulatory authority. Future research can explore the additional perspective of the regulated firms in the mobile telecommunications market, which can lead to an additional dimension in our conceptual framework.

The last conceptualization refers to *regulatory practice for adaptivity to coevolution* of technology, market/economics and policy making/regulation. Adaptivity to coevolution introduces a dynamic relationship between these three subsystems. This dynamic way of conceptualization requires learning capabilities for all actors involved in regulatory practice. As Finger & Varone (2009, p. 87) state, the static view of market regulation needs to be replaced by a dynamic approach of an

evolutionary market (Finger and Varone, 2009, p. 87). The concepts of *responsive regulation* and *smart regulation* present such a dynamic view on changes in the regulated firms and include a transfer towards self- and co-regulatory alternatives.

Our core category compared to *regulatory practice for adaptivity to coevolution*:

- Although our conceptual framework shows the internal dynamics of regulatory practice, the framework does not address cycles of change on a more extended timescale. We do address the uncertainties that represent coevolution within/among the market issues, but we do not address the consequences of coevolution for the institutionalization of the regulatory authorities themselves in the longer term;
- We offer a process approach to adaptivity for coevolution on the level of regulatory practice. This extends the extant concepts with a procedural dimension of coevolution.

7.6. Core category refined

The comparison of our conceptualization of the *Process of Matching and Mixing* with extant concepts from literature on regulatory practice enables us to assess the added value to our conceptual framework as well as to assess our contribution to the extant literature. We revisit the elements of our conceptual framework that we presented in sections 6.2 to 6.5 to structure our discussion.

7.6.1. Process of exploration

In 6.2 we formulated the following synthesis:

The characteristics of duration and intensity contribute to the conceptualization of regulatory practice as a process of exploration to develop a regulatory arrangement. During this process the issue at hand needs to be addressed by the appropriate activity or activities. The nature of the market issue (ex-ante/ex post; social rationale/economic rationale) influences the way in which the NRA explores the development of the regulatory arrangement along the way. This can turn out to be a rather straightforward or an exploratory process. This process of matching the market issue with a mix of regulatory activities along the way is the main concern of the NRAs. We therefore label our core category as a Process of Matching and Mixing. The conceptual framework needs to include this core category as a combination of the dimensions Market Issues and Regulatory Activities. In addition the Process of Matching and Mixing influences the duration and intensity of the development of the regulatory arrangement.

In the extant literature exploration is also conceptualized with the objective of solving knowledge gaps, creating trust and solving difficulties with rule interpretation. In addition, the exploration intends to match a regulatory intervention to fit with the regulated firm's behavior and or to fit with coevolution. Although the extant literature is more oriented on matters of compliance, the exploratory way of working is similar as in our domain of research.

Our study into the procedural aspects of regulation of CSTS extends the work by authors who looked into aspects of regulation in stable markets and do not address the influence of uncertainties that we discovered. Neither do the extant concepts go into the details of actual regulatory practice to show how the regulator uses a wide range of different activities to develop the regulatory arrangement.

We therefore conclude that:

- The concept of an exploratory process is core to both the extant literature and our core category;
- We provide a more integral overview of the way in which this exploratory process is executed in CSTSs, which enhances the understanding of how regulators address market issues and are influenced by uncertainties in the development of regulatory arrangements to contribute to the objectives of safeguarding public values and fair competition.

7.6.2. Phases

In 6.3 we formulated the following synthesis:

The distinction in phases contributes to the conceptualization of regulatory practice as a phased process to develop a regulatory arrangement. The phases are characterized by their nature of initiation, analysis, exploration, formulation and closure. After closure of the case the phases can be repeated when continued monitoring & evaluation takes place, when an appeal is made against the decision, or when new information is received. Also sequencing can lead to a repeated regulatory cycle. The conceptual framework needs to include the dimension Phases and the options after closure of the case.

Regulatory practice as a phased approach is not explicitly addressed in the extant literature that we used for our conceptual comparison. However, the concepts of responsive regulation and really responsive regulation do address the fact that repeated confrontations between the regulator and the regulated firms takes place and contribute to a mutual learning process. We did not analyse the way in which parallel running dossiers can influence decisions and regulatees' behavior due to playing chess at several boards at once. The extant concepts do not address the aftermath of a regulatory arrangement, whereas we show the continued monitoring and evaluation after a case is closed. Such activities are also part of regulatory practice. Therefore our framework offers a more extended overview of regulatory practice by displaying the phases and the aftermath of a regulatory arrangement, whereas extant concepts can add the interactions between the regulator and the regulated firms and as such add a more strategic dimension to our framework.

We therefore conclude that:

- The phases in our conceptual framework are illustrative of a continued regulatory process;
- The extant concepts do not address the aftermath of a regulatory arrangement, whereas we show the continued monitoring and evaluation after a case is closed. Such activities are also part of regulatory practice;
- Extant concepts from the perspective of the regulated firms can be used to extend the framework. As we took the perspective of the regulatory authority, their activities were not coded in full in this study. We solely considered their activities as object of regulation or as contributing to arrangements of co- and self-regulation.

7.6.3. Uncertainties

In 6.4 we formulated the following synthesis:

Five categories of uncertainties in the regulatory process can be defined:

- 1. the uncertainty of the effects of regulatory arrangements on the market;*
- 2. the development of new policies for rules and regulations;*
- 3. discussions on the authority of regulators to deal with market issues,*
- 4. difficulties to assess technological innovations and*
- 5. unpredictable services demand by end users.*

These uncertainties influence the regulatory activities and as such can lead to an extended or more intense process for the development of regulatory arrangements. The conceptual framework needs to include the dimension Uncertainties.

The extant concepts that we reviewed do not address the uncertainties in the regulatory process that all actors involved are confronted with. This is exemplary for regulation of CSTS and puts high demands on dealing with uncertainties in the development of a regulatory arrangement. Our conceptual framework includes these uncertainties.

The concept of coevolution as presented in extant literature addresses how the continued evolution of technology, market and regulation plays a role in institutional reform. However, we did not address the activities of regulated firms as we took the perspective of the regulatory authorities. In that respect extant literature which does look into the activities of the regulated firms can explain the influence of business strategies on regulatory practice.

We therefore conclude that:

- ➔ Our core category explains the challenges for regulating CSTS by including the sources of uncertainties;
- ➔ Adaptivity to coevolution is a concept that we addressed on the level of regulatory practice, but it also plays a role in the longer term of institutional reform;
- ➔ In our conceptual framework the influence of business activities are present in the regulatory dossiers but not explicitly considered as a source of uncertainty. Therefore extant concepts from this perspective can be used to extend our conceptual framework by continued/additional coding of empirical data.

7.6.4. Fine-tuning of the regulatory arrangement

In section 6.5.5 we formulated the following synthesis:

We found four categories of fine-tuning that take place in the formulation phase of the regulatory arrangement: choosing the actors to which a regulatory arrangement applies, determine the duration of the regulatory arrangement, whether regular evaluations should be applied and considering the lead time to implement an arrangement. The conceptual framework needs to include the dimension Fine-tuning in the Exploration and Formulation phase. The fine-tuning options are Explored and then finalized in the Formulation phase.

The fine-tuning of the regulatory arrangement is a dimension in our conceptual framework because of the objective to support market competition in the mobile telecommunications market amongst

market parties that are unequal in size and market share. Therefore regulatory arrangements can be either aimed at dominant firms only or at all competitors in the market. In addition, the dynamics in market development is addressed by fine-tuning the period to which the arrangement applies or needs to be evaluated. This is a strategy to cope with coevolution and thus can be compared to the concept of regulatory practice as a process of adaptivity.

- ➔ The conceptualization of regulatory practice as a process of adaptivity can not only be related to adaptivity to the regulated firm and/or coevolution, but also to adaptivity of the regulatory arrangement itself to match with the case at hand. It can be fine-tuned through details on the market parties it applies to, on the duration and by including evaluations to assess whether the arrangement can be lifted or needs to be continued. This is a dimension of regulatory practice that we contribute to the extant conceptualizations.

7.6.5. Adaptations to conceptual framework

Whereas all extant conceptualizations are in some way related to our core category and the other dimensions in our framework, the conceptualization of regulatory practice that we present complements extant literature in the domain of regulation. We provide a conceptual framework to explain regulatory practice in a complex socio-technical system such as the mobile telecommunications market. We also add the role of technological innovation that not only leads to market issues but is also a source of uncertainty and thus influences regulatory practice. Extant conceptualizations lack this attention to technological innovation but do address additional concepts such as the regulatory conversations on the micro-level of regulatory practice, the social and informal interactions between actors involved, the strategic behaviour of the regulated firms and the conversational versus constructivist approach to rule interpretation.

Based on the conceptual comparison we added the following elements:

- I. the category of business activities as an additional source of uncertainty;
- II. the market party behaviour as dimension to be taken into account in the *Process of Matching and Mixing*;
- III. the category of coevolution to position the longer timescale of changes in the mobile telecommunications market that influence contemporary regulatory practice.

The final conceptual framework is visualized in Figure 18. As the elements I-III are outcomes of the conceptual literature comparison, they require future research to assess influence on the dimensions and their relationships that are based in the empirical data of this study. They are therefor indicated by dashed lines in Figure 18.

7.7. Substantive concept of exploratory regulatory practice

Based on the adaptations to our conceptual framework, we extend our core category to take the additional matching activities into account. We use these adaptations to formulate the substantive concept of *Exploratory Regulatory Practice*. This substantive concept explains the way in which regulatory authorities deal with the tensions in the mobile telecommunications system.

The exploratory character of regulatory practice represents that an NRA explores:

1. the appropriate mix of activities to match with the market issue;
2. the development of an appropriate regulatory arrangement along the way, by going through the phases of initiation, analysis, exploration, formulation and closure (with a possible return of the market issue after closure of the case);
3. the influence of uncertainties on their regulatory activities;
4. the appropriate fine-tuning to formulate the regulatory arrangement;
5. the strategic behavior of the regulated firms and
6. how the coevolution of market, technology and regulation on a longer timescale influences contemporary regulatory practice.

The substantive concept of *Exploratory Regulatory Practice* explains the way in which regulatory authorities deal with the tensions and uncertainties in the mobile telecommunications system.

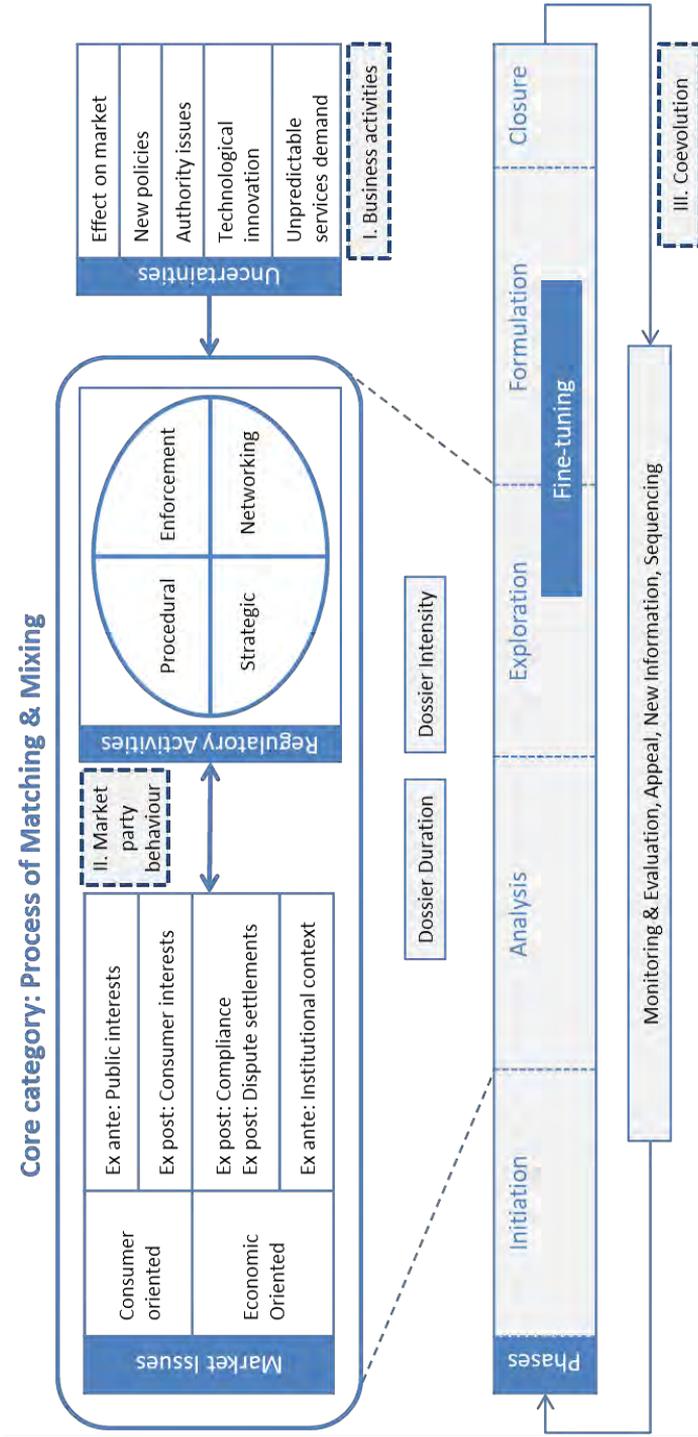


Figure 18 Final conceptual framework of Exploratory Regulatory Practice

7.8. Conclusion on conceptual comparison

Regulatory practice as a *Process of Matching and Mixing* emerged as the core category in our CGT study. The core category represents the “main concern and its recurrent solution” (Christiansen, 2011, p. 21) and “it accounts for most of the ongoing behavior in the substantive area being researched” (Glaser, 1998, p. 135). In our study the core category explains the main concern of NRAs in the regulation of mobile telecommunications systems: how to deal with market issues and which activities to perform towards the development of a regulatory arrangement. We integrated this core category and the other dimensions into a conceptual framework in section 6.6.

In this chapter we used a conceptual comparison to continue the development of our conceptual framework. To this end we formulated the sub question:

4. How does the conceptual framework of regulatory practice in the mobile telecommunications system compare and relate to extant theoretical concepts of regulatory practice?

We performed a literature search on concepts in extant literature that conceptualize ‘regulatory practice’ in general, which we defined as “the activities of a national regulatory authority in the process of regulation”. Based on the conceptual comparison we added the extant concepts of

- adaptation to *Market Parties’ Behaviour* in our core category;
- the sub category of *Business Activities* as a category in the dimension *Uncertainties* and
- the concept of *Coevolution* to denote the longer timescale of changes in the mobile telecommunications system that influence contemporary regulatory practice.

Based on the conceptual comparison we formulate our substantive concept of *Exploratory Regulatory Practice*. This substantive concept captures the relationships between the core category and the additional dimensions that influence the core category and thus regulatory practice as a *Process of Matching and Mixing*. The substantive concept of *Exploratory Regulatory Practice* contributes to the existing literature by the integration of dimensions that characterize regulatory practice in the mobile telecommunications system. This concept explains regulatory practice in the context of a CSTS on a practical level. Therefore we claim to have operationalized regulatory practice after a change in the institutional environment of the CSTS of the mobile telecommunications system took place. In the next chapter we evaluate our conceptual framework.

8. Evaluation of the Conceptual Framework

8.1. Introduction to evaluation of the conceptual framework

In this chapter we present the evaluation of our conceptual framework of *Exploratory Regulatory Practice* with its core category of the *Process of Matching and Mixing*. The central sub question is:

5. To which extent does the conceptual framework explain how regulatory authorities deal with the tensions in the mobile telecommunications system?

Amongst researchers that deploy a GT approach there is no uniform list of evaluation criteria. The differences can be traced back to the variants in GT that developed over time that we presented in section 3.3.3. However, GT researchers do share the opinion that the evaluation criteria that are applied to quantitative research do not one on one fit with the criteria for qualitative research because of their positivistic connotations, such as validity, significance, verification and reproducibility (Strauss & Corbin, 1990; Glaser, 1998; Lomborg & Kirkevold, 2003). Their arguments are based on the nature of qualitative research in which social phenomenon are object of study and the qualitative researcher who aims at conceptualization to describe and explain the social phenomenon. Due to the human interaction in the context of the study, the object of study is “not conceived of as static but as continually changing in response to evolving conditions” (Corbin and Strauss, 1990, p. 5). As a consequence, capturing this interaction to develop a theoretical explanation requires a research approach that respects the dynamics of interactions in the research field. To do so the research approach needs to work from the level of specific interactions towards a more abstract level to attain an explanatory set of related concepts.

Within a GT approach respect for these social dynamics are addressed by some of its core characteristics that are shared in all variants. These pertain to:

- Using an inductive approach to the empirical data, which implies not using a preconceived scheme for the coding but to let the concepts emerge from the empirical data;
- the method of constant comparison that leads to continued comparison between incidents found in the empirical data;
- theoretical sampling during the research process;
- the comparison with a conceptual literature review that is used as data, and
- labelling the research deliverable applicable to the substantive domain from which the empirical data were retrieved, to show the limitations of the explanatory power of the derived concepts. (Corbin & Strauss, 1990; Glaser, 1998; Lomborg & Kirkevold, 2003; Urquhart, Lehmann & Myers, 2010; Rieger, 2019).

These core characteristics are at the base of the evaluation criteria for a GT study. Corbin & Strauss mention that “[e]very mode of discovery develops its own standards – and canons and procedures for achieving them. What is important is that all of these are made explicit.” (Corbin and Strauss, 1990, p. 4-5). The terminology used in literature on the evaluation of GT studies shows a wide variation of criteria. Therefore we restrict ourselves to an overview of criteria related to the three main variants of the GT approach that we introduced in section 3.3.3: the Classic, Straussian and Constructivist GT approaches. In Table 47 we summarize the evaluation criteria that are commonly attributed to these three variants, with the remark that apart from the ones in the CGT approach, the other criteria are subject to evolution. This is amongst others presented by Rieger who shows the evolution in evaluation criteria that were formulated by Strauss and Corbin in their consecutive publications (Rieger, 2019).

The evaluation criteria in Table 47 indicate that the grounding of the theory in the empirical data is a common criterion to all three main GT approaches: the outcomes of a GT study must represent the behavioral patterns and be recognizable by the human actors to which the theory refers (*fit, empirical grounding, credibility, resonance*). The constructivist GT approach goes beyond recognizability by stating that the derived theory must also offer guidelines for the daily lives of the human actors in the study (*usefulness*). The Straussian and the Constructivist GT approaches share the importance of presentation of the derived concepts which should enable readers to assess the analytical process (*adequacy/credibility*), whereas in the CGT more room is given to the creative leaps that can be made by the researcher (Langley, 1999), but still the main concern of the actors in the area of research should be captured by the core category (*relevance*). In the constructivist GT approach the researcher is expected to “develop mutuality with participants” (Rieger, 2018, p. 8), which requires reflexivity from the part of the researcher on possible bias of interpretation of the empirical data. In addition, the human actors involved in the study should be able to identify with the findings (*resonance*). The CGT and SGT have in common that the theory/conceptualization is open to change over time in order to continue to be relevant and to continue to offer new theoretical insights (*relevance, modifiability, grounding of the research findings*).

Table 47 Evaluation criteria in variants of GT approaches

Legend: this table is based on (Strauss & Corbin, 1990; Urquhart, 1997; Glaser, 1998; Lomborg & Kirkevold, 2003; Charmaz, 2006; Rieger, 2019)

Type of GT approach	Evaluation criteria used
Classic Grounded Theory Approach (based on (Glaser, 1998, pp. 236-237))	Fit: refers to the extent in which the theoretical concepts that are developed are firmly based in (patterns in) the empirical data
	Relevance: refers to the degree in which the core category explains the behavioral patterns or the main concern of the actors in the substantive area of research
	Work(ability): aims to evaluate the explanatory power of the conceptual framework and its potential for prediction
	Modifiability: refers to the extent in which the theory is open to modification based on continuation of the constant comparative method or comparison with extant conceptual literature
Straussian Grounded Theory Approach (based on (Corbin & Strauss, 1990))	Adequacy of the research process: refers to presentation of the research process in such a way that a reader can assess how the analytical process was performed, which decisions were made going from the empirical data towards the conceptualization.
	Grounding of the research findings: refers to the strength of the categories that are generated and the relationships between them to generate a theory with explanatory power. Additionally, the theory should reflect interaction over time and offer new theoretical insights
	Strauss & Corbin provided different sets of criteria over time, a.o. ten criteria in (Strauss & Corbin, 1998). In 1990 they published the following criteria: 1. validity and credibility of the data 2. plausibility and value of the theory itself 3. adequacy of the research process 4. empirical grounding of the research findings
Constructivist Grounded Theory Approach (based on (Charmaz, 2006, pp. 182-183))	Credibility: the GT that has been developed needs to show a strong link between the intimate observations and the categories that are based on them. The presentation of the GT needs to be convincing and suitable for an independent assessment by others.
	Originality: the GT that has been developed needs to offer new conceptual insights and invite a theoretical discussion on its contribution to extant concepts
	Resonance: the GT should have resonance in the community/context of study. This entails that the human actors to which the theory refers should be able to identify with the findings.
	Usefulness: the derived theory is useful when it can offer guidelines in everyday life of human actors as well as yield generic concepts that can be used/extended in other substantive contexts.

Based on our research beliefs, we chose to follow the CGT approach in this study. Therefore we use the evaluation criteria that are defined by Glaser, co-ordinator of CGT. These evaluation criteria are: fit, relevance, workability and modifiability. The order of the criteria is deliberate, fit should come first and each next criteria is supported by the previous one(s) (Glaser, 1998). In the following sections we present these evaluation criteria to evaluate our conceptual framework one by one (sections 8.1.1 to 8.1.4) before drawing the conclusion on the evaluation in section 8.2.

8.1.1. Fit

The first evaluation criterion of 'fit' is defined as follows:

"Fit is another word for validity which means does the concept represent the pattern of data it purports to denote. This is the beginning functional requirement of relating theory to data" (Glaser, 1998, p. 236).

As such *fit* refers to the extent in which the theoretical concepts that are developed are firmly based in (patterns in) the empirical data. The criterion relies on the open approach to the empirical data and trusting in the emergence of concepts from the data: the core category and substantive theory should be based on the empirical data and as such 'represent the pattern of data' (Glaser, 1998; Rieger, 2019). This way of working is in contrast with coding the data by means of a predefined theoretical framework (Lomborg and Kirkevold, 2003, p. 191).

In our study we did not use sensitizing concepts nor a predefined list of codes derived from extant theories. Instead, in the open coding phase we applied line-by-line coding and the initial codes were chosen as closely as possible to terms used in the documents that we coded. Labelling the codes as activities was a bottom-up step and fits with our main objective to explain *how regulatory authorities deal with the tensions in the mobile telecommunications system*. This 'how'-question is an open question; it is through the coding of the regulatory dossiers that we arrived at a long list of types of activities which we labelled as properties. As such, the properties represent the activities that were actually performed by the regulators, thus we consider them to be well grounded in the empirical data on the practice of regulators. In the selective coding phase we grouped the properties of the regulatory activities into sub categories (procedural, networking, strategic and enforcement activities) to form the dimension of *Regulatory Activities*.

In the theoretical coding phase we combined the dimension of *Market Issues* with the dimension of *Regulatory Activities*. This combination led to the core category of the *Process of Matching and Mixing*. We consider our core category to be compliant with the criterion of 'fit' as defined for a classic GT approach: there is a strong link with the empirical data that we illustrated by means of examples in chapters 0 and 5. Also the other dimensions of *Uncertainties* and *Fine-tuning* were derived through line-by-line coding of the empirical data. Consequently, we consider the concepts in our framework to be firmly based in (patterns in) the empirical data and, thus, compliant with the criterion of 'fit'.

8.1.2. Relevance

The criterion of relevance in a GT study refers to the degree in which the core category explains the behavioral patterns or the main concern of the actors in the substantive area of research. Glaser formulates relevance as follows:

"And what emerges with fit is the next criteria; relevance. It is automatic that the emergent concepts will relate to the true issues of the participants in the substantive area. Grounded theory generate[s] a theory of how what is really going [on] is continually resolved" (Glaser, 1998, p. 236).

In other words: we evaluate whether our core conceptual framework can be considered relevant by showing the main concern of the regulatory authorities in the mobile telecommunications system.

For this evaluation criterion we need to reflect on our choice for using formal documents as source for the empirical data. As researcher we did not participate in the regulatory process; neither did we interact with the actors in the substantive domain of research. Interaction with the participants in the substantive domain during the research process is an alternative method of data collection in studying a social phenomenon, but can also lead to bias in the coding due to a smaller set of available empirical data and the researcher's role (Glaser, 1998). Instead we used formal documents

that yielded a large set of empirical data which could not have been possible via participatory observation, interviewing or other qualitative data collection methods. But the consequence was that we analysed regulatory practice with less emphasis on the social micro processes and the human aspects of regulatory practice. However, the use of formal documents allowed us to counterbalance the risk of bias in the empirical data by the large amount of data from five years of regulatory dossiers of three NRAs. In the GT approach this is deemed important “to establish that the frequencies and patterns of the findings indicate an objective reality which is not influenced by the researcher’s bias” (Wu and Beaunae, 2014, p. 11). Through the coding of the empirical data we arrived at a core category that presents the main concern of the NRAs: how to mix their (types of) activities to match with the market issue at hand and how to deal with uncertainties in order to develop a regulatory arrangement.

We therefore consider that our conceptual framework demonstrates “what’s really going on that is important to the people in the substantive area” (Glaser, 1998, p. 237) and as such can be considered to comply with the criterion of ‘relevance’.

8.1.3. Workability

For the criterion of ‘workability’, Glaser uses the following description:

“With concepts that fit and are relevant the grounded theorist starts to integrate a core category and sub-core category theory that account for most of the variation of behavior in the substantive area. He starts to explain how the main concern of the participants is continually resolved” (Glaser, 1998, p. 237).

Workability is one step further than relevance and aims to evaluate the explanatory power of the conceptual framework and its potential for prediction (Lomborg and Kirkevold, 2003, p. 191). We therefore discuss the conceptual framework on the extent in which it explains how the regulatory authorities continually solve the tensions in the market and deal with uncertainties in developing a regulatory arrangement. And the extent in which the conceptual framework has predictive power.

The explanatory power of our conceptual framework of *Exploratory Regulatory Practice* is grounded in the integration of the dimensions and their relationships as visualized in the conceptual framework. We do not only show the tensions in the market that the NRAs need to take into account, but also the process by which they address them. The framework explains which types of market issues are dealt with, how they are dealt with and why (for social and economic rationales), how uncertainties influence the regulatory activities and how the process of developing a regulatory arrangement requires several consecutive phases, see Table 2 (Gregor, 2006). The explanatory power is from the perspective of these authorities in the specific context of mobile telecommunications system (we reflect on this specification in section 9.5).

Our conceptual framework of *Exploratory Regulatory Practice* has explanatory power; however we are critical on its predictive power. Corbin & Strauss state: “A grounded theory should explain as well as describe. It may also implicitly give some degree of predictability, but only with regard to specific conditions” (Corbin and Strauss, 1990, p. 5, emphasis added). We discuss the limitations of the predictive power of our conceptual framework, which we interpret as whether the framework can

predict how regulatory authorities will deal with future issues in the mobile telecommunications market.

First, the predictive power of our framework is limited to the substantive domain of the mobile telecommunications system. By means of the method of constant comparison, a GT study leads to concepts that are “abstract from time, place and people” (Glaser, 1998, p. 160). However, our conceptual framework is developed to explain regulatory practice in the mobile telecommunications system. Therefore, any predictive power would be limited to this substantive domain. Future research can lead to a more general theory of regulatory practice; we come back to this in the next section on modifiability.

Second, the framework explains a social phenomenon in a dynamic environment. Although we discovered patterns in regulatory practice, the dynamics in a CSTS are such that unpredictability is one of its key characteristics. We presented this in section 1.3 where we defined the mobile telecommunications system as a CSTS. The substantive concept of *Exploratory Regulatory Practice* reflects this unpredictability and offers a way to deal with it at the same time. In that respect the substantive concept is predictive: CSTS require exploratory regulatory practice to address market issues and uncertainties.

Third, although we do indicate influences between the dimensions in the conceptual framework, these are not testable propositions (Bacharach, 1989). Our conceptual framework is a process framework, not a conceptual model with independent and dependent variables (Webster and Watson, 2002, p. xix). We refer to Langley’s (1999) article on strategies for theory development based on process data, in which she states that “*Some [research] strategies seem best adapted to the detection of patterns in processes, whereas others penetrate their driving mechanisms. Some are more oriented toward the meaning of the process for the people involved, whereas some are more concerned with prediction*” (Langley, 1999, p. 695). We were not looking for the effects of regulatory activities on the outcomes of regulatory arrangements or higher level objectives, but took a process-oriented perspective. So our research objective was not to yield predictions, but explanations. However, the conceptual framework does show the relationship between the dimensions and as such can be used for future research focused on deriving predictions, e.g. a proposition can be generated to test for the strength of influence of uncertainty in specific types of market issues. This will translate elements of the process framework towards a variance model (Langley, 1999), but this requires further research that is beyond the aim of our study.

Fourth, the types of issues in the market will change with new generations of mobile standards and with new actor roles and services in the market. The regulatory activities will change with new regulatory frameworks for more mature markets (see Figure 3). Public values are dynamic over time (see section 1.3.2) and business models change due to technological advance (see e.g. section 6.4.4). Therefore the dimensions or their categories can change over time and the conceptual framework gives guidance where to look for these changes and the core category of *Exploratory Regulatory Practice* enables regulatory authorities to address changes. For example, the overview of the market issues provides evidence for future market issues that may reoccur, e.g. with the licence allocation for the 5th generation of mobile networks (5G). This is a new stage in the mobile telecommunications market in which changes in the technical subsystem will lead to new uncertainties and thus to interactions between the institutional and multi-actor subsystems. We elaborate on this by

presenting an example of changes over time, with the constant variable that NRAs continue to match and mix their activities with the type of issue at hand:

5G mobile networks will provide high bandwidths for real time data exchange and Internet of Things applications. Potential 5G based services such as for autonomous vehicles, virtual reality applications or video streaming require low latency, which puts high pressure on the quality of the network also in terms of reliability and availability (Shafi et al., 2017). To this end full coverage by means of 5G antennas is required, which leads to huge investments by MNOs. They will compete for market share and RoIs which may be at odds with network coverage in rural areas (Brown, Fitch, Owens, Saunders, Sutton & Temple, 2016; Bauer & Bohlin, 2018). On the other hand, citizens may protest against the multitude of antennas that are installed in their living environment and may raise health concerns because of the increased use of radio magnetic fields (Betzalel, Ben Ishai & Feldman, 2018; Sun, Zhang, Hu & Qian, 2018; Singh, Gupta & Sharma, 2019). Thus public values and fair market competition will continue to be on the regulatory agenda and regulators will be confronted with market issues. They will need to find a match between the types of new issues and their regulatory activities to develop arrangements to deal with them (or not).

In conclusion, we consider our conceptual framework to comply with the criterion of workability as defined as an integrated framework that explains "*how the main concern of the participants is continually resolved*" (Glaser, 1998, p. 236). In our conceptual framework the dimensions are integrated and the relationships between them are made explicit. The framework has explanatory power as it explains how regulatory authorities address the market issues by means of the substantive concept of *Exploratory Regulatory Practice*. As regards the predictive power of the framework we offered a critical reflection as we developed a process framework and not a conceptual model with independent and dependent variables.

8.1.4. Modifiability

The last criterion for evaluation in a classic GT approach is 'modifiability'. This criterion is defined as follows:

"In understanding and applying the grounded theory new incidents occur that might not be included. Through the constant-comparative method, the theory can constantly be modified to fit and work with relevance. The literature review modifies the theory when appropriate. ...The theory gets modified by subsequent data: period." (Glaser, 1998, p. 237).

As we illustrated in our conceptual comparison, extant literature was used to enhance the initial conceptual framework to e.g. include strategic behavior of regulated firms. But also additional empirical data can lead to extension of the (sub)categories and dimensions in the conceptual framework, e.g. extra or other regulatory activities can be discovered or new uncertainties can be found.

We used empirical data from the period 1997-2002 for our conceptualization, with the idea that this was a period in which a lot of regulatory activities took place shortly after the liberalization of the mobile telecommunications market and the installment of sector-specific independent regulatory

authorities. In the meantime, licences for 4th generation mobile networks have been allocated, mobile services abound, new actors have entered the market (e.g. app developers), the European Regulatory Framework from 2004 onwards became more based on generic principles of competition law and the 5th generation of mobile networks is on the verge of exploitation. These changes can be used to continue the coding of empirical data from regulatory dossiers, towards a continued development of the conceptual framework and its core category.

In addition, empirical data on regulatory practice in other CSTS can be used to continue the coding process and additional conceptual comparison can be used to go beyond a substantive conceptualization (SGT) towards a formal grounded theory (FGT). This process of modifiability towards a FGT is described by Glaser as follows:

"All grounded theory has the generalizing implication....Generalizing to another area yields substantive generality. Generalizing to many substantive areas starts to generate a formal theory". (Glaser, 1998, p. 241).

On working towards an FGT, Glaser comments:

"Thus FGT can be defined as a theory of a SGT core category's general implications, using, as widely as possible, other data and studies in the same substantive area and in other areas" (Glaser, 2007, p. 99).

To summarize: by means of continued coding of empirical data and conceptual comparison the core category and conceptual framework can be extended. By means of continued research into regulatory practice the framework for the substantive domain of regulatory practice in the mobile telecommunications system can be developed into a more general conceptual framework of *Exploratory Regulatory Practice* that can be applicable to other regulatory domains and other CSTS.

8.2. Conclusion on evaluation of the conceptual framework

In this chapter we addressed the sub question:

5. To which extent does the conceptual framework explain how regulatory authorities deal with the tensions in the mobile telecommunications system?

We evaluated our conceptual framework of *Exploratory Regulatory Practice* with its core category of the *Process of Matching and Mixing* by using the criteria for a classic GT approach: fit, relevance, workability and modifiability. We claim that our framework matches these criteria, based on the following arguments:

1. *Fit*: our coding of the empirical data was performed without predefined codes or theoretical concepts; our concepts are firmly based in emergence from the empirical data;
2. *Relevance*: our conceptual framework demonstrates "what's really going on that is important to the people in the substantive area" (Glaser, 1998, p. 237) and as such can be considered to comply with the criterion of 'relevance';

3. *Workability*: we developed an integrated conceptual framework with concepts of regulatory practice that explains “*how the main concern of the participants is continually resolved*” (Glaser, 1998, p. 236). The relationships between the dimensions are established. We therefore consider our conceptual framework to comply with the criterion of workability. The framework has explanatory power as it explains how regulatory authorities address the market issues by means of the substantive concept of *Exploratory Regulatory Practice*. We did not strive for developing a predictive framework.
4. *Modifiability*: Our conceptual framework can be extended towards a more generalized theory of regulatory practice as an exploratory process to deal with tensions in the market and uncertainties in CSTS. Data from other substantive domains or extant theoretical concepts can be used to extend, add or modify dimensions of the conceptual framework, potentially towards the development of a formal grounded theory of regulatory practice.

In the next and last chapter we conclude our study with answering our main research question, presenting the scientific and societal contribution and reflecting on the research process. Finally, we formulate future research topics.

9. Conclusion and Reflection

In our study we developed a conceptual framework of regulatory practice in a CSTS by following a GT approach from a socio-technical perspective. The framework explains how regulatory authorities deal with the tensions and uncertainties in the mobile telecommunications system. We hereby contribute to a knowledge gap in academic literature in the field of regulatory studies in the mobile telecommunications markets. In these studies only slices of regulatory practice are presented and the focus is more on analysis and description rather than conceptualization. We claim to have developed a conceptual framework that is firmly based in empirical data and as such fits with the actual practice of the regulators in an era in which a major institutional change took place in the (mobile) telecommunications system.

In this concluding chapter we show how the answering of the sub questions led to the objective of developing the conceptual framework in section 9.1. In section 9.2 we present our scientific contribution and in section 9.3 our societal contribution. Next, in section 9.4 we reflect on our research process. And in section 9.5 we formulate future research topics.

9.1. Conceptual framework of regulatory practice

With the increasing dependence of many of today's essential services for society on large scale technical infrastructures, their regulation presents a challenge to deal with the tensions in these CSTSs. These systems are characterized by multiple actors with potentially conflicting interests but also interdependency, by public values that need to be safeguarded and by technical dynamics due to innovations. The interactions between the institutional, the multi-actor and the technical subsystems lead to markets that are dynamic and subject to uncertainties.

One of these CSTS is the mobile telecommunications system, which is central in this study. The mobile telecommunications market became a CSTS after a major change in the institutional subsystem: the liberalisation of the telecommunications market in the EU from 1997 onwards. This reform turned the telecommunications market from a state monopoly into a competitive market. As

a consequence changes in the institutional, the multi-actor and the technical subsystem occurred. The interactions between these subsystems led to tensions between MNOs, SPs, retailers and end users. The tensions reflect the juxtaposition between the business oriented objectives that compete for market shares and return on investments versus regulatory objectives that aim for fair market competition and public values. However, despite their competition, the market players also have common interests in a well-functioning overall mobile telecommunications system.

The current literature on regulation of mobile telecommunications markets does not provide a conceptual overview of how regulatory authorities deal with the tensions in the mobile telecommunications market as a CSTS. Extant literature is rather focused on studying the use and effect of specific regulatory interventions in the market or the authors take a mono-disciplinary perspective to analyze the mobile telecommunications market, such as an economic or legal perspective (see 2.4.3). This ignores the relationship between the tensions in the subsystems in order to assess how interventions will affect other parts of the CSTS. Regulatory authorities need to assess these interdependencies and to deal with uncertainties in the system. In our study we aim to explain how they do so.

In chapter 2 we presented a systematic literature review over the period 1989-2019 to know which aspects of regulation of the mobile telecommunications market were covered by extant academic literature. The results show that the literature is very fragmented, the majority of the sources look into a single regulatory instrument, conceptualization is rarely the aim of the authors' research activities and a process-orientation on regulation is lacking. This means that a conceptual view on regulatory practice in the mobile telecommunications market is lacking. No integral overview is available that shows the process by which regulatory authorities respond to market issues in the complex socio-technical mobile telecommunications system over time. And no study so far explains the sources of uncertainties that regulatory authorities are confronted with in the execution of their regulatory practice. Therefore, our research objective was ***to develop a conceptual framework of regulatory practice that explains how regulatory authorities deal with the tensions and uncertainties in the mobile telecommunications system.***

In chapter 3 we presented our research philosophy and our research strategy. We chose an inductive, exploratory research approach. The classic GT approach fits with our research philosophy and provides for a structured way of working to ground the conceptual framework in empirical data. Our research strategy consists of three phases of coding: open, selective and theoretical coding. These coding phases led to the development of dimensions for the conceptual framework of regulatory practice.

In chapter 4 we developed the first dimension that represents the market issues, by answering the sub question:

1. How to conceptualize the market issues that a national regulatory authority in the mobile telecommunications system deals with?

We collected the empirical data from 61 regulatory dossiers that three NRAs dealt with: OFTEL in the United Kingdom, OPTA in the Netherlands and ART in France, over the period 1997-2002. The reconstruction of these regulatory dossiers yielded the empirical data for the coding process. For the open and selective coding phases we used software for QDA: Atlas.ti.

We created the dimension *Market Issues* by means of the categories of social and economic rationale for regulation, each with sub categories of ex post and ex ante regulation (see Table 25).

Ex post social regulation consists of safeguarding consumer interests by means of individual consumer's complaint handling. Ex ante social regulation aims at safeguarding public interests for the wider public, such as defining favorable terms of usage, striving for reasonable retail tariffs and promoting quality of service in mobile services.

Ex post economic regulation consists of compliance management, which is regulating cases of non-compliance with legal rules and dealing with dispute settlement cases that are requested by market parties or dealing with market parties' complaints. Ex ante economic regulation aims at developing the institutional context on the infrastructural level for interconnection and interoperability and supporting technological or service innovation by developing market conditions to enable the adoption of new technologies or services.

The next dimension that we created for the conceptual framework refers to the NRA's regulatory activities. To this end we answered the sub question:

2. How to conceptualize the activities that a national regulatory authority in the mobile telecommunications system performs to deal with market issues?

We used the textual reconstructions of the 61 regulatory dossiers in a chronological order. In the phase of open coding we coded every single activity by means of line by line coding, which yielded 525 so-called properties. By means of selective coding we grouped the regulatory activities into four categories:

- *Procedural activities*: The procedural activities are the actions of (mainly but not exclusively) the regulatory authority to support the process of dealing with a market issue;
- *Enforcement activities*: The enforcement activities represent the decisions that the NRA takes to solve a market issue. The enforcement activities represent the decisions that the NRA takes to solve a market issue. Examples are behavioral directions such as a designation of SMP, penalties or a licence adaptation.
- *Strategic activities*: The strategic activities represent the options that a regulatory authority has to refrain from a top-down regulatory approach in solving a market issue. Instead, a solution is found by relying on market forces or on communal actions with or by the market parties;
- *Networking activities*: The networking activities are those activities that either another national or international regulatory authority performs within an NRA dossier, or the other way around: the activities that an NRA performs for other regulatory organizations.

These four categories form the dimension *Regulatory Activities*.

For the phase of theoretical coding, we formulated the following the sub question:

3. Which are the dimensions and their relationships for the conceptual framework for regulatory practice in the mobile telecommunications system?

In the theoretical coding phase we established the relationship between the dimensions *Market Issues* and *Regulatory Activities* to create the core category that explains the main concern of the NRAs in dealing with the tensions in the mobile telecommunications system. We labelled our core category as the *Process of Matching and Mixing* because the main concern of the regulatory authorities is choosing an appropriate mix of activities that matches with the market issue at hand along the way.

This core category is at the center of the conceptual framework that further consists of the following dimensions:

- a phased approach, including the aftermath phase of a regulatory arrangement;
- the uncertainties that influence the regulatory activities and
- the fine-tuning of the regulatory arrangement in the *Exploration* and *Formulation* phases.

We integrated the dimensions into a first version of our conceptual framework of regulatory practice in the mobile telecommunications system. This visualization of the framework is presented in Figure 15.

The subsequent phase in our GT approach was the conceptual comparison in which we answered the following sub question:

4. How does the conceptual framework of regulatory practice in the mobile telecommunications system compare and relate to extant theoretical concepts of regulatory practice?

We compared our conceptualization of regulatory practice in the mobile telecommunications market with conceptualizations from academic literature on regulatory practice in general. To this end we performed a conceptual literature review to evaluate our framework in a theoretical way and to argue for our contribution to extant conceptualizations. By means of coding the selected articles, we discerned two main conceptualizations of regulatory practice (presented in the concept matrix in Table 41):

A. Regulatory practice as conversation, with three different functions of communicative processes:

1. for knowledge exchange (Black, 2002; Minoque, 2002; Ahdieh, 2006; Finger & Varone, 2009);
2. for building trust (Black, 2002; Minoque, 2002; Eccles & Pointing, 2013);
3. for rule interpretation (Lentz, 2001; Black, 2002; Georgosouli, 2009).

B. Regulatory practice as an adaptive process, with two forms of adaptivity:

1. adaptivity to the behavior of the regulatees (Ayres & Braithwaite, 1992; Gunningham, Grabosky & Sinclair, 1998; Baldwin & Black, 2008; Eccles & Pointing, 2013);
2. adaptivity to the coevolution of regulation, technology and markets (Gunningham, Grabosky & Sinclair, 1998; Finger & Varone, 2009).

The comparison showed that our core category of the *Process of Matching and Mixing* complements other studies that do not take the integral regulatory process as object of study. Other studies rather deal with the outcomes of the process or with markets that do not show the dynamics of markets

like the mobile telecommunications market. The extant concepts contribute to our conceptualization by addressing the matching of a regulatory arrangement with the behavior of the regulatees, by identification of the business activities of the regulated firms as a source of uncertainties and by including the coevolution in technology, market and regulation on an extended timescale.

Based on the conceptual comparison we adapted our conceptual framework (see Figure 18) and formulated our substantive concept of *Exploratory Regulatory Practice*. The exploratory character of regulatory practice refers to the exploration of:

1. the appropriate mix of regulatory activities to match with the market issue;
2. the development of a regulatory arrangement in a phased process along the way;
3. the influence of uncertainties on their regulatory practice and the development of the regulatory arrangement;
4. the appropriate fine-tuning of the regulatory arrangement;
5. the strategic behavior of the regulated firms and
6. how the coevolution of market, technology and regulation on a longer timescale influences contemporary regulatory practice.

In the last phase of the CGT approach we evaluated the conceptual framework by answering the sub question:

5. To which extent does the conceptual framework explain how regulatory authorities deal with the tensions in the mobile telecommunications system?

We used the evaluation criteria from the CGT approach: fit, relevance, workability and modifiability. The conceptual framework is well grounded in the empirical data, without using preconceived codes or concepts (*fit*). The framework demonstrates the actual concern of the regulatory authorities which is how to deal with the market issue and uncertainties in their regulatory practice (*relevance*). We developed an integrated conceptual framework in which dimensions of regulatory practice and their relationships are established. The framework has explanatory power as it explains how regulatory authorities address the market issues through *Exploratory Regulatory Practice* (*workability*). The core category and conceptual framework are both modifiable: data from other substantive domains or extant theoretical concepts can be used to extend, add or modify dimensions of the conceptual framework, potentially towards the development of a formal grounded theory of regulatory practice (*modifiability*).

9.2. Scientific contribution

The regulation of complex socio-technical systems requires conceptual frameworks to understand the interactions between the institutional, multi-actor and technological subsystems and how this influences regulatory practice. In this study we developed such a conceptual framework for regulatory practice in the mobile telecommunications system.

In our contextual literature review (see section 2.4.3) we found that conceptualization is rarely the aim of the authors' research activities in the domain of regulation of mobile telecommunications markets. The majority of the authors study a single market issue or a single regulatory instrument,

hence a process-orientation on regulation is lacking and the studies predominantly represent an economic or legal erspective on regulation. We address our contribution to these knowledge gaps as follows.

First, the scientific relevance of this study is in the contribution to regulatory studies in the telecommunications domain that so far lacked a socio-technical perspective on the regulatory process at the level of dealing with market issues. This denies the importance of looking into interactions between the subsystems in order to formulate regulation for such a CSTS. Our conceptualization of regulatory practice provides an overview of the dimensions that illustrate the way in which the regulatory authorities deal with the tensions between the market parties and the uncertainties that arise from these interactions by means of exploratory regulatory practice. Academic researchers in the (mobile) telecommunications domain can take a more conceptual approach in their regulatory studies as this is needed for society, policy makers and regulators to understand the tensions in CSTS. Very detailed or abstract analyses need to be complemented with conceptualizations of regulation that address the actual concerns of regulatory authorities. Our study provides an example of such a research approach.

Second, we contribute to the contextual literature by providing a full overview of market issues in the mobile telecommunications market over an extended period of time. We also provide a full overview of (types of) regulatory activities that can be used to develop a regulatory arrangement. In addition we identify the sources of uncertainties that influence regulatory practice. This complements studies in which a single market issue or a single regulatory instrument are studied. Those offer indepth analyses but are limited to slices of regulatory practice and as such do not present the complete picture of regulation as a process in which a multitude of activities are performed to develop a regulatory arrangement in a CSTS.

Third, our substantive concept of *Exploratory Regulatory Practice* contributes to the academic literature with its process-orientation towards dealing with tensions in the mobile telecommunications system. For researchers in regulatory studies the conceptual framework provides for a socio-technical perspective that transcends an economic or legal perspective. The conceptual framework opens the black box of regulatory practice and shows the context in which legal and economic aspects play a role in regulatory practice. CSTSs require such approaches in order to assess the consequences of an intervention in one of the subsystems and how this influences the other subsystems.

In addition to our contributions to knowledge gaps in the academic literature, we consider our conceptual framework of *Exploratory Regulatory Practice* to have the potential for conceptualization in other substantive areas. We base this on the argumentation that the tensions in the mobile telecommunications system were high in the period for which we collected the empirical data due to interaction between the changes on different aspects: technological innovation in mobile telecommunications, the installment of new independent regulatory authorities, a new European regulatory framework, new entrants in the market and a vast uptake of mobile services in society. As such we expect that the framework covers regulatory practice in similar CSTSs. As we did not test this within this study the explanatory power of *Exploratory Regulatory Practice* in other CSTS is subject to future research (see 9.5.2). In the next section we discuss our societal contribution.

9.3. Societal contribution

Valorisation of academic research refers to the contribution of academic research to society. Therefore we reflect on the relevance of our study for actors who are involved in the regulation of mobile telecommunications systems.

This study provides a full overview of the market issues that took place after the licences for frequencies for mobile telecommunications networks were granted. This overview can be used to evaluate and design the requirements for next generation mobile telecommunication networks that are either stated in law and regulations or in the licences to operate such networks. The overview can support policy makers and regulators to assess whether the licences and the regulations for future generations of networks sufficiently address potential market issues.

With new generations of mobile networks new issues may arise that can be assessed with the conceptual framework, but they may also lead to new categories in the dimensions of the framework (see section 9.5.2). The character of 5G mobile technologies allows for new types of services, for which “[v]alue generation ... and the rate and direction of innovation hinges on the realization of innovation complementarities between networks, applications and services” (Bauer and Bohlin, 2018, p. 9). Subsequently, new actors will be involved in the creation of mobile services, for example experts from application domains such as health, mobility and smart cities (Bauer and Bohlin, 2018, p. 9). In our conceptual framework we include the uncertainties that are based in a diversity of sources. For 5G these uncertainties will be present too and will be hard to predict, therefore a process-orientation in regulatory practice is required. The concept of *Exploratory Regulatory Practice* serves this goal.

Our study also shows that mobile networks are CSTS of which one of the characteristics is the unpredictability of its future developments. We position that regulatory authorities need an exploratory way of working to deal with these uncertainties. The more variance in procedural, networking, strategic and enforcement activities they can perform and combine, the better they are equipped to address the tensions that require regulatory activities. To this end the conceptual framework can be used to evaluate whether a regulatory authority can perform the required regulatory activities to deal with market issues. Or to assess how intersystemic regulation can be applied if the NRA cannot perform the required activities, or does not have the required knowledge nor the legal authority to develop a regulatory arrangement.

Finally, an increasing number of actors from municipalities, mobile application domains, NGO's and citizens will be involved in discussions on next generations of mobile networks and services such as 5G. Our study provides them with an overview of potential tensions and uncertainties with which they can be confronted. Concepts from this study can be used in their discussions with other actors in the multi-actor subsystem and shows the interactions between the subsystems and how tensions can be addressed by means of regulation or other forms of governance.

9.4. Reflection on the research process

In this section we reflect on our research process and the challenges we encountered in performing our study. These relate to the following aspects of our research process:

1. the choice for a GT approach (in 9.4.1);
2. our research strategy (in 9.4.2);
3. our socio-technical perspective (in 9.4.3).

9.4.1. Reflection on our GT approach

The choice for a CGT approach was challenging and satisfying. Challenging in the sense that following a CGT approach is having patience and doing a lot of research before patterns emerge from the empirical data through open, selective and theoretical coding. Therefore having trust in the GT approach is often mentioned as a prerequisite for doing a GT study (Glaser, 2002a, pp. 28-29). Puzzling with the coding and recoding of properties, attending to the emerging categories without forcing them and establishing the relationships between the dimensions takes time. But the GT approach also yielded many breakthrough moments that were a treat for our conceptual thinking.

Another challenge was in the reporting of the study in a linear way. The way in which we report our research project in this thesis is far more structured than the actual process went.... As Langley says: “[p]rocess data is messy. Making sense of them is a challenge” (Langley, 1999, p. 691) and referring to Weick (1989) she adds that “there will always be an uncodifiable step that relies on the insight and imagination of the researcher” (Langley, 1999, p. 707). Because of the open research approach and the comparative, non-linear process of empirical data coding, reporting the research outcomes of a GT approach puts demands on making the research process transparent (Vallet, 2003). By means of providing examples from the empirical data we show how the dimensions of our framework are grounded in the empirical data. We chose for an elaborate account of how we constructed the dimensions and how these were integrated into a conceptual framework. This is one way to present a GT study, we have seen many other ways of reporting GT studies which can be informative for other GT researchers.

The evolution of the GT approach into several variants has led to many controversies among academic scholars. As a consequence, the literature on GT can be confusing as researchers do not always specify the GT variant they have chosen or mix up elements from the variants, which leads to methodological confusion (Glaser, 2009; Urquhart & Fernández, 2013). In addition, many qualitative researchers claim to apply GT but do not explicitly state in which way they do so. This is recognized and reported upon by several authors such as (Urquhart, 2001; McCallin, 2003; Heath & Cowley, 2004; O’Connor, Netting & Thomas, 2008; Glaser, 2009; Tan, 2010). Novice researchers report on their own search for clarity in their GT research design (Wu & Beaunae, 2014; Nagel, Tilley, Burns & Aubin, 2015). We recognize this confusion and lack of clarity; it took us in depth reading to phantom the ins and outs of the different variants and the consequences for developing a research strategy. Therefore, for novice researchers we recommend the book by Cathy Urquhart: *Grounded Theory for Qualitative Research. A Practical Guide* (Urquhart, 2013). The book contains stepwise instructions to set up a GT study and puts the discussions on the variants of GT approaches into perspective. We ourselves continued to read about the GT approach and articles in which it was applied during our entire study and we will not stop doing so as they make an interesting read.

9.4.2. Reflection on research strategy

In this section we reflect on our research strategy by discussing some of the most debated aspects of a research strategy based on a GT approach. These relate to:

- The use of formal documents for the empirical data retrieval
- Using qualitative data analysis software
- Substantive concept versus substantive theory
- Units of analysis
- Conceptual comparison
- Evaluation of the framework

Using formal documents

Using formal documents from the regulatory practice of three NRAs allowed a deep-dive into the details of market issues and regulatory activities. We were always able to revisit the empirical data during the coding process (Glaser and Strauss, 1967, pp. 180-183; Yin, 1994, p. 80). Our choice to cover five years of regulatory practice in three different countries yielded a lot of data that contributes to levelling out differences in regulatory practice towards generic concepts. In addition, the volume of the empirical data is deemed necessary to prevent bias in the analysis and interpretation (Glaser, 1978). However, we also see the limitations of using this type of empirical data.

First, our choice limited access to more fine grained information e.g. on non-documented activities such as persuasion or informal interactions, behind the scene discussions and the way in which the regulators themselves experienced the process (see sections 5.3.1 and 7.5). Filling in these aspects requires interviews or participatory observation, which is hampered by the choice of using empirical data from a period in the past.

Second, we are aware that formal documents represent formalized accounts of regulatory practice, which may not be unbiased due to political considerations or the socio-cultural context in which they were published (Yin, 1994, p. 80). As such they are not primary data but representation of the outcome of a political decision making process (Glaser and Strauss, 1967, p. 181). Still we consider them as good resources due to requirements on NRAs to publish public documents that reflect factual events that would have been subject to public discussion if not. A future research topic is to confront our findings with practitioners to assess the workability of the framework by means of their perceptions and experiences (see 9.5).

Third, the choice for document analysis from the perspective of the NRAs limits our view on self-initiated initiatives of market parties without a role for the regulatory authority. Future research can shed more light on the contributions and roles of market parties, interest groups or other regulatory authorities to regulatory practice.

Last, the method of reconstruction of the regulatory process through the analysis of formal documents has the setback of limiting ourselves to a particular subset of regulatory practice. We only studied regulatory activities that relate to market issues that are reported upon. Hall et al. in their study on the role of culture in the decision-making process of OfTel present a list of four types of decisions for NRAs (Hall, Scott & Hood, 2000):

1. “public front-office decisions that embodied the outcomes of a formal regulatory process, such as licence modifications, the issuing of orders against licensees or determinations of disputes. Such decisions were carried out under statutory procedures, with publication of outcomes”;
2. “Others were less public or less formal decisions – to issue informal advice to a firm in the hope of modifying its behaviour or to broker a solution to a customer complaint outside the framework of formal rules and powers”;
3. “A third category was decisions about OfTel’s ‘internal policies’ (...) These were decisions about systems or approaches, how to run the organization or what its priorities should be”;
4. “Others were strictly back-office decisions, invisible from outside, over issues such as how and who to recruit, how to allocate budgetary resources, when to consult ministers or others on particular issues.” (Hall, Scott and Hood, 2000, p. 108).

In our study we only addressed the first type of decisions by focusing on regulatory practice to solve market issues of which the “publication of outcomes” enabled us to do in-depth analysis of regulatory practice.

Using qualitative data analysis software

A diversity of Computer Assisted Qualitative Data Analysis software (CAQDAS) is available to support qualitative research, e.g. Atlas.ti, NVivo, Qiqqa, Kwalitan, and MAXQDA (Tesch, 1990; Dey, 1993; Peters & Wester, 2007). Some of these software packages such as Atlas.ti and Kwalitan have been specifically designed to support the GT coding phases of open, selective and theoretical coding (Peters & Wester, 2007). The main advantages of using CAQDAS is the structured way of working with the data and the ease of use when searching for examples to sustain the reporting on a GT study. Also arguments of transparency are put forward: software-based analysis can give more rigor and more transparency for those who review a GT study (Morison & Moir, 1998; Welsh, 2002).

However, some grounded theorists object to the use of CAQDAS. Especially founding grounded theorist Glaser is opposed to software-assisted data analysis for the possible leading role the software can take (Bryant and Charmaz, 2007b, p. 24). Glaser argues that using software leads to fragmentation of the data that is void of its context. He states that knowledge of the context is essential to the coding process towards theoretical concepts that are grounded in empirical data. He considers the structuring effect of CAQDAS in juxtaposition with the creativity of the researcher (Bryant and Charmaz, 2007b, p. 24).

Although grounded theory researchers see the risks, they also recognize the inevitability of using software to support the coding process. Several researchers propose reconciliation for the trade-off between the risk of the software controlling the researcher’s coding process versus the creativity and close contact with the empirical data (Roberts & Wilson, 2002). Amongst others, Mehmetoglu and Dann propose that manual and software-based analysis can complement each other and can both be used within the same study (Mehmetoglu & Dann, 2003). Morison and Moir explain that

“[s]oftware can be particularly helpful for data storage, searching and retrieval and certain aspects of concept organization and theory testing, but it cannot replace those moments of intuition when the relationships between concepts crystallise in the researcher’s imagination” (Morison and Moir, 1998, p. 115).

We recognize the risks from our own experience and counterbalanced this in our study. We used Atlas.ti for the open and selective coding phases of our research and could not have done without as the number of open codes was too big to handle otherwise. For the selective coding phase we turned to a visual mapping strategy to better understand the sequence of regulatory activities (see e.g. Figure 9 and Figure 10). In addition we regularly used hand drawings in order to develop the conceptual framework. We consider the combination of using CAQDAS for coding and structuring the properties into categories and dimensions as indispensable. But we also value visual mapping strategies for keeping the link with the context of the data. These two may be united as the functionalities in CAQDAS are extended to include visual mapping within the software (Friese, 2016, p. 44). In addition advances in big data analysis (tools) and automated data analysis may change the empirical data analysis towards the great numbers. However, the interpretation will remain a human effort (Friese, 2016, p. 39).

Substantive concept versus substantive theory

The complete overview of the market issues that we created seems to be contradictory to a CGT approach that does not strive for completeness and accuracy but for developing a substantive theory based on theoretical sampling (Fernández and Lehmann, 2005, p. 16). We therefore reflect on this in relation to our research objective of developing a conceptual framework.

Our objective was to explain how NRAs deal with tensions and uncertainties in the mobile telecommunications system. We consider a conceptual framework as a means to explain their regulatory practice by showing the relationships between the dimensions *Market Issues*, *Regulatory Activities*, *Phases*, *Sources of Uncertainties*, and *Fine-tuning* of the regulatory arrangement. The completeness of our empirical data enabled us to reconstruct the sequences of activities within the dossiers. This led to the emergence of the core category *Process of Matching & Mixing*. Thus, the completeness of the data served our aim to understand the tensions and uncertainties in the mobile telecommunications system and to explain how regulatory authorities deal with them.

This requires a reflection on developing a conceptual framework rather than a substantive theory, which is the original objective of a GT approach (see 3.3.2). The extent in which the conceptual framework represents a substantive theory is up for debate. As Goldkuhl and Cronholm state:

“Strauss & Corbin (1998, p.22) define a theory as “a set of well-developed categories (e.g. themes, concepts) that are systematically interrelated through statements of relationship to form a theoretical framework that /explains some relevant social ... phenomenon”. Moreover, Glaser & Strauss (1967, p. 22), argue that “the form in which a theory is presented does not make it a theory; it is a theory because it explains or predicts something”. Both definitions have in common that they emphasize the importance of that theories should explain something and go beyond descriptions of empirical observations.” (Goldkuhl and Cronholm, 2019, pp. 11-12).

In this sense, our framework can be considered a theoretical framework, but we do not consider it as representing a substantive theory in the sense of formulating testable hypotheses or propositions. In assessing the status of our conceptual framework, we refer to Urquhart, Lehmann and Myers (2010) who propose a framework to position GT studies along the axes of theory scope (from bounded context, substantive focus to formal concepts) and degree of conceptualization (from description to interpretation and ultimately theory) (Urquhart, Lehmann and Myers, 2010, p. 366). Based on their framework we position our study as having substantive focus (on the mobile telecommunications system) on the axe of ‘theory scope’. As for the axe ‘degree of conceptualization’ we position our framework between interpretation and theory because in our conceptual framework we include relationships between the dimensions and we show relationships between the dimensions, but these are not testable hypotheses or propositions. The framework does offer relationships that can be used to formulate them.

Units of analysis

In our study we classified the market issues on the basis of the main regulatory objective for regulation (social/public values versus economic/ fair market competition rationale, see Figure 1) and their nature (ex post versus ex ante, see Table 22 and Table 24). However, it is a well-known issue that qualitative process data are hard to clearly isolate (Langley, 1999, p. 692). Indeed, the distinction between market issues was not always straightforward as they could be interwoven. We label this as *dependency*: the phenomenon that market issues are interrelated or made dependent upon each other or even merged into one regulatory dossier. In addition, we found *layering*: the phenomenon that a market issue is elaborated upon to include more issues or actors along the way. So our classification of market issues is a synthetic one based on the EU regulatory framework for the liberalization of the telecommunications market in which the regulatory objectives are specified.

A different way to classify the market issues may be possible, but we do not expect that this will change our core category as the main concern will remain how to match the regulatory activities with the market issue at hand. Neither will it change the substantive concept of *Exploratory Regulatory Practice* for the same reason. Nor will it change the conceptualization of the duration and intensity that we based on the classification of the market issues (see 6.2.3) because the aim was to conceptualize: the concept that the type of market issue matters for the duration of the process and the intensity of regulatory activities remains.

Conceptual comparison

For the conceptual comparison in this study we used extant concepts that relate to regulatory practice itself, which we define as 'the activities of a sector-specific NRA in the process of regulating the mobile telecommunications system'. Another avenue to compare is with more generic theories or conceptual frameworks from the domain of public management, such as networked governance (De Bruijn & Ten Heuvelhof, 1999), Kingdon's Multiple Streams Model (Kingdon, 1984) or game theoretical models (Tsebelis, 1991). This comparison can serve as a confrontation with alternative conceptualizations to enhance its explanatory power (see 8.1.3), which is subject to future research.

Evaluation of the framework

We evaluated our conceptual framework by means of the evaluation criteria fit, relevance, workability and modifiability that are common in a CGT approach (Glaser, 1998). However, other types of evaluation can be used, e.g. a walk-through of the process by practitioners, by means of serious gaming, agent based modelling or by process modelling. Especially an evaluation with the participants in the substantive area can enhance the relevance of the framework and evaluate the societal contribution of our study (see 9.3).

9.4.3. Reflection on our socio-technical perspective

Among the GT variants one of the major issues of debate is on the role of the researcher and how the researcher influences the interpretation of the empirical data. In a CGT approach, the researcher is expected to be as objective as possible. However, this idea of the objectivity is challenged by o.a. the constructivist GT approach. As Rieger puts it: "the concept of the uncontaminated researcher is a naïve notion" (Rieger, 2018, p. 5). In our study we did not interact with the regulatory actors themselves and we did not use sensitizing or predetermined concepts for analyzing the empirical data. However, we did adopt a socio-technical perspective that fits with regarding the mobile telecommunications system as a CSTS. The socio-technical perspective is useful as a broad, non-limiting perspective (in contrast to e.g. a legal or economic perspective) and as such fits with an interpretive epistemological belief. This perspective allowed our interpretation of the data to be open to all aspects of the system, which does not limit the coding towards an exclusive technical or actor-conceptualization. We consider the conceptual framework of *Exploratory Regulatory Practice* to reflect this openness to all types of market issues, regulatory activities, and technical innovations that occurred.

We took care of potential bias by coding with two research assistants in the open and selective coding phases, by collecting extensive empirical data on three NRAs to prevent skewness towards a specific national context and by staying as close to the textual formulations of the NRAs as possible in coding the data. Taking a socio-technical perspective supported our open coding strategies to do justice to regulatory practice in a CSTS and to enable the emergence of the concepts from the empirical data.

9.5. Future research topics

Based on our reflection and the choices made in our research design we formulate future research topics for our conceptual framework of *Exploratory Regulatory Practice*, for the applicability of the framework to other CSTS and for the use of a GT approach.

9.5.1. Conceptual framework of Exploratory Regulatory Practice

We developed our conceptual framework from the perspective of the regulatory authorities. This delineation excluded taking the range of activities of the regulated market parties into account. These were only considered as activities within the market issues. For example, the market parties submitted complaints, asked for dispute settlement resolutions, implemented technological innovations and new services that led to new market issues, applied co- and self-regulation and participated in the regulatory process as actor in the multi-actor system. In addition they were at the receiving end of regulatory arrangements that were aimed to influence their business strategies. In our conceptual comparison we concluded that regulatory concepts such as (*Really*) *Responsive Regulation* and *Smart Regulation* address the role of the behaviour of regulated firms in a regulatory setting. Following up on this we already added their business activities as a source of uncertainties to the framework and inserted the market party behaviour as an influencing element in the core category *Process of Matching & Mixing*. These are preliminary additions, future research is required to further conceptualize the business activities and market party behaviour and how this fits into the conceptual framework. To do so a continued coding process can be executed that uses empirical data from the business perspective in the mobile telecommunications system in the era of study. Doing so would of course entail a move away from taking the perspective of the regulatory authorities.

9.5.2. Applicability to other CSTS

Society is dependent on CSTS that are increasingly interconnected and co-evolving. These systems are subject to uncertainties that make it hard to predict the consequences of regulatory interventions in the system. Therefore, we need conceptual and theoretical knowledge to analyze and model the interdependent relations between the institutional, multi-actor and technical subsystems. Interdisciplinarity is key to understand these interactions and inductive, exploratory research can contribute to new perspectives based on empirical data.

Our choice for the mobile telecommunications system led to a conceptual framework that is based on the empirical data from one CSTS. Future research can contribute to modify and extend our concept of *Exploratory Regulatory Practice* to other CSTS or to other periods of time. We provide two examples to do so.

For upscaling the conceptual framework to other substantive areas such as other CSTS or other institutional contexts such as non-EU countries, we refer to Glaser who states that “[w]hen it comes to generalizing the theory to other substantive areas it does not get shut down, it just gets modified by constant comparisons with new data for a new substantive area which generalizes it....Trust grows with this generalizing to a formal level [of] a substantive grounded theory” (Glaser, 1998, p. 237). In this sense our conceptual framework can be considered as the first stage in the generation of a substantive theory on regulatory practice in CSTS. This requires a continued comparative

process of empirical data coding with instances of regulatory practice in other domains. In this way the GT process can be continued to lead towards a formal theory on regulatory practice in CSTS (see 3.3.2 and Figure 6). On working towards generalizability of the conceptual framework, Urquhart et al. state: “Scaling up is the process of grouping higher-level categories into broader themes. Scaling up contributes to the generalizability” (Urquhart, Lehmann and Myers, 2010, p. 369).

For upscaling towards another period of time we have two considerations. First, we used extensive empirical data that in principle led to concepts that are “abstract from time, place and people” (Glaser, 1998, p. 160). As such the concept of *Exploratory Regulatory Practice* can be of all times. However, CSTS operate in dynamic contexts that are subject to change: the institutional context evolves, innovation in technologies occurs and the multi-actor arena can change. Especially in domains in which digitization is a driving force behind evolutionary or even revolutionary developments in CSTS, the context is subject to change. With reference to substantive theories Lomborg & Kirkevoid state that “[i]f one recognizes that social reality is dynamic and therefore continuously goes through slight changes, then the fitness of a theory must be understood as being situated in a context with possibilities for modification as the theory is brought into new contexts where new data are available” (Lomborg and Kirkevoid, 2003, p. 191). They add that “[t]heories will always be provisional and become outdated because they are embedded in historical epochs and eras” (Lomborg and Kirkevoid, 2003, p. 194). However, in CSTSs market issues and uncertainties will also be of all times and as such the concept of *Exploratory Regulatory Practice* can still continue to capture and explain regulatory practice because a process oriented approach is particularly suited to address these dynamics.

Second, in our study we used empirical data from an era in which the telecommunications market transitioned from a monopolistic towards a competitive market. We consider this as a phase of competition engineering, which was succeeded by a new regulatory framework (NRF) based on concepts from general competition law. This NRF was implemented in the EU Member States to sustain the competition in the telecommunications market from 2002 onwards (see section 2.2.1 and Figure 3). Particular types of regulatory activities and market issues have become less relevant. In the same sense, other types of market issues and regulatory activities can occur in a next era. For example, the introduction of the 5th Generation (5G) of mobile networks that by using higher bandwidths enable a new range of mobile applications. We expect that these will lead to market issues that can be different than the ones in our empirical data. By means of a continued process of coding and constant comparison the concept of *Exploratory Regulatory Practice* can include new evidence from regulatory practice. E.g. the role of municipalities in decision making on the use of 5G services for smart city applications can become more prominent. This entails changes in the multi-actor system and may bring other types of regulatory activities to the table. We evaluated our conceptual framework on modifiability, so changes in empirical data can be accommodated to include as an extension of properties, sub categories or dimensions or as additions. Still, as noted above, the concept of *Exploratory Regulatory Practice* has the potential to be “abstract from time, place and people” (Glaser, 1998, p. 160).

9.5.3. Using the GT approach

A GT approach provides for a structured research strategy for developing conceptualizations or theoretical models that can shed a new perspective on substantive domains of research. Foregoing

the use of existing theories or theoretical models enables the researcher to look at the domain without preconceptions. As Wiesche et al. in their review article on the use of GT in information systems research position: “They challenge the validity and applicability of existing theories, opening up new avenues for researchModels can be the basis of new theories or can be reframed as theories if other researchers draw on the models to develop hypothesis to specify and test theories” (Wiesche *et al.*, 2017, p. 694). We add that a substantive theory developed by means of a GT approach is particularly suited to analyze and explain interactions in CSTS. Its inductive nature and the rigorous procedures combined with a constructivist ontology and an interpretive epistemology are well suited to understand processes and the interactions between the institutional, actor and technical subsystems in CSTS. The GT study can yield comprehensive conceptualizations and theories that are firmly rooted in empirical data. For the current transitions that are needed in system innovation (e.g. transitions in the energy and transport sectors, smart cities, as well as digital transitions), comprehensive frameworks and theories are needed to provide for an integral overview of what is needed to further these transitions in society. Future research into the use of the GT approach in studies in the domain of CSTS is needed to show its strengths and weaknesses in contributing to understand and explain the interactions, tensions, and uncertainties involved.

As for this study, our conceptualization of regulatory practice yields a process-oriented and integrated perspective on the regulation of CSTS. This contributes to researchers and practitioners to look beyond the formal analysis of the legal institutional framework and the formal regulatory instruments that tend to ignore regulation as a process. A look into the regulatory process “means looking behind the institutional façade to grasp the ‘real world’ of public action” (Minoque, 2001, p. 12). We claim to have developed a conceptual framework to explain such perusal of public action in the real world.

Bibliography

Adhieh, R. B. (2013) 'Dialectical Regulation', *Connecticut Law Review*, (38), pp. 863–927. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2354168%5Cnpapers3://publication/uuid/7D2F2EE6-165D-4213-8DCE-692C4B8E0AB9.

Agentschap Telecom (2003) *Jaarverslag 2002 (Annual Report 2002)*. Groningen: Agentschap Telecom.

Agentschap Telecom (2006) *Strategisch Toezichtplan. Toezicht op elektronisch communicatiedomein*. Groningen: Agentschap Telecom.

Ahdieh, R. (2006) 'Dialectical Regulation', *Connecticut Law Review*, 38, pp. 863–927. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=953674.

Andenas, M. and Zleptnig, S. (2004) *Telecommunications Dispute Resolution: procedures and effectiveness*. London: British Institute of International and Comparative Law.

Andersson, K., Foros, O. and Steen, F. (2004) *The SMS Bandwagon in Norway: What Made the Market? 21/04*. Bergen.

Andrews, T. (2006) 'The Literature Review in Grounded Theory: A response to McCallin (2003)', *Grounded Theory Review*, 5(2–3), pp. 29–35.

Anker, P. (2020) *Frequentieland*. Available at: <http://www.frequentieland.nl/> (Accessed: 15 February 2020).

Anells, M. (1996) 'Grounded Theory Method: Philosophical Perspectives, Paradigm of Inquiry, and Postmodernism', *Qualitative Health Research*, 6(3), pp. 379–393.

Armstrong, M. and Wright, J. (2008) *Mobile Call Termination*. 9866. Available at: <https://mpira.ub.uni-muenchen.de/9866/>.

Arnbak, J. C. (1997) 'Managing the Radio Spectrum in the New Environment', in Melody, W. H. (ed.) *Telecom reform: Principles, policies and regulatory practices*. Lyngby: Den Private Ingeniorfond, Technical University of Denmark, pp. 131–139.

Arnbak, J. C. (2002a) 'Multi-utility regulation: yet another convergence?', in Mansell, R., Samarajiva, R., and Mahan, A. (eds) *Networking Knowledge for Information Societies: Institutions & Intervention*. Delft: Delft University Press, pp. 141–150.

Arnbak, J. C. (2002b) 'Opening van netten. Over liberalisering en toezicht in networksectoren', *Bestuurskunde*, 11(3), pp. 108–118.

Arnbak, J. C. and Ubacht, J. (1995) '(Verkeerd) verbonden aan de informatie-infrastructuur? ((Wrongly) connected to the information infrastructure?)', in Baten, I. and Ubacht, J. (eds) *Een kwestie van toegang. Bijdragen aan het debat over het publieke domein van de informatievoorziening. (A matter of access. Contributions to the debate on the public domain of the information facilities)*. Den Haag: Rathenau Instituut, pp. 87–102.

Arnbak, J. C. and Ubacht, J. (1996) 'Special Session on Information Infrastructures "Towards Realisation of the Information Society" Rapporteur's report'. Paris: OECD: OCDE/GD(96)28, pp. 9–19.

ART (1997a) 'Décision no 97-339 de l'ART en date du 17 octobre 1997 relative à l'exemption des opérateurs de téléphonie mobile de la partie de la rémunération à l'interconnexion correspondant au déséquilibre de la structure courante des tarifs téléphoniques'. Paris: ART, October 17th 1997.

ART (1997b) 'Enquête d'évaluation sur la qualité de service des réseaux de téléphonie mobile en France en 1997'. Paris: ART, November 1997.

ART (1998a) 'Décision no 98-506 de l'Autorité de régulation des télécommunications en date du 24 juin 1998 se prononçant sur un différend entre Copper Communications et France Télécom'. Paris: ART, June 24th 1998.

ART (1998b) 'Décision no 98-826 de l'Autorité de régulation des télécommunications, en date du 2 octobre 1998, relative à la demande de Cegetel visant à ce que France Télécom soit mise en demeure de cesser certaines pratiques'. Paris: ART, October 2nd 1998.

ART (1998c) 'Décision no 98-982 de l'Autorité de régulation des télécommunications en date du 27 November 1998 établissant pour 1999 la liste des opérateurs exerçant une influence significative sur un marché de télécommunications.' Paris: ART, November 27th 1998.

ART (1998d) 'Enquête d'évaluation de la qualité de service des réseaux de téléphonie mobile en France en 1998'. Paris: ART.

ART (1998e) 'Téléphonie mobile. L'Autorité de régulation des télécommunications précise son analyse quant à l'utilisation des boîtiers de raccordement vers les réseaux de téléphonie mobile'. Paris: ART, March 4th 1998.

ART (1998f) 'Téléphonie mobile. L'Autorité lance un appel à commentaires sur l'utilisation des « brouilleurs » dans les salles de spectacles'. Paris: ART, March 4th 1998.

ART (1999a) 'Avis no 99-715 de l'Autorité de régulation des télécommunications en date du 1er septembre 1999 sur le projet de décret relatif à la présélection du transporteur et modifiant l'article D.99-16 du code des postes et télécommunications'. Paris: ART, September 1st 1999.

ART (1999b) 'Brouilleurs GSM. L'Autorité rappelle la réglementation et précise son analyse quant à l'utilisation des brouilleurs GSM. Communiqué de presse'. Paris: ART, June 10th 1999.

ART (1999c) 'Décision no 99-1077 de l'Autorité de régulation des télécommunications en date du 8 décembre 1999 précisant les conditions et les délais de mise en oeuvre de la sélection du transporteur appel par appel et de la présélection'. Paris: ART, December 8th 1999.

ART (1999d) 'Décision no 99-1143 de l'Autorité des télécommunications en date du 22 décembre 1999 adoptant une spécification technique relative aux interfaces d'interconnexion'. Paris: ART, December 22nd 1999.

ART (1999e) 'Décision no 99-197 de l'Autorité de régulation des télécommunications en date du 1er mars 1999 se prononçant sur un différend entre la Société Française du Radiotéléphone et France

Télécom relatif aux conditions d'interconnexion pour les appels entrants su'. Paris: ART, March 1st 1999.

ART (1999f) 'Décision no 99-490 de l'Autorité de régulation des télécommunications en date du 9 juin 1999 portant adoption des lignes directrices relatives aux procédures opérationnelles de la présélection'. Paris: ART, June 9th 1999. Available at: <http://admi.net/jo/19990805/ARTL9900232S.html>.

ART (1999g) 'Décision no 99-767 de l'Autorité de régulation des télécommunications en date du 15 septembre 1999 établissant pour 2000 la liste des opérateurs exerçant une influence significative sur un marché de télécommunications'. Paris: ART, September 15th 1999.

ART (1999h) 'Décision no 99-823 de l'Autorité de régulation des télécommunications en date du 30 septembre 1999 complétant la décision no 99-767 en date du 15 Septembre 1999 établissant pour 2000 la liste des opérateurs exerçant une influence significative sur un march'. Paris: ART, September 30th 1999.

ART (1999i) 'Enquête d'évaluation de la qualité de service des réseaux de téléphonie mobile en France menée en 1999'. Paris: ART.

ART (1999j) 'L'Autorité de régulation des télécommunications tire les conclusions de la table ronde sur les appels entrants'. Paris: ART, June 29th 1999.

ART (2000a) 'Avis no 00-948 de l'Autorité de régulation des télécommunications en date du 15 septembre 2000 donné au Conseil de la concurrence sur la demande de mesures conservatoires présentée par la société WAPPUP.COM à l'encontre des pratiques mises en oeuvre par le'. Paris: ART, September 15th 2000.

ART (2000b) 'Décision no 00-1092 de l'Autorité de régulation des télécommunications en date du 13 octobre 2000 se prononçant sur un différend entre MFS Communications et France Télécom Mobiles relatif à l'interconnexion pour l'acheminement du trafic à destination du r'. Paris: ART, October 13th 2000.

ART (2000c) 'Décision no 00-1328 de l'Autorité de régulation des télécommunications en date du 15 décembre 2000 complétant la décision no 00-813 en date du 28 juillet 2000 établissant pour 2001 la liste des opérateurs exerçant une influence significative sur un marché'. Paris: ART, December 15th 2000.

ART (2000d) 'Décision no 00-1367 de l'Autorité de régulation des télécommunications en date du 22 décembre 2000 précisant les conditions de garantie de protection contre les brouillages préjudiciables des réseaux radioélectrique soumis à autorisation individuelle sur '. Paris: ART, December 22nd 2000.

ART (2000e) 'Décision no 00-430 de l'Autorité de régulation des télécommunications en date du 19 mai 2000 adoptant des lignes directrices relatives aux modalités de communication des conventions d'interconnexion'. Paris: ART, May 19th 2000.

ART (2000f) 'Décision no 00-835 de l'Autorité de régulation des télécommunications en date du 28 juillet 2000 proposant au ministre chargé des télécommunications les modalités et les conditions d'attribution des autorisations pour l'introduction en France métropolitai'. Paris: ART, July 28th 2000.

ART (2000g) 'Décision no 00-974 de l'Autorité de régulation des télécommunications en date du 20 septembre 2000 se prononçant sur un différend entre Bouygues Télécom et France Télécom relatif à l'interconnexion pour l'acheminement du trafic à destination du réseau rad'. Paris: ART, September

20th 2000.

ART (2000h) 'Des décisions favorables à une nouvelle baisse du prix des appels vers les mobiles. Communiqué de presse'. Paris: ART, October 30th 2000.

ART (2000i) 'Sélection du Transporteur. L'Autorité souhaite informer les consommateurs des conditions de mise en œuvre prochaine de la sélection du transporteur vers les mobile. Communiqué de presse'. Paris: ART, October 18th 2000.

ART (2001a) 'Annual report 2000'. Paris: ART, November 2001.

ART (2001b) 'Décision no 01-1206 de l'Autorité de régulation des télécommunications en date du 14 décembre 2001 complétant la décision no 01-750 en date du 24 juillet 2001 établissant pour 2002 la liste des opérateurs exerçant une influence significative sur un marché'. Paris: ART, December 14th 2001.

ART (2001c) 'Decision no 01-352 de l'Autorité de régulation des télécommunications en date du 6 avril 2001 relative à la consultation d'une convention d'interconnexion par la société MFS Communications'. Paris: ART, April 6th 2001.

ART (2001d) 'Décision no 01-458 de l'Autorité de régulation des télécommunications en date du 11 mai 2001 portant adoption de lignes directrices relatives aux conditions tarifaires d'interconnexion des opérateurs mobiles puissants sur le marché national de l'interconne'. Paris: ART, May 11th 2001.

ART (2001e) 'Décision no 01-595 de l'Autorité de régulation des télécommunications en date du 19 juin 2001 relative à l'avis de l'Autorité sur le projet de rapport du Gouvernement au Parlement sur la couverture du territoire par les réseaux de téléphonie mobile'. Paris: ART, June 19th 2001.

ART (2001f) 'Décision no 01-970 de l'Autorité de régulation des télécommunications en date du 16 novembre 2001 portant sur le niveau de la charge de terminaison d'appel sur le réseau de Orange France'. Paris: ART, November 2001.

ART (2001g) 'Décision no 01-971 de l'Autorité de régulation des télécommunications en date du 16 novembre 2001 portant sur le niveau de la charge de terminaison d'appel sur le réseau de SFR'. Paris: ART, November 16th 2001.

ART (2001h) 'Extension of call-by-call carrier selection and pre-selection to local calls. Call for comments on the conditions of implementation'. Paris: ART, May 21th 2001.

ART (2001i) 'L'Autorité rend publics les résultats d'une seconde enquête d'évaluation de la couverture des réseaux de téléphonie mobile. Communiqué de presse.' Paris: ART, July 6th 2001.

ART (2001j) 'Position de l'Autorité de régulation des télécommunications sur le partage d'infrastructures dans les réseaux mobiles de troisième génération'. Paris: ART, December 10th 2001. Available at: <http://www.arcep.fr/index.php?id=8072#>.

ART (2001k) 'Téléphone mobile. L'Autorité lance un appel à commentaires sur l'utilisation des "brouilleurs" dans les salles de spectacles'. Paris: ART, December 6th 2001.

ART (2001l) *The French Telecommunications Regulatory Authority (ART)*. Available at: <https://web.archive.org/web/20021001200226/http://www.art-telecom.fr/eng/index.htm> (Accessed: 10 April 2020).

ART (2002a) 'Couverture Mobile GSM. L'Autorité publie la position commune des trois opérateurs relative à la couverture des zones blanches et poursuit son action pour assurer la traduction

concrète et rapide des ces engagements. Communiqué de presse.' Paris: ART, October 4th 2002.

ART (2002b) 'Décision no 02-549 de l'Autorité de régulation des télécommunications en date du 11 juillet 2002, portant adoption des lignes directrices relatives à la Portabilité des Numéros Mobiles (PNM)'. Paris: ART, July 11th 2002.

ART (2002c) *Enquête 2001 sur la qualité de service des réseaux de téléphonie mobile en France*. Paris: ART, February 2nd 2002.

ART (2002d) *Synthèse du rapport de l'Autorité de régulation des télécommunications sur l'adaptation de la régulation*. Paris: ART, July 2002.

ART (2005) 'La Régulation des Activités Postales et la Création de l'ARCEP'. Paris: ART. Available at: <http://www.arcep.fr/index.php?id=13>, last consulted September 8th 2010.

Atiyas, I., Doganoglu, T. and Reichhuber, M. (2009) 'General Access Payment Mechanisms', in Preissl, B., Haucap, J., and Curwen, P. (eds) *Telecommunications Markets: drivers and impediments*. Heidelberg: Springer Physica-Verlag HD, pp. 17–41. doi: 10.1007/978-3-7908-2082-9.

Ayres, I. and Braithwaite, J. (1992) *Responsive Regulation: Transcending the Deregulation Debate*. Oxford: Oxford University Press.

Bacharach, S. B. (1989) 'Organizational Theories : Some Criteria for Evaluation', *The Academy of Management Review*, 14(4), pp. 496–515.

Baek, J. W. (2018) 'The Determinants of Prices in Mobile Voice Market : The Impact of Regulatory Policy and Market Structure', *Journal of Industrial Economics and Business*, 31(5), pp. 1879–1903. doi: 10.22558/jieb.2018.10.31.5.1879.

Baldwin, R. and Black, J. (2007) *Really Responsive Regulation*. 15/2007. London: London School of Economics and Political Science (LSE). Available at: <http://www.lse.ac.uk/collections/law/wps/WPS15-2007BlackandBaldwin.pdf>.

Baldwin, R. and Black, J. (2008) 'Really Responsive Regulation', *The Modern Law Review Limited*. London: London School of Economics and Political Science (LSE), 71(1), pp. 59–94.

Ballon, P., Walravens, N., Spedalieri, A. and Venezia, C. (2008) 'The Reconfiguration of Mobile Service Provision: Towards Platform Business Models', in *19th ITS European Regional Conference*. Rome, September 18-20 2008.

Bauer, J. M. and Bohlin, E. (2018) 'Roles and Effects of Access Regulation in 5G Markets', *SSRN Electronic Journal*, September, p. 57. doi: 10.2139/ssrn.3246177.

Beck Jørgensen, T. and Bozeman, B. (2007) 'Public Values', *Administration & Society*, 39(3), pp. 354–381. doi: 10.1177/0095399707300703.

Bekkers, R. and Smits, J. (1995) *Mobiele telecommunicatie in Nederland en België. Regulering, standaarden en toepassingen (Mobile telecommunications in the Netherlands and Belgium. Regulator, standards and applications)*. Deventer: Kluwer BedrijfsInformatie.

Betzalel, N., Ben Ishai, P. and Feldman, Y. (2018) 'The human skin as a sub-THz receiver – Does 5G pose a danger to it or not?', *Environmental Research*. Elsevier Inc., 163(September 2017), pp. 208–216. doi: 10.1016/j.envres.2018.01.032.

De Bijl, P. W. J. and Peitz, M. (2009) 'Acces regulation and the adoption of VoIP', *Journal of Regulatory Economics*, 34(2), pp. 111–134.

- Binmore, K. and Harbord, D. (2005) 'Bargaining over fixed-to-mobile termination rates: Countervailing buyer power as a constraint on monopoly power', *Journal of Competition Law and Economics*, 1(3), pp. 449–472. doi: 10.1093/joclec/nhi013.
- Black, J. (2002) 'Regulatory conversations', *Journal of Law and Society*, 29(1), pp. 163–196.
- Black, J. and Baldwin, R. (2010) 'Really Responsive Risk-Based Regulation', *Law & policy*, 32(2). Available at: <http://onlinelibrary.wiley.com/doi/10.1111/j.1467-9930.2010.00318.x/full%5Cnpapers3://publication/uuid/E21159F9-775F-4B78-991B-D55DCF3ACD6F>.
- Blumer, H. (1954) 'What is Wrong with Social Theory?', *American Sociological Association*, 19(1), pp. 3–10. Available at: <https://www.jstor.org/stable/2088165>.
- Bonen, Z. (1979) *Evolution of a Sociotechnical System. A Model and Some Implications*. WP 1054-79. Cambridge, MA.
- Brereton, P., Kitchenham, B. A., Budgen, D., Turner, M. and Khalil, M. (2007) 'Lessons from applying the systematic literature review process within the software engineering domain', *Journal of Systems and Software*. Elsevier Inc., 80(4), pp. 571–583. doi: 10.1016/j.jss.2006.07.009.
- Brown, T., Fitch, M., Owens, D., Saunders, S., Sutton, A. and Temple, S. (2016) *5G Whitepaper : Meeting the Challenge of 'Universal' Coverage, Reach and Reliability in the Coming 5G Era*. Guildford. Available at: [https://www.electronicsspecifier.com/attachment/view/56c5a8e4e34e24566fb98109/University of Surrey 5GIC whitepaper - Meeting the challenge of "Universal" coverage, reach and reliability in the coming 5G era](https://www.electronicsspecifier.com/attachment/view/56c5a8e4e34e24566fb98109/University of Surrey 5GIC whitepaper - Meeting the challenge of).
- De Bruijn, J. A. and Ten Heuvelhof, E. F. (1995) *Netwerkmanagement*. Utrecht: Lemma.
- De Bruijn, J. A. and Ten Heuvelhof, E. F. (1999) *Management in Netwerken [Management in Networks]*. 3rd edn. Utrecht: Boom Lemma Uitgevers.
- Bryant, A. and Charmaz, K. (2007a) 'Grounded Theory in Historical Perspective: An Epistemological Account', in Bryant, A. and Charmaz, K. (eds) *The Sage Handbook of Grounded Theory*. London: Sage, pp. 31–57.
- Bryant, A. and Charmaz, K. (2007b) 'Grounded Theory Research: Methods and Practice', in Bryant, A. and Charmaz, K. (eds) *The Sage Handbook of Grounded Theory*. London: Sage, pp. 1–29.
- Bryant, A. and Charmaz, K. (2007c) *The Sage Handbook of Grounded Theory*. London: Sage.
- BTG (2006) *Annual Report*. Driebergen: BTG.
- Camponovo, G. and Cerutti, D. (2005) 'WLAN communities and Internet access sharing: A regulatory overview', in *4th Annual International Conference on Mobile Business, ICMB 2005*. Institute of Electrical and Electronics Engineers Inc., pp. 281–287. doi: 10.1109/ICMB.2005.118.
- Cave, M., Majumdar, S. K. and Vogelsang, I. (2002) *Handbook of Telecommunications Economics. Structure, Regulation and Competition*. Amsterdam: Elsevier.
- Charmaz, K. (2000) 'Grounded Theory: Objectivist and Constructivist Methods', in Denzin, N. K. and Lincoln, Y. S. (eds) *Handbook of Qualitative Research*. Thousand Oaks, California: Sage, pp. 509–535.
- Charmaz, K. (2006) *Constructing Grounded Theory. A Practical Guide Through Qualitative Analysis*. Thousand Oaks, California: Sage.

Cho, D., Ferreira, P. and Telang, R. (2016) *The Impact of Mobile Number Portability on Price and Consumer Welfare*. Available at: <https://ssrn.com/abstract=2265104>.

Christiansen, O. (2011) 'The Literature Review in Classic Grounded Theory Studies: A methodological note', *The Grounded Theory Review*, 10(3), pp. 21–25.

Clark, V. (1999a) 'U.K. court ruling gives One2Oe ammunition in 3G race', *Total Telecom*, August.

Clark, V. (1999b) 'U.K. mobile players luke-warm about national roaming plans', *Total Telecom*, July.

CMA (2020) *Communication Managers Association (CMA)*. Available at: <https://www.bcs.org/membership/member-communities/communications-management-association-cma-specialist-group/> (Accessed: 10 April 2020).

Code des Postes et des Télécommunications (1996) *Loi no. 96-659 du 26 juillet 1996 de réglementation des télécommunications*. France: Journal Officiel de la République Française.

Coen, D. and Thatcher, M. (2008) 'Network governance and multi-level delegation: European networks of regulatory agencies', *Journal of Public Policy*, 28(1), pp. 49–71. doi: 10.1017/S0143814X08000779.

Cohen, T. (2003) 'Rethinking (Reluctant) Capture: South African Telecommunications and the Impact of Regulation', *Journal of African Law*. Cambridge University Press (CUP), 47(1), pp. 65–87. doi: 10.1017/s0221855303001986.

Competition Commission (2005) *Annual Report and Accounts 2004-2005*. London: Competition Commission.

Conseil de la Concurrence (2020) *Conseil de la Concurrence*. Available at: <https://www.autoritedelaconcurrence.fr/fr>.

Consumentenbond (Dutch National Consumer Association) (2020). Available at: <https://www.consumentenbond.nl/> (Accessed: 10 April 2020).

Corbin, J. and Strauss, A. (1990) 'Grounded theory research: Procedures, canons, and evaluative criteria', *Qualitative Sociology*, 13(1), pp. 3–21. doi: 10.1007/BF00988593.

Council of the European Communities (1988) 'Council Resolution of 30 June 1988 on the development of the common market for telecommunications services and equipment up to 1992'. Brussels: Council of the European Communities, June 30th 1988.

Council of the European Communities (1991) 'Council Directive 91/263 on the approximation of the laws of the Member States concerning telecommunications terminal equipment, including the mutual recognition of their conformity'. Brussels: Council of the European Communities, April 29th 1991.

Denzin, N. K. and Lincoln, Y. S. (eds) (1994) *Handbook of Qualitative Research*. 1st edn. Thousand Oaks: Sage Publications.

Dewenter, R. and Kruse, J. (2011) 'Calling party pays or receiving party pays? The diffusion of mobile telephony with endogenous regulation', *Information Economics and Policy*, 23(1), pp. 107–117. doi: 10.1016/j.infoecopol.2010.09.001.

Dey, I. (1993) *Qualitative Data Analysis: A User Friendly Guide for Social Science*. Edited by Routledge. London. doi: <http://dx.doi.org/10.4324/9780203412497>.

Dommering, E. J., Van Eijk, N. A. N. M., Nijhof, J. A. M. and Verberne, M. L. (1999) *Handboek Telecommunicatierecht. Inleiding tot het recht en de techniek van de telecommunicatie*. Den Haag: SDU.

Dommering, E. J., Verberne, M. L., Burger, P. and Sitompoel, N. (1999) 'Europees telecommunicatierecht', in Dommering, E. J., Van Eijk, N. A. N. M., Nijhof, J. A. M., and Verberne, M. L. (eds) *Handboek Telecommunicatierecht. Inleiding tot het recht en de techniek van de telecommunicatie*. The Hague: SDU, pp. 123–210.

Donovan, K. P. and Martin, A. K. (2012) 'The rise of African SIM registration: the emerging dynamics of regulatory change', *First Monday*, 19(2).

Eccles, T. and Pointing, J. (2013) 'Smart regulation, shifting architectures and changes in governance', *International Journal of Law in the Built Environment*, 5(1), pp. 71–88. doi: 10.1108/17561451311312838.

Eckert, S. (2018) 'Two spheres of regulation: Balancing social and economic goals', *Regulation and Governance*, 12(2), pp. 177–191. doi: 10.1111/rego.12137.

Effendi, M. R. (2016) 'Regulatory incentives in Indonesia', in *Proceeding of 2016 10th International Conference on Telecommunication Systems Services and Applications, TSSA 2016: Special Issue in Radar Technology*. Institute of Electrical and Electronics Engineers Inc. doi: 10.1109/TSSA.2016.7871098.

Egan, M. (1998) 'Regulatory strategies, delegation and european market integration', *Journal of European Public Policy*, 5(3), pp. 485–506. doi: 10.1080/135017698343938.

Ehrlich, E. M., Eisenach, J. A. and Leighton, W. A. (2010) 'The Impact of Regulation on Innovation and Choice in Wireless Communications', *Review of Network Economics*, 9(1), pp. 2–44. Available at: <http://ssrn.com/abstract=1478528> Electronic copy available at: <http://ssrn.com/abstract=1478528>.

Eliassen, K. A. and Sjoavaag, M. (1999) 'European Telecommunications Liberalisation'. London & New York: Routledge.

Van Engelenburg, S. (2019) *Designing context-aware architectures for business-to-government information sharing*. Delft University of Technology, Doctoral thesis. doi: <https://doi.org/10.4233/uuid:d25fd4fd-02d7-4811-b675-615badbb3c05>.

European Commission (1987) 'Towards a Dynamic European Economy. Green paper on the development of the common market for telecommunications services and equipment'. Brussels: European Commission, COM(87) 29.

European Commission (1990) 'Commission Directive 90/388/EEC on competition in the markets for telecommunications services'. Brussels: European Commission, OJ L 192/1.

European Commission (1993a) 'Developing Universal Service for Telecommunications in a Competitive Environment'. Brussels: European Commission, COM (93) 1.

European Commission (1993b) 'White Paper on growth, competitiveness and employment: The challenges and ways forward into the 21st century'. Brussels: European Commission, December 5th 1993, COM(93) 700 final.

European Commission (1996a) 'Commission Directive 96/19/EC of 13 March 1996 amending Directive 90/388/EEC with regard to the implementation of full competition in telecommunications markets'. Brussels: European Commission, PbEG 1996 L 74/13.

European Commission (1996b) 'Directive 96/2/EG of January 16, 1996 amending Directive 90/388/EEG with regard to mobile and personal communications'. Brussels: European Commission, OJ 1996 L 20/59.

European Commission (1996c) 'Full Competition Directive. Commission directive 96/19/EC of 13 March 1996 amending Directive 90/388/EEC with regard to the implementation of full competition in telecommunications markets'. Brussels: European Commission, OJ 1996 L.

European Commission (1998a) 'Letter to all NRA's on Sim Lock'. Brussels: European Commission September, 30th 1998.

European Commission (1998b) 'Notice on the application of the competition rules to access agreements in the telecommunications sector. Framework, relevant markets and principles'. Brussels: European Commission, OJ C 265/2.

European Commission (1999) 'Commission Successfully Closes Investigation into Mobile and Fixed Telephony Prices Following Significant Reductions Throughout the EU'. Brussels: European Commission, IP/99/298.

European Commission (2001) 'Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions. The Introduction of Third Generation Mobile Communications in the European Union : State of Play and the Way For'. Brussels: European Commission, COM (2001) 141 final.

European Parliament and the Council of the European Union (1997a) 'Directive 97/13/EC of the European Parliament and of the Council of 10 April 1997 on a common framework for general authorizations and individual licences in the field of telecommunications services. "Licensing Directive"'. Brussels: European Parliament and the Council of the European Union, OJ L 177/1.

European Parliament and the Council of the European Union (1997b) 'Directive 97/33/EC of the European Parliament and of the Council of 30 June 1997 on interconnection in Telecommunications with regard to ensuring universal service and interoperability through application of the principles of Open Network Provision (ONP)'. Brussels: European Parliament and the Council of the European Union, OJ L 199/3.

European Parliament and the Council of the European Union (1997c) 'Directive 97/66/EC of the European Parliament and the Council of the European Union of 15 December 1997 concerning the processing of personal data and the protection of privacy in the telecommunications sector'. European Parliament and the Council of the European Union, OJ L 24/1.

European Parliament and the Council of the European Union (1998a) 'Directive 98/10/EC of the European Parliament and of the Council of 26 February 1998 on the application of open network provision (ONP) to voice telephony and on universal service for telecommunications in a competitive environment.' Brussels: European Parliament and the Council of the European Union, OJ L 268.

European Parliament and the Council of the European Union (1998b) 'Directive 98/61/EC of the European Parliament and of the Council of 24 September 1998 amending Directive 97/33/EC with regard to operator number portability and carrier pre-selection'. Brussels: European Parliament and the Council of the European Union, OJ L 268.

European Parliament and the Council of the European Union (1999) 'Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE)'. Brussels: European Parliament and the Council of the European Union, OJ L 91/10.

European Parliament and the Council of the European Union (2002) 'Directive 2002/21/EC on a common regulatory framework for electronic communications networks'. Brussels: European Parliament and the Council of the European Union, OJ L108/33.

European Parliament and the Council of the European Union (2009) 'Regulation (EC) No 1211/2009 of the European Parliament and of the Council of 25 November 2009 establishing the Body of European Regulators for Electronic Communications (BEREC) and the Office', *Official Journal of the European Union*. Brussels: European Parliament and the Council of the European Union, OJ L 337, p. L337/1-L337/10.

European Radiocommunications Office (2004) *GSM Frequency Utilisation within Europe*. Copenhagen.

Falch, M., Henten, A. and Tadayoni, R. (2009) 'International roaming: Is there a need for EU-regulation beyond 2010?', *Info*, 11(4), pp. 19–33. doi: 10.1108/14636690910970955.

Faulhaber, G. R. (2009) *A National Broadband Plan for Our Future: A Customer-Centric Framework, International Journal of Communication*. Available at: <http://ssrn.com/abstract=1574974> Electronic copy available at: <http://ssrn.com/abstract=1574974> <http://ijoc.org>.

FCS (2020) *Federation of Communication Services*. Available at: <http://www.fcs.org.uk/> (Accessed: 10 April 2020).

Feintuck, M. (2010) 'Regulatory Rationales Beyond the Economic: In Search of the Public Interest', in Baldwin, R., Cave, M., and Lodge, M. (eds) *Oxford Book of Regulation*. New York: Oxford University Press, pp. 39–64.

Fernández, W. and Lehmann, H. (2005) 'Achieving Rigour and Relevance in Systems Studies: Using grounded theory to investigate organizational change', *The Grounded Theory Review*, 5(1), pp. 79–107.

Finger, M., Groenewegen, J. and Kunneke, R. (2005) 'The quest for coherence between institutions and technologies in infrastructures', *Journal of Network Industries*, 6(4), pp. 227–259.

Finger, M. and Varone, F. (2009) 'Regulatory practices and the role of technology in network industries: the case of Europe', in Kunneke, R. W., Groenewegen, J., and Auger, J.-F. (eds) *The Governance of Network Industries. Institutions, Technology and Policy in Reregulated Infrastructures*. Cheltenham: Edward Elgar, pp. 87–101.

Friese, S. (2016) 'Qualitative data analysis software - the state of the art', *Kwalon*, 12(1), pp. 34–45.

Fuentelsaz, L., Maicas, J. P. and Polo, Y. (2012) 'Switching costs, network effects, and competition in the European mobile telecommunications industry', *Information Systems Research*. INFORMS Inst. for Operations Res. and the Management Sciences, 23(1), pp. 93–108. doi: 10.1287/isre.1100.0303.

García-Murillo, M. A. (2007) 'Number portability in Central America', *Info*, 9(4), pp. 25–37. doi: 10.1108/14636690710762110.

Garnham, N. (1997) 'Universal Service', in Melody, W. H. (ed.) *Telecom reform: Principles, policies and regulatory practices*. Lyngby: Den Private Ingeniørfond, Technical University of Denmark, pp. 207–212.

- Geels, F. W. (2004) 'From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory', *Research Policy*, 33(6–7), pp. 897–920. doi: 10.1016/j.respol.2004.01.015.
- Genakos, C. and Valletti, T. (2011) 'Testing the "Waterbed" Effect in Mobile Telephony', *Journal of European Economic Association*, 9(6), pp. 1114–1142.
- Georgosouli, A. (2009) 'Regulatory interpretation: Conversational or constructive?', *Oxford Journal of Legal Studies*, 30(2), pp. 361–384. doi: 10.1093/ojls/gqp027.
- Geradin, D. (2000) 'Institutional Aspects of EU Regulatory Reforms in the Telecommunications Sector: An Analysis of the Role of National Regulatory Authorities', *Journal of Network Industries*, 1(1), pp. 5–32. doi: 10.1177/178359170000100102.
- Glachant, J.-M. (2009) 'Creating institutional arrangements that make markets work: the case of retail markets in the electricity sector', in Kunneke, R., Groenewegen, J., and Auger, J. F. (eds) *The Governance of Network Industries. Institutions, Technology and Policy in Reregulated Infrastructures*. Cheltenham, UK: Edward Elgar, pp. 46–60.
- Glaser, B. G. (1978) *Theoretical Sensitivity*. Mill Valley, CA, USA: Sociology Press.
- Glaser, B. G. (1992) *Basics of grounded theory analysis: Emergence versus forcing*. Mill Valley, CA, USA: Sociological Press.
- Glaser, B. G. (1998) *Doing Grounded Theory: Issues and Discussions*. 2nd edn. Mill Valley, CA, USA: Sociology Press.
- Glaser, B. G. (2001) *The Grounded Theory Perspective: Conceptualization Contrasted with Description*. Mill Valley, CA, USA: Sociology Press.
- Glaser, B. G. (2002a) 'Conceptualization: On Theory and Theorizing Using Grounded Theory', *International Journal of Qualitative Methods*, 1(2), pp. 23–38. doi: 10.1177/160940690200100203.
- Glaser, B. G. (2002b) 'Constructivist Grounded Theory?', *Forum Qualitative Social Research*, 3(3, article 12), p. no pages. Available at: <http://nbn-resolving.de/urn:nbn:de:0114-fqs0203125>.
- Glaser, B. G. (2007) 'Doing Formal Theory', in Bryant, A. and Charmaz, K. (eds) *The Sage Handbook of Grounded Theory*. London: Sage, pp. 97–113.
- Glaser, B. G. (2008) 'Quantitative & Qualitative Research', *Grounded Theory Review*, 7(2), pp. 1–18. Available at: <http://groundedtheoryreview.com/2008/06/30/1052/>.
- Glaser, B. G. (2009) 'The Novice GT Researcher', *Grounded Theory Review*, 8(2), pp. 1–21. Available at: <http://groundedtheoryreview.com/2009/06/30/914/>.
- Glaser, B. G. and Strauss, A. L. (1967) *The Discovery of Grounded Theory. Strategies for Qualitative Research*. 20th edn. New Brunswick: Aldine Transaction.
- Goldberg, D. and Verhulst, S. (1997) 'Spectrum management reform in the United Kingdom: the Wireless Telegraphy Bill 1997', *Mediaforum*, 9, pp. 128–131.
- Goldkuhl, G. and Cronholm, S. (2019) 'Grounded Theory in Information Systems Research - from Themes in IS Discourse to Possible Developments', in *Fortieth International Conference on Information Systems*. Munich, pp. 1–17.
- Gregor, S. (2006) 'The Nature of Theory in Information Systems', *MIS Quarterly*, 30(3), pp. 611–642.

Available at: <http://heim.ifi.uio.no/~petterog/Kurs/INF5220/NatureofTheoryMISQ.pdf>.

Grzybowski, L. (2005) 'Regulation of Mobile Telephony across the European Union: An Empirical Analysis', *Journal of Regulatory Economics*, 28(1), pp. 47–67.

Grzybowski, L. (2008) 'The competitiveness of mobile telephony across the European Union', *International Journal of the Economics of Business*, 15(1), pp. 99–115. doi: 10.1080/13571510701830549.

Guba, E. G. and Lincoln, Y. S. (1994) 'Competing Paradigms in Qualitative Research', in Denzin, N. K. and Lincoln, Y. S. (eds) *Handbook of Qualitative Research*. Thousand Oaks: Sage Publications, pp. 105–118.

Gunningham, N. (2010) 'Enforcement and Compliance Strategies', in *The Oxford Handbook of Regulation*, pp. 120–145. doi: 10.1093/oxfordhb/9780199560219.003.0007.

Gunningham, N., Grabosky, P. and Sinclair, P. (1998) *Smart Regulation. Designing Environmental Policy*. Oxford: Clarendon Press.

Gupta, R., Gupta, V. and Rajamanickam, R. (2017) 'E-Governance to m-Governance in Telecom Sector through Regulatory Body', in *Proceedings - 2nd World Congress on Computing and Communication Technologies, WCCCT 2017*. Institute of Electrical and Electronics Engineers Inc., pp. 203–206. doi: 10.1109/WCCCT.2016.57.

Haggard, S. (1999) 'The Politics of Governance: Lessons from the East Asian Crisis', *International Conference on Democracy, Market Economy and Development*. Seoul, Korea.

Haig, B. D. (2018) *Method Matters in Psychology. Essays in Applied Philosophy of Science, Method Matters in Psychology*. doi: 10.1007/978-3-030-01051-5.

Hall, C., Scott, C. and Hood, C. (2000) *Telecommunications Regulation. Culture, chaos and interdependence inside the regulatory process*. London/New York: Routledge.

Hallberg, L. R. M. (2006) 'The "core category" of grounded theory: Making constant comparisons', *International Journal of Qualitative Studies on Health and Well-being*, 1(3), pp. 141–148. doi: 10.1080/17482620600858399.

Haucap, J. (2009) 'The Regulatory Framework for European Telecommunications Markets Between Subsidiarity and Centralization', in Preissl, B., Haucap, J., and Curwen, P. J. (eds) *Telecommunication Markets, Contributions to Economics*. Springer Physica-Verlag HD, pp. 463–479. doi: 10.1007/978-3-7908-2082-9_26.

Hazlett, T., Oh, S. and Skorup, B. (2016) *Natural Experiments in Mobile Phone Regulation: Estimated Effects of Prohibiting Handset Bundling in Finland and Belgium*. Available at: <https://www.researchgate.net/publication/305653901>.

Heath, H. and Cowley, S. (2004) 'Developing a grounded theory approach: a comparison of Glaser and Strauss', *International Journal of Nursing Studies*, 41(2), pp. 141–150. Available at: <http://www.sciencedirect.com/science/article/B6T7T-49FGKCG-1/2/1cbe16a75b12b77b1f13224e1b97db35>.

Herder, P., Bouwmans, I., Dijkema, G., Stikkelman, R. and Weijnen, M. (2008) 'Designing Infrastructures Using a Complex Systems Approach', *Journal of Design Research*, 7(1), pp. 17–34.

Höffler, F. (2009) 'Mobile termination and collusion, revisited', *Journal of Regulatory Economics*,

35(3), pp. 246–274. doi: 10.1007/s11149-009-9087-2.

Holton, J. A. (2007) 'The Coding Process and Its Challenges', in Bryant, A. and Charmaz, K. (eds) *The Sage Handbook of Grounded Theory*. Los Angeles, CA: Sage, pp. 265–290.

Holton, J. A. and Walsh, I. (2017) *Classic grounded theory: Applications with qualitative & quantitative data*. Los Angeles, CA: Sage.

Hudson, H. (1994) 'Universal service in the Information Age', *Telecommunications Policy*, 18(8), pp. 658–667.

Hulsink, W. (1996) *Do Nations Matter in a Globalising Industry? The restructuring of Telecommunications Governance Regimes in France, the Netherlands and the United Kingdom (1980-1994)*. Erasmus Universiteit Rotterdam, doctoral thesis.

Hulsink, W. (1999) *Privatisation and Liberalisation in European Telecommunications. Comparing Britain, the Netherlands and France*. London: Routledge.

Hulsink, W. and Schenk, H. (1998) 'Privatisation and Deregulation in the Netherlands', in Parker, D. (ed.) *Privatisation in the European Union. Theory and Policy Perspectives*. London: Routledge, pp. 242–257.

Ilic, M. and Jelinek, M. (2009) 'Changing paradigms in electric energy systems', in *The Governance of Network Industries. Institutions, Technology and Policy in Reregulated Infrastructures*. Cheltenham, UK: Edward Elgar, pp. 134–166.

Instellingswet Autoriteit Consument en Markt, Wet van 28 februari 2013, houdende regels omtrent de instelling van de Autoriteit Consument en Markt (2013). Koninkrijk der Nederlanden. Available at: <https://wetten.overheid.nl/BWBR0033043/2019-01-01#Opschrift>.

Intven, H., Oliver, J. and Sepúlveda, E. (2000a) 'Competition Policy', in Intven, H. (ed.) *Telecommunications Regulation Handbook*. Washington: The World Bank, pp. 5.1-5.40.

Intven, H., Oliver, J. and Sepúlveda, E. (2000b) 'Overview of Telecommunications Regulation', in Intven, H. (ed.) *Telecommunications Regulation Handbook*. Washington: The World Bank, pp. 1.1-1.26.

ITU (1998) 'Strategic plan for the Union 2004-2007. Resolution 71 (revision Marrakesh, 2002)'. Minneapolis: ITU Plenipotentiary Conference 1998.

ITU (1999) *World Telecommunication Development Report 1999: Mobile Cellular*. Geneva: ITU.

JANET (no date) 'Fact Sheet Mobile Networking: 1G to 4G'. Available at: <http://www.ja.net/documents/factsheets/>

Jansen, M. C. W., Ros, A. P. and Van der Windt, N. (2002) *De draad kwijt? Onderzoek naar de gang van zaken rond de Nederlandse UMTS-veiling*. Rotterdam: Erasmus Universiteit.

Judicial System in the Netherlands (no date). Available at: <http://www.rechtspraak.nl/information+in+english> (Accessed: 22 December 2019).

Van de Kaa, G. and Greeven, M. J. (2017) 'Mobile telecommunication standardization in Japan, China, the United States, and Europe: a comparison of regulatory and industrial regimes', *Telecommunication Systems*. Springer New York LLC, 65(1), pp. 181–192. doi: 10.1007/s11235-016-0214-y.

- Kaestner, R. and Kahn, B. (1990) 'The effects of regulation and competition on the price of AT&T intrastate telephone service.', *Journal of Regulatory Economics*1, 2(4), pp. 363–377.
- Kay, J. and Vickers, J. (1990) 'Regulatory Refrom: An Appraisal', in Majone, G. (ed.) *Deregulation or re-regulation? Regulatory reform in Europe and the United States*. London: Pinter Publishers, pp. 223–251.
- Kensi, A., Barka, H. and Hajji, N. (2019) 'Switching Behavior in Mobile Phone Sector: The Case of Mobile Number Portability in Morocco', *IJCSNS International Journal of Computer Science and Network Security*, 19(5), pp. 53–61.
- Kingdon, J. W. (1984) *Agendas, Alternatives, and Public Policies*. New York: Longman.
- Klein, H. K. and Myers, M. D. (2011) 'A Classification Scheme for Interpretive Research in Information Systems', in Trauth, E. M. (ed.) *Qualitative Research in IS: Issues and Trends*. Hershey: IGI Global, pp. 218–239. doi: 10.4018/9781930708068.ch009.
- Klein, M. (1996) 'Competition in Network Industries'. World Bank, Private Sector Development Department, Policy Research Working Papers, no. 1591.
- Kongaut, C. and Bohlin, E. (2014) 'Impacts of mobile termination rates on retail prices: The implication for regulators', *Info*, 16(2), pp. 80–93. doi: 10.1108/info-11-2012-0043.
- Künneke, R. W. and Groenewegen, J. (2009) 'Challenges for readjusting the governance of network industries', in Künneke, R. W., Groenewegen, J., and Auger, J.-F. (eds) *The Governance of Network Industries. Institutions, Technology and Policy in Reregulated Infrastructures*. Cheltenham, UK: Edgar Elgar, pp. 1–24.
- Künneke, R. W., Groenewegen, J. and Auger, J. F. (2009) *The governance of network industries: Institutions, technology and policy in reregulated infrastructures, The Governance of Network Industries: Institutions, Technology and Policy in Reregulated Infrastructures*. Edited by R. W. Kunneke, J. Groenewegen, and J.-F. Auger. Cheltenham, UK: Edward Elgar. doi: 10.4337/9781849802178.
- Laakso, K., Rubin, A. and Linturi, H. (2012) 'The Role of Regulation in the Mobile Operator Business in Finland', *Foresight*, 14(2), pp. 157–173.
- Lahusen, C. (2000) 'The good government: Cooperative environmental regulation in a comparative perspective.', *European Environment*, 10(6), pp. 253–264.
- Langley, A. (1999) 'Strategies for theorizing from process data', *Academy of Management Review*, 24(4), pp. 691–710. doi: 10.5465/AMR.1999.2553248.
- Lempert, L. B. (2007) 'Asking Questions of the Data: Memo Writing in the Grounded Theory Tradition', in Bryant, A. and Charmaz, K. (eds) *The Sage Handbook of Grounded Theory*. London: Sage, pp. 245–264.
- Lentz, R. G. (2001) 'Regulation as Linguistic Engineering', in Mansell, R. and Raboy, M. (eds) *Handbook of Global Media and Communication Policy*. Wiley Blackwell, pp. 432–448. doi: <https://doi.org/10.1002/9781444395433.ch27>.
- Lomborg, K. and Kirkevold, M. (2003) 'Truth and validity in grounded theory -- a reconsidered realist interpretation of the criteria: fit, work, relevance and modifiability.', *Nursing philosophy: an international journal for healthcare professionals*, 4(3), pp. 189–200. doi: 10.1046/j.1466-769X.2003.00139.x.

- Long, C. D. (1995) *Telecommunications Law and Practice*. London: Sweet & Maxwell.
- Longstaff, P. H. (2003) 'Competition in the Communications Sector: Can Unpredictable Systems be Regulated?', in *14th European Regional Conference of the International Telecommunication Society*. Helsinki.
- Lord Chancellor's Department (2000) 'House of Commons Hansard Written Answers for 10 Mar 2000 (pt 4)'. London: House of Commons. Available at: <https://publications.parliament.uk/pa/cm199900/cmhansrd/vo000310/text/00310w04.htm>.
- Luis López, Á. (2011) 'Mobile termination rates and the receiver-pays regime', *Information Economics and Policy*, 23(2), pp. 171–181. doi: 10.1016/j.infoecopol.2011.02.001.
- Macmillan, R. (2005) 'Reflections on Regulation and Dispute Resolution in the Indian Telecommunication Sector', *Journal of the Indian Law Institute*, 47(1), pp. 29–52. Available at: www.itu.int/ITU-D/treg/Case.
- Madden, G. and Ahmad, H. (2013) '3G spectrum auction aftermarket network deployment', *Applied Economics Letters*, 20(3), pp. 300–303. doi: 10.1080/13504851.2012.697116.
- Madden, G., Bohlin, E., Tran, T. and Morey, A. (2014) 'Spectrum Licensing, Policy Instruments and Market Entry', *Review of Industrial Organization*, 44(3), pp. 277–298. doi: 10.1007/s11151-013-9405-9.
- Majone, G. (1996) *Regulating Europe*. London & New York: Routledge.
- Majone, G. (1997) 'From the Positive to the Regulatory State: Causes and Consequences of Changes in the Mode of Governance', *Journal of Public Policy*, 17(2), pp. 139–167.
- Mansell, R. (1993) *The New Telecommunications*. London: Sage.
- Mansell, R., Davies, A. and Hulsink, W. (1995) *The New Telecommunications in the Netherlands. Strategic developments in technologies and markets*. Den Haag: Rathenau Instituut.
- Marsden, C. (2010) 'European Law and Regulation of Mobile Net Neutrality', *European Journal of Law and Technology*, 1(2). Available at: <http://ssrn.com/abstract=1579282><http://ejlt.org//issue/current>.
- May, P. J. (2005) 'Compliance motivations: Perspectives of farmers, homebuilders, and marine facilities.', *Law and Policy*, 27(2), pp. 317–347.
- Mazar, H. (2008) 'An analysis of regulatory frameworks for wireless communications, societal concerns, and risks'. Dissertation.com.
- McCallin, A. M. (2003) 'Designing a Grounded Theory Study: some practicalities', *Nursing in Critical Care*, 8(5), pp. 203–208.
- McDermont, M. (2018) 'Alternative imaginings of regulation: An experiment in co-production', *Journal of Law and Society*, 45(1), pp. 156–175.
- McMillan, D. (1999) 'U.K. Court Enforces 3G National Roaming', *Total Telecom e-newsletter*. Available at: last consulted on May 23rd 2006.
- McMillan, J. (1995) 'Why auction the spectrum?', *Telecommunications Policy*, 19(3), pp. 191–199. doi: 10.1016/0308-5961(94)00021-J.

Mededingingswet, Wet van 22 mei 1997, houdende nieuwe regels omtrent de economische mededinging (Dutch Competition Act) (1997).

Mehmetoglu, M. and Dann, G. (2003) 'Atlas/ti and content/semiotic analysis in tourism research', *Tourism Analysis*, 8(1), pp. 1–13. Available at: <https://doi.org/10.3727/108354203108750120>.

Melody, W. H. (1997) 'Policy objectives and Models of Regulation', in Melody, W. (ed.) *Telecom reform: Principles, policies and regulatory practices*. Lyngby: Private Ingeniørfond, Technical University of Denmark, pp. 13–29.

Melody, W. H. (1999) 'Telecom reform: progress and prospects', *Telecommunications Policy*, 23(1), pp. 7–34.

Menard, C. (2009) 'Why reform infrastructures and with what institutional arrangements? The case of public-private partnerships in water supply', in Kunneke, R., Groenewegen, J., and Auger, J. F. (eds) *The Governance of Network Industries. Institutions, Technology and Policy in Reregulated Infrastructures*. Cheltenham, UK: Edward Elgar, pp. 25–45.

Milne, C. (1998) 'Stages of universal service policy', *Telecommunications Policy*, 22(9), pp. 775–780.

Ministère de l'économie des finances et de l'industrie (1999) 'Décret no 99-922 du 27 Octobre 1999 modifiant l'article D. 99-16 du code des postes et télécommunications et relatif à la présélection du transporteur, J.O. no 254 du 31 Octobre 1999, p. 16347'.

Ministerie van Verkeer & Waterstaat DG Telecommunicatie en Post (1994) *GSM Tender document*. The Hague: Ministerie van Verkeer en Waterstaat.

Ministerie van Verkeer en Waterstaat DG Telecommunicatie en Post (2000) *Nationaal Antennebeleid*. Den Haag: Ministerie van Verkeer & Waterstaat.

Minoque, M. (2002) 'Governance-Based Analysis of Regulation', *Annals of Public and Cooperative Economics*, 73(4), pp. 649–666.

Mitchell, B., Neu, W., Neumann, K.-H. and Vogelsang, I. (1996) 'Interconnection: the key to further liberalisation in Europe', in Bianchi, A. and Richeri, G. (eds) *Telecommunication: New Dynamics and Driving Forces*. Amsterdam: IOS Press, pp. 71–98.

mm02 (2004) 'Annual Review 2004'. Slough, Berkshire, UK: mm02 plc. Available at: http://www.02.com/media_files/Review_4/pdf.

Moran, M. and Prosser, T. (1994a) 'Introduction: politics, privatization and constitutions', in Moran, M. and Prosser, T. (eds) *Privatization and regulatory change in Europe*. Buckingham: Open University Press, pp. 1–13.

Moran, M. and Prosser, T. (1994b) 'Privatization and regulatory change in Europe'. Buckingham: Open University Press.

Morison, M. and Moir, J. (1998) 'The role of computer software in the analysis of qualitative data: efficient clerk, research assistant or Trojan horse?', *Journal of Advanced Nursing*, 28(1), pp. 106–116. Available at: <http://dx.doi.org/10.1046/j.1365-2648.1998.00768.x>.

Morse, J. M. (2009) 'Tussles, Tensions, and Resolutions', in Morse, J. M., Stern, P. N., Corbin, J., Bowers, B., Charmaz, K., and Clarke, A. C. (eds) *Developing Grounded Theory. The Second Generation*. Walnut Creek, CA.: Left Coast Press, pp. 13–19.

Morse, J. M., Stern, P. N., Corbin, J., Bowers, B., Charmaz, K. and Clarke, A. C. (eds) (2009) *Developing*

grounded theory. The second generation, Developing Qualitative Inquiry. Walnut Creek: Left Coast Press. doi: 10.1177/1049732307301611.

Mueller, M. (1997) 'Universal Service and the Telecommunications Act. Myth Made Law', *Communications of the ACM*, 40(3), pp. 39–47.

Myers, M. D. (1997) 'Qualitative Research in Information Systems', *MIS Quarterly*, 21(2), pp. 241–242. Available at: https://s3.amazonaws.com/academia.edu.documents/11137785/qualitative_research_in_information_systems.pdf?response-content-disposition=inline%3Bfilename%3DQualitative_research_in_information_syst.pdf&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIAI.

Nagel, D. A., Tilley, C., Burns, V. F. and Aubin, D. (2015) 'When novice researchers adopt constructivist grounded theory: Navigating less travelled paradigmatic and methodological paths in PhD dissertation work', *International Journal of Doctoral Studies*, 10(September), pp. 365–383. doi: 10.28945/2300.

Nihoul, P. L. G. (2002) 'Authorities, competition and electronic communications', *Info*, 4(1), pp. 7–23.

Noam, E. (1994) 'Beyond liberalisation. From the network of networks to the system of systems', *Telecommunications Policy*, 18(4), pp. 286–294.

Noam, E. M. (1992) 'Network tipping: the rise and fall of the public network monopoly', in Noam, E. M. (ed.) *Telecommunications in Europe*. New York: Oxford University Press, pp. 26–42.

Nowotny, K. (1989) 'The economics of public utility regulation: an overview', in K. Nowotny, David B. Smith, and Harry M. Trebbing (eds) *Public Utility Regulation*. Boston: Kluwer Academic Publishers, pp. 9–27.

O'Connor, M. K., Netting, F. E. and Thomas, M. L. (2008) 'Grounded Theory. Managing the Challenge for Those Facing Institutional Review Board Oversight', *Qualitative Inquiry*, 14(1), pp. 28–45.

OECD (2004) 'OECD Reviews of Regulatory Reform: France 2004. Charting a Clear Way Forward'. Paris: OECD. doi: <https://dx.doi.org/10.1787/9789264015487-en>.

Office of the Telecommunications Ombudsman (2003) *Introducing: The Telecommunications Ombudsman Service. The Ombudsman's first report*. Warrington: Otel.

OFT (2002) *Complaint submitted under the Competition Act 1998 by the Federation of Wholesale Distributors alleging an infringement of the prohibition imposed by section 2(1) of the Act by Vodafone Ltd*. London: Office of Fair Trading.

OFT (2003) *Annual Plan 2004*. London: Office of Fair Trading.

OFT (2004) *A guide to the Office of Fair Trading*. London: Office of Fair Trading.

Oftel (1994) 'Fair Competition in Mobile Service Provision'. London: Oftel, May 1994.

Oftel (1995a) 'Fair Trading in Telecommunications'. London: Oftel, December 1995.

Oftel (1995b) 'Inquiry by the Monopolies and Mergers Commission into telephone number portability. Explanatory Statement from the Director General of Telecommunications'. London: Oftel, December 1995.

Oftel (1995c) 'The Customer Interface to Public Networks'. London: Oftel, July 1995.

- Oftel (1996a) 'Duct and Pole Sharing'. London: Oftel, February 1996.
- Oftel (1996b) 'Fair Trading in Mobile Service Provision. Consultation document'. London: Oftel, May 1996.
- Oftel (1997a) 'Dealing with anti-competitive behaviour – an Oftel Guide'. London: Oftel, December 1997.
- Oftel (1997b) 'Duct and Pole Sharing'. London: Oftel, October 1997.
- Oftel (1997c) 'Fair Trading Condition, Incorporation into existing telecommunications licences'. London: Oftel, March 1997.
- Oftel (1997d) 'Fair Trading Condition Enforcement Procedure'. London: Oftel, March 1997.
- Oftel (1997e) 'Fair Trading in the Mobile Telephony Market. Statement'. London: Oftel, April 1997.
- Oftel (1997f) 'Guidelines on the Operation of the Fair Trading Condition'. London: Oftel, March 1997.
- Oftel (1997g) 'Improving Accountability'. London: Oftel.
- Oftel (1997h) 'Interconnection and interoperability. A framework for competing networks'. London: Oftel, April 1997.
- Oftel (1997i) 'Number Portability in the Mobile Telephony Market. Explanatory Note'. London: Oftel, October 3rd 1997.
- Oftel (1997j) 'Number Portability in the mobile telephony market'. London: Oftel, July 1997.
- Oftel (1997k) 'Numbering Conventions'. London: Oftel, April 1997.
- Oftel (1997l) 'Oftel's Management Plan for 1997/98 and beyond'. London: Oftel. Available at: https://webarchive.nationalarchives.gov.uk/20140107183932/http://www.ofcom.org.uk/static/archive/oftel/publications/1995_98/about_oftel/manage97.htm.
- Oftel (1997m) 'Prices of calls to mobile phones'. London: Oftel, March 1997.
- Oftel (1997n) 'The Economic Evaluation of Number Portability in the UK Mobile Telephony Market'. London: Oftel, July 1997.
- Oftel (1998a) 'Identification of Significant Market Power for the purposes of the Interconnection Directive'. London: Oftel, February 1998.
- Oftel (1998b) 'Interconnection & Interoperability of Services over Telephony Networks'. London: Oftel, April 1998.
- Oftel (1998c) 'Modification of the Licences of Orange and Mercury Personal Communications (MPCL)'. London: Oftel, April 1998.
- Oftel (1998d) 'Oftel's submission to the Monopolies and Mergers Commission inquiry into the prices of calls to mobile phones'. London: Oftel, May 1998.
- Oftel (1998e) 'Personal Numbering Services'. London: Oftel, March 31st 1998.
- Oftel (1998f) 'Prices of calls to mobile phones. Statement issued by the Direct General of Telecommunications'. London: Oftel, March 1998.

Oftel (1998g) 'Proposal to determine that BT has Interface Control in the supply of certain telecoms services'. London: Oftel, August 1998.

Oftel (1998h) 'Statement by the Director General of Telecommunications on collocation and facility sharing'. London: Oftel, November 1998.

Oftel (1999a) 'Access to second-generation mobile networks for new entrant third generation mobile operators'. London: Oftel, May 1999. Available at: <https://webarchive.nationalarchives.gov.uk/20080715024902/http://www.ofcom.org.uk/static/archive/oftel/publications/1999/consumer/2g3g0599.htm>.

Oftel (1999b) 'Competition in the mobile market'. London: Oftel, February 1999.

Oftel (1999c) 'Customer choice: Oftel's review of indirect access for mobile networks'. London: Oftel, February 1999.

Oftel (1999d) 'Guidelines on Interconnection and Interoperability'. London: Oftel, July 1999.

Oftel (1999e) 'Mobile Network Phone Companies Survey of Successful Call Rates: April – June 1999'. London: Oftel, October 1999.

Oftel (1999f) 'Mobile Number Portability Direction requests', *Competition Bulletin, issue 15*, March, n.p. Available at: [https://webarchive.nationalarchives.gov.uk/20080713161023/http://www.ofcom.org.uk/static/archive/oftel/publications/comp_bull/archive/bull15.htm#Mobile Number Portability Direction requests](https://webarchive.nationalarchives.gov.uk/20080713161023/http://www.ofcom.org.uk/static/archive/oftel/publications/comp_bull/archive/bull15.htm#Mobile%20Number%20Portability%20Direction%20requests).

Oftel (1999g) 'Mobile Price Monitoring. A consultation on a model developed by National Economic Research Associates to identify trends in the price of calls from mobile phones in the UK'. London: Oftel, September 1999.

Oftel (1999h) 'Mobile Virtual Network Operators: Oftel inquiry into what MVNOs could offer consumers'. London: Oftel, June 1999.

Oftel (1999i) 'Notice of determinations that Vodafone and BT Cellnet have Market Influence under Condition 56 of their respective Licences'. London: Oftel, November 1999.

Oftel (1999j) 'Oftel Statement on Mobile Virtual Network Operators'. London: Oftel, October 1999.

Oftel (1999k) 'Oftel statement on national roaming. Revised Version'. London: Oftel, October 1999.

Oftel (1999l) 'Oftel statement on national roaming'. London: Oftel, July 1999.

Oftel (1999m) 'One2One: Mobile Number Portability Charges', *Competition Bulletin, issue 11*, January, p. n.p.

Oftel (1999n) *Operator Policy Forum*. Available at: https://webarchive.nationalarchives.gov.uk/20080712180334/http://www.ofcom.org.uk/static/archive/oftel/ind_groups/op_policy/index.htm.

Oftel (1999o) 'Orange: Mobile Number Portability Charges', *Competition Bulletin, issue 11*, January. Available at: https://webarchive.nationalarchives.gov.uk/20080713161535/http://www.ofcom.org.uk/static/archive/oftel/publications/comp_bull/archive/bull11.htm.

Oftel (1999p) 'Pre-paid mobile services and the regulatory framework'. London: Oftel, July 27th 1999.

- Oftel (1999q) 'Pre-pay services on the BT Cellnet network', *Competition Bulletin, issue 14*, November. Available at:
https://webarchive.nationalarchives.gov.uk/20160106034051/http://www.ofcom.org.uk/static/archive/oftel/publications/comp_bull/archive/bull14.htm.
- Oftel (1999r) 'Proposed amendments to the procedural notes of the advisory body on fair trading in telecommunications'. London: Oftel, April 1999.
- Oftel (1999s) 'Review of the mobile market'. London: Oftel, July 1999.
- Oftel (1999t) 'Rights and obligations to interconnect under the EC Interconnection Directive. Statement issued by the Direct General of Telecommunications'. London: Oftel, April 1999.
- Oftel (2000a) 'A consultative document issued by the Director General of Telecommunications setting out proposals for future retail price and network charge controls'. London: Oftel, October 2000.
- Oftel (2000b) 'BT Cellnet Genie service', *Competition Bulletin, issue 18*, November, p. n.p. Available at:
[https://webarchive.nationalarchives.gov.uk/20080713160918/http://www.ofcom.org.uk/static/archive/oftel/publications/comp_bull/archive/bull18.htm#BT Cellnet Genie service](https://webarchive.nationalarchives.gov.uk/20080713160918/http://www.ofcom.org.uk/static/archive/oftel/publications/comp_bull/archive/bull18.htm#BT%20Cellnet%20Genie%20service).
- Oftel (2000c) 'Encouraging self- and co-regulation in telecoms to benefit consumers'. London: Oftel, June 2000.
- Oftel (2000d) 'Guidelines on Market Influence determinations'. London: Oftel, March 2000.
- Oftel (2000e) 'Oftel gains new powers under Electronic Communication Act'. London: Oftel, July 25th 2000.
- Oftel (2000f) 'Price Control Review: A consultative document issued by the Director General of Telecommunications on possible approaches for future retail price and network charge controls'. London: Oftel, March 2000.
- Oftel (2000g) 'Wholesale pre-paid mobile services. A statement issued by the Director General of Telecommunications'. London: Oftel, July 2000.
- Oftel (2001a) '3G Mobile Infrastructure Sharing in the UK. Note for information'. London: Oftel, May 2001.
- Oftel (2001b) 'Competition in the Provision of Fixed Telephony Services'. London: Oftel, July 2001.
- Oftel (2001c) 'Directions under the provisions of Regulation 6(6) of the Telecommunications (Interconnection) Regulations 1997 of a dispute between Orange Personal Communications Services Limited ("Orange") and British Telecommunications PLC ("BT")'. London: Oftel, September 21st 2001.
- Oftel (2001d) 'Draft directions under the provisions of Regulation 6(6) of the Telecommunications (Interconnection) Regulations 1997 of a dispute between Orange Personal Communications Services Limited ("Orange") and British Telecommunications PLC ("BT")'. London: Oftel, August 2nd 2001.
- Oftel (2001e) 'Draft Oftel Management Plan 2001/2002'. London: Oftel, December 2001.
- Oftel (2001f) 'Effective Competition Review: Mobile'. London: Oftel, February 2001.
- Oftel (2001g) 'Giving consumers confidence in price comparisons of telecommunications services'.

London: Oftel, December 14th 2001.

Oftel (2001h) 'Mobile Number Portability and SIM Unlocking Research, Mystery Shopping Project'. London: Oftel, May 2001.

Oftel (2001i) 'Notices of determinations to remove the MI determinations that Vodafone and BT Cellnet have Market Influence under Condition 56 of their respective licences'. London: Oftel, December 2001.

Oftel (2001j) 'Restoring Trust in Personal Numbering. Consultation Document'. London: Oftel, May 2001.

Oftel (2001k) 'Restoring Trust in Personal Numbering. Statement'. London: Oftel, October 31st 2001.

Oftel (2001l) 'Review of the Charge Control on Calls to Mobiles'. London: Oftel, 26 September 2001.

Oftel (2001m) 'The benefits of self and co-regulation to consumers and industry'. London: Oftel, July 2001.

Oftel (2001n) 'The Oftel formula returns'. London: Oftel, December 2001.

Oftel (2001o) 'Use of multiple SIM cards in mobile phones, by consumers in Italy, Finland & Portugal'. London: Oftel, July 2001.

Oftel (2002a) 'Draft Decisions and Explanatory Memorandum on the Director General's intention to remove the Determinations that Vodafone and BT Cellnet have Market Influence under Condition 56 of their respective Licences'. London: Oftel, 5 March 2002.

Oftel (2002b) 'Numbering conventions for the United Kingdom, issue 4'. London: Oftel, March 1st 2002.

Oftel (2002c) 'Oftel Price Assurance Standard: The new accreditation scheme giving consumers confidence in websites providing price comparisons of telecoms services'. London: Oftel, September 30th 2002.

Oftel (no date) 'Competition Bulletin'. London: Oftel.

Oftel and DTI (1999) 'Rights and obligations to interconnect under the EC Interconnection Directive. A consultation document'. London: Oftel & DTI, April 1990.

Oftel and OFT (2000) 'The Application of the Competition Act in the Telecommunications Sector'. London: Oftel & OFT, January 2000.

OPTA/NMa (2000) *Samenwerkingsprotocol OPTA/NMa (Protocol on cooperation OPTA/NMa)*. The Hague: OPTA/NMa, December 19th 2000.

OPTA (1998a) 'Besluit van het college van Onafhankelijke Post en Telecommunicatie Autoriteit over de mate van kostengeoriënteerdheid van de door KPN voorgestelde tarieven voor de spraaktelefoon dienst'. The Hague: OPTA, November 23rd 1998.

OPTA (1998b) 'Consultatiedocument over bijzondere toegangsdiensten (Consultation document on special access services)'. The Hague: OPTA, June 4th 1998.

OPTA (1999a) 'Besluit geschil Dutchtone-KPN. (Decision dispute Dutchtone vs KPN)'. The Hague: OPTA, April 2nd 1999.

OPTA (1999b) 'Besluit tot aanwijzing van Koninklijke KPN N.V. als partij met aanmerkelijke macht op de markt voor mobiele telefonie (Decision to designate Royal KPN as a party with significant market power in the mobile telecommunications market)'. The Hague: OPTA, October 20th 1999.

OPTA (1999c) 'Besluit tot aanwijzing van Libertel N.V. als partij met aanmerkelijke macht op de markt voor mobiele telefonie (Decision to designate Libertel N.V. as a party with significant market power in the mobile telecommunications market)'. The Hague: OPTA, October 20th 1999.

OPTA (1999d) 'Brief aan de Minister van Verkeer en Waterstaat inzake Beleidsvoornemen UMTS (Letter to the Minister of Transport and Public Works on UMTS policy resolution)'. The Hague: OPTA, May 7th 1999.

OPTA (1999e) 'Connecties nr 6', July.

OPTA (1999f) 'Mededeling aan de verschillende marktpartijen over aanwijzing aanmerkelijke marktmacht (Communication to the various market players on SMP designation)'. The Hague: OPTA, July 26th 1999.

OPTA (1999g) 'OPTA wil stap voor stap betere dienstverlening bij meenemen mobiel nummer (OPTA wants a gradual improvement in mobile number portability)'. The Hague: OPTA, November 1st 1999.

OPTA (1999h) 'Richtsnoeren met betrekking tot ontbundelde toegang tot de aansluitlijn ("MDF-access") (Guidelines to MDF access)'. The Hague: OPTA, March 12th 1999.

OPTA (1999i) 'Standpunt van OPTA over nadere invulling aan het vereiste van kostenoriëntatie voor tarieven vast naar mobiel (OPTA's position on additional details on the requirement of cost orientation for fixed to mobile rates)'. The Hague: OPTA, October 19th 1999.

OPTA (1999j) 'Voorlichting aan consument over SIM-lock schiet tekort (Consumer information on SIM-lock fails)', *Connecties*, February, p. 9.

OPTA (2000a) *Annual Report 2000*. The Hague: OPTA.

OPTA (2000b) 'Beslissing op bezwaar - last onder dwangsom nummerportabiliteit. Brief aan marktpartijen (Decision on appeal - penalty on a daily basis number portability. Letter to market parties)'. The Hague: OPTA, July 6th 2000.

OPTA (2000c) 'Besluit van het college van OPTA van 24 oktober 2000, kenmerk OPTA/EGM/2000/202762 (Decision by the Commission of OPTA of October 24th 2000)'. The Hague: OPTA, OPTA/EGM/2000/202762.

OPTA (2000d) 'Bijzondere Toegang tot Mobiele Netwerken (Special Access to Mobile Networks)'. The Hague: OPTA, November 13th 2000.

OPTA (2000e) 'Definitieve last onder dwangsom voor mobiele aanbieders bij meenemen mobiel nummer (Final penalty on a daily basis for mobile network operators referring to mobile number portability)'. The Hague: OPTA, January 1st 2000.

OPTA (2000f) 'Meenemen van telefoonnummer verloopt steeds beter. (Telephone number portability continues to improve)'. The Hague: OPTA, July 10th 2000.

OPTA (2000g) 'Oordeel over de wijze van toerekening van kosten naar gesprekken van vaste naar mobiele aansluitingen (Judgement on the costs allocation method of calls from fixed to mobile connectons)'. The Hague: OPTA, December 21st 2000.

OPTA (2000h) 'Richtsnoeren aanwijzing aanmerkelijke macht op de markt (Guidelines designation

significant market power}'. The Hague: OPTA, March 6th 2000.

OPTA (2001a) 'Beleidsregels Aankiesbaarheidsdiensten (Guidelines Special Access}'. The Hague: OPTA, July 6th 2001.

OPTA (2001b) 'Beleidsregels Nummerportabiliteit Mobiele Telefoonie. (Guidelines Mobile Number Portability}'. The Hague: OPTA, June 27th 2001.

OPTA (2001c) 'Besluit tot intrekking van de aanwijzing van Libertel-Vodafone als partij met aanmerkelijke macht op de markt voor mobiele telefoonie (Decision to withdraw the designation of Libertel-Vodafone as a market party with significant market power in the market o'. The Hague: OPTA, December 19th 2001.

OPTA (2001d) 'Besluit van het college van de Onafhankelijke Post en Telecommunicatie Autoriteit in het geschil tussen KPN Mobile the Netherlands B.V. en Telfort Mobiel B.V. (Decision of the Board of OPTA in the dispute between KPN Mobile The Netherlands B.V. and Telfor'. The Hague: OPTA, December 18th 2001.

OPTA (2001e) 'Brief intrekking last onder dwangsom nummerportabiliteit (Letter on the annulment of penalty on a daily basis number portability}'. The Hague: OPTA, June 29th 2001.

OPTA (2001f) 'Consultatiedocument Vormen van bijzondere toegang tot mobiele netwerken en redelijkheid van verzoeken hiertoe (Consultation document on types of special access to mobile networks and the reasonableness of requests for such access}'. The Hague: OPTA, November 30th 2001.

OPTA (2001g) 'De regulering van mobiele terminating tarieven (Regulation of mobile terminating tariffs}'. The Hague: OPTA, December 19th 2001.

OPTA (2001h) 'Mededeling aan de verschillende marktpartijen over aanwijzing AMM (Communication to the various market parties on the designation of SMP}'. The Hague: OPTA, OPTA/IBT/2001/203851, December 19th 2001.

OPTA (2001i) 'Onderzoek naar ongevraagd versturen van SMS-berichten. Investigation into unrequested SMS-messages.', *Connecties*, pp. 8–9.

OPTA (2001j) 'Richtlijn Rapportage Nummerportabiliteit (Directive for Reporting Number Portability}'. The Hague: OPTA, July 2nd 2001.

OPTA (2002a) 'Beleidsregels inzake de regulering van mobiele terminating tarieven (Guidelines on the regulation of mobile termination tariffs}'. The Hague: OPTA, March 28th 2002.

OPTA (2002b) 'Letter Significant Market Power 2002, Market Survey'. The Hague: OPTA, May 2nd 2002.

OPTA (2003) 'Beleidsregels Nummerportabiliteit Mobiele Telefoonie (Guidelines Mobile Number Portability}'. The Hague: OPTA, July 7th 2003.

OPTA Wet, Wet van 5 juli 1997, houdende regels inzake instelling van een college voor de post- en telecommunicatiemarkt (1997).

Organisation for Economic Co-operation and Development/PUMA (2000) *Reducing the Risk of Policy Failure: Challenges for Regulatory Compliance*. Paris: OECD/PUMA.

Organisation for Economic Co-operation and Development (1995) *Universal Service Obligations in a Competitive Telecommunications Market*. Paris: OECD.

Organisation for Economic Co-operation and Development (2000a) 'Cellular Mobile Pricing Structures and Trends'. Paris: OECD, Working Party on Telecommunication and Information Services Policies.

Organisation for Economic Co-operation and Development (2000b) *Telecommunications Regulations: Institutional Structures and Responsibilities*. Paris: OECD.

Organisation for Economic Co-operation and Development (2005) 'Universal Services Obligations in a Competitive Telecommunications Environment'. Paris: OECD (Information Computer Communications Policy, no 38). Available at: <http://www.oecd.org/dataoecd/38/26/2349175.pdf>.

Organisation for Economic Co-operation and Development (2017) *Mobile subscriptions per 100 inhabitants for OECD, last updated October 2017, OECD Key ICT Indicators*. Available at: <https://www.oecd.org/internet/oecdkeyictindicators.htm> (Accessed: 24 January 2019).

Orlikowski, W. and Baroudi, J. J. (1990) 'Studying Information Technology in Organizations: Research Approaches and Assumptions'. New York: New York University, Center for Research on Information Systems, Information Systems Department, Digital Economy Research, Leonard N. Stern School of Business (Working Paper Series, STERN IS-90-4), p. 35.

Osborne, D. and Gaebler, T. (1992) *Reinventing Government: how the entrepreneurial spirit is transforming the public sector*. Reading, Massachusetts: Addison-Wesley.

Ottow, A. (2003) *Dispute Resolution under the new European Framework, Dispute Resolution under the new European Framework*. Amsterdam. Available at: www.ivir.nl.

Panzar, J. C. and Willig, R. D. (1981) 'Economies of Scope', *The American Economic Review*. American Economic Association, 71(2), pp. 268–272. Available at: <http://www.jstor.org/stable/1815729>.

Parliament of the United Kingdom (2003) 'Communications Act 2003', *Office of the Queen's Printer for Scotland*. Available at: <http://www.legislation.gov.uk/ukpga/2003/21/contents>.

Penard, T. (2001) *Comment analyser le succès de la téléphonie mobile en France?* Rennes: Université de Rennes. Available at: <http://perso.univ-rennes1.fr/thierry.penard/biblio/artmobile1.pdf>.

Penard, T. (2002) 'Competition and Strategy on the Mobile Telephony Market: a Look at the GSM Business Model in France', *Communications & Strategies*, (1st quarter), pp. 49–80.

Pereira, J. P. R. (2013) 'Effects of NGNs on market definition', in *Advances in Intelligent Systems and Computing*. Springer Verlag, pp. 939–949. doi: 10.1007/978-3-642-36981-0_88.

Peters, V. and Wester, F. (2007) 'How Qualitative Data Analysis Software may Support the Qualitative Analysis Process', *Quality & Quantity*, 41(5), pp. 635–659. doi: 10.1007/s11135-006-9016-8.

Picciotti, S. (2007) 'Constructing Compliance: Game playing, tax law and the regulatory state', *Law and Policy*, 29(1), pp. 11–30.

Picciotto, S. (2002) 'Reconceptualizing Regulation in the Era of Globalization', *Journal of Law and Society*, 29(1), pp. 1–11. doi: 10.1111/1467-6478.00208.

Picciotto, S. (2007) 'Constructing Compliance: Game-Playing, Tax Law and the Regulatory State', *Law & Policy*, 29(1), pp. 11–30.

Di Pillo, F., Cricelli, L., Gastaldi, M. and Levaldi, N. (2010) 'Asymmetry in mobile access charges: Is it an effective regulatory measure?', *Netnomics*, 11(3), pp. 291–314. doi: 10.1007/s11066-009-9043-4.

- Prosser, T. (1997) *Law and the Regulators*. Oxford: Clarendon Press.
- Prosser, T. (2005) 'Appeals in Regulation', in Vass, P. (ed.) *Regulatory Review 2004/2005*. Bath: University of Bath, Centre for the study of Regulated Industries (CRI), pp. 195–213.
- Puddephatt, A. J. (2006) 'An Interview with Kathy Charmaz: On Constructing Grounded Theory', *Qualitative Sociology Review*, 11(3), pp. 5–20. Available at: http://www.qualitativesociologyreview.org/ENG/archive_eng.php.
- Rapp, L. (1996) 'Public service or universal service?', *Telecommunications Policy*, 20(6), pp. 391–397.
- Regli, B. J. W. (1997) *Wireless: Strategically Liberalizing the Telecommunications Market*. New Jersey: Lawrence Erlbaum Associates.
- Reichertz, J. (2007) 'Abduction: The Logic of Discovery of Grounded Theory', in Bryant, A. and Charmaz, K. (eds) *The Sage Handbook of Grounded Theory*. London: Sage, pp. 214–228.
- De Reuver, M. (2009) *Governing mobile service innovation in co-evolving value networks*. Delft University of Technology, doctoral thesis.
- Riccardi, D., Ciriani, S. and Quelin, B. (2009) 'Does Regulation Impact the Entry in a Mature Regulated Industry?', in Curwen, P., Haucap, J., and Preissl, B. (eds) *Telecommunications Markets*. Heidelberg: Physica-Verlag HD (Contributions to Economics), pp. 283–305. doi: 10.1007/978-3-7908-2082-9.
- Rieger, K. L. (2019) 'Discriminating among grounded theory approaches', *Nursing Inquiry*, 26(1), pp. 1–12. doi: 10.1111/nin.12261.
- Riley, A. (2000) 'A Unique Antitrust Regulatory Problem: Co-ordinating Concurrent Competition Powers', *Utilities Law Review*, 11(2), pp. 36–40.
- Roberts, K. A. and Wilson, R. W. (2002) 'ICT and the Research Process: Issues Around the Compatibility of Technology with Qualitative Data Analysis', *FORUM: Qualitative Social Research Sozialsforschung*, 3(2), p. art. 23.
- Ruhle, E.-O. and Freund, N. (2013) 'Electronic communications services in the world of apps: Regulatory challenges', in *24th European Regional Conference of the International Telecommunication Society*. Florence, October 20th-23rd 2013. Available at: www.econstor.eu.
- Sandbach, J. and Van Hooft, L. (2010) 'Using on-net/off-net price differential to measure the size of call externalities and its implications for setting efficient MTRs', in Falch, M. and Markendahl, J. (eds) *Promoting New Telecom Infrastructures*. Edward Elgar, pp. 264–283.
- Sappington, D. E. . and Weisman, D. L. (1996) *Designing Incentive Regulation for the Telecommunications Industry*. Cambridge/London: MIT Press.
- Schwandt, T. A. (1994) 'Constructivist, Interpretivist Approaches to Human Inquiry', in Denzin, N. K. and Lincoln, Y. S. (eds) *Handbook of Qualitative Research*. Thousand Oaks: Sage Publications, pp. 118–137.
- Scott, C., Hall, C. and Hood, C. (1997) 'Regulatory Space and Institutional Reform: the case of telecommunications', in Vass, P. (ed.) *Regulatory Review 1997*. Bath: University of Bath, Centre for the Study of Regulated Industries (CRI), pp. 231–253.
- Scott, H. (2007) *The temporal integration of connected study into a structured life: a grounded theory*. University of Portsmouth, doctoral thesis.

- Shafi, M., Molisch, A. F., Smith, P. J., Haustein, T., Zhu, P., De Silva, P., Tufvesson, F., Benjebbour, A. and Wunder, G. (2017) '5G: A tutorial overview of standards, trials, challenges, deployment, and practice', *IEEE Journal on Selected Areas in Communications*, 35(6), pp. 1201–1221. doi: 10.1109/JSAC.2017.2692307.
- Sheargold, E. and Mitchell, A. D. (2016) 'The TPP and Good Regulatory Practices: An Opportunity for Regulatory Coherence to Promote Regulatory Autonomy?', *World Trade Review*, 15(4), pp. 587–612.
- Shim, W. (2016) *Policy Constellation Matters: Evidence from Investment in the Telecommunications Industry in European Countries*, *International Telecommunications Policy Review*. Available at: <http://ssrn.com/abstract=2756981><http://ssrn.com/abstract=2756981>.
- Singh, M. P., Gupta, A. K. and Sharma, M. (2019) '5G: Challenges, Opportunities, and Health Concerns', *International Journal of Engineering Research and Technology*, 7(12), pp. 1–5.
- Sørensen, C., De Reuver, M. and Basole, R. C. (2015) 'Mobile platforms and ecosystems', *Journal of Information Technology*, 30(3), pp. 195–197. doi: 10.1057/jit.2015.22.
- Spiller, P. T. (1996) 'A positive political theory of regulatory instruments: contract, administrative law or regulatory specificity?', *Southern California Law Review*, 68(431), pp. 477–515.
- Srinuan, C., Srinuan, P. and Bohlin, E. (2011) 'Entry relaxation and an independent regulator: Performance impact on the mobile telecoms industry in Asia', in Jarvis, D. S. L., Ramesh, M., Wu, X., and Araral jr., E. (eds) *Infrastructure Regulation: What Works, Why and How Do We Know?* Singapore: World Scientific, pp. 83–108.
- Steinfeld, C., Bauer, J. M. and Caby, L. (1994) *Telecommunication in Transition. Policies, Services and Technologies in the European Community*. Thousand Oaks (CA): Sage.
- Stichting voor Economisch Onderzoek (2001) *Toegang tot mobiele netwerken*. Amsterdam: SEO, University of Amsterdam.
- stN (2020) *Stichting Telecomgebruikers Nederland*. Available at: <https://www.stn.nl/organisatie/stichting-telecomgebruikers-nederland/> (Accessed: 10 April 2020).
- Strauss, A. and Corbin, J. (1990) *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. 1st edn. Thousand Oaks, CA: Sage.
- Strauss, A. and Corbin, J. (1998) *Basics of Qualitative Research. Techniques and Procedures for Developing Grounded Theory*. 2nd edn. Thousand Oaks, CA: Sage.
- Strübing, J. (2007) 'Research as Pragmatic Problem-solving: the Pragmatist Roots of Empirically-grounded Theorizing', in Bryant, A. and Charmaz, K. (eds) *The Sage Handbook of Grounded Theory*. London: Sage, pp. 580–602.
- Sun, H., Zhang, Z., Hu, R. Q. and Qian, Y. (2018) 'Wearable communications in 5G: Challenges and Enabling Technologies', *IEEE Vehicular Technology Magazine*, 13(3), pp. 100–109. doi: 10.1109/MVT.2018.2810317.
- Sung, N. (2014) 'Market concentration and competition in OECD mobile telecommunications markets', *Applied Economics*, 46(25), pp. 3037–3048. doi: <https://doi.org/10.1080/00036846.2014.920480>.

- Suryanegara, M., Mirfananda, A. S., Asvial, M. and Hayati, N. (2018) '5G as intelligent system: Model and regulatory consequences', in *Lecture Notes in Networks and Systems*. Springer, pp. 893–902. doi: 10.1007/978-3-319-56994-9_61.
- Sutherland, E. (2007) 'The regulation of the quality of service in mobile networks', *Info*, pp. 17–34. doi: 10.1108/14636690710827668.
- Sutherland, E. (2010) 'International mobile roaming: competition, economics and regulation', p. 37. Available at: <http://www.gsm.org/newsroom/press-releases/2010/4634.htm>.
- Sutherland, E. (2011a) *International mobile roaming: an update*. Available at: <http://ssrn.com/abstract=1786446>.
- Sutherland, E. (2011b) 'International mobile roaming in the Arab states', *Info*, 13(2), pp. 35–52. doi: 10.1108/14636691111121629.
- Sutherland, E. (2011c) 'Lessons from 'Bill Shock'-trans-border mobile tariff structures', in *EVUA Mobility Conference*. Amsterdam, pp. 1–10. Available at: <http://ssrn.com/abstract=1948644><http://www.evua.org/>.
- Sutherland, E. (2011d) 'The regulation of national roaming', in *International Telecommunications Society*. Budapest, p. 24. Available at: <http://ssrn.com/abstract=1941446>.
- Sutherland, E. (2012) *A review of international mobile roaming to December 2011*. Witwatersrand, South Africa. Available at: <http://ssrn.com/abstract=1894604>.
- Tan, J. (2010) 'Grounded theory in practice: issues and discussion for new qualitative researchers', *Journal of Documentation*, 66(1), pp. 93–112.
- Tangerås, T. P. and Tåg, J. (2016) 'International network competition under national regulation', *International Journal of Industrial Organization*, 47, pp. 152–185. doi: 10.1016/j.ijindorg.2016.04.006.
- Tehrani, R. H., Vahid, S., Triantafyllopoulou, D., Lee, H. and Moessner, K. (2016) 'Licensed spectrum sharing schemes for mobile operators: A survey and outlook', *IEEE Communications Surveys and Tutorials*. Institute of Electrical and Electronics Engineers Inc., 18(4), pp. 2591–2623. doi: 10.1109/COMST.2016.2583499.
- Telecommunicatiewet, Wet van 19 oktober 1998, houdende regels inzake de telecommunicatie* (1998). Available at: <https://wetten.overheid.nl/BWBR0009950/2019-01-01>.
- Telecommunications Act* (1984). United Kingdom.
- Tesch, R. (1990) *Qualitative Research: analysis types and software tools*. New York: Routledge. doi: 10.4324/9781315067339.
- Van Thiel, S. (2000) *Quangocratization: Trends, Causes and Consequences*. Utrecht University, Interuniversity Center for Social Science Theory (ICS), doctoral thesis.
- Tranfield, D., Denyer, D. and Smart, P. (2003) 'Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review', *British Journal of Management*, 14, pp. 207–222.
- Troshani, I. and Rao Hill, S. (2009) 'Linking stakeholder salience with mobile services diffusion', *International Journal Mobile Communications*, 7(3), pp. 269–289.

- Troshani, I. and Rao Hill, S. (2011) 'Regulating Mobile Services: an Institution-Based View', *International Journal of E-Business Research*, 7(1), pp. 52–70. Available at: www.igi-global.com/ijebr.
- Tsebelis, G. (1991) 'The effect of fines on regulated industries: Game theory vs. Decision theory', *Journal of Theoretical Politics*, 3(1), pp. 81–101. doi: 10.1177/0951692891003001006.
- Von Tunzelmann, N. (2003) 'Historical coevolution of governance and technology in the industrial revolutions', *Structural Change and Economic Dynamics*, 14(4), pp. 365–384. doi: 10.1016/S0954-349X(03)00029-8.
- Ubacht, J. (2004) 'Regulatory Practice in Telecommunications Markets: How to Grasp the 'Real World of Public Action'?', *Communications & Strategies*, 2nd quarter(54), pp. 219–242.
- Ubacht, J. (2006) 'Regulatory practice in mobile telecommunications markets: Matching past, present and future', in *ITS Europe 2006*. Amsterdam.
- Ubacht, J. (2016) 'A Process Perspective on Regulation', *Competition and Regulation in Network Industries*, 17(1), pp. 78–97. doi: 10.1177/178359171601700104.
- Ubacht, J. and Wille, D. (1999) 'Telefonie via de ether (Telephony by air)', in Twist, M. van and Veeneman, W. (eds) *Marktwerking op Weg: Over concurrentiebevordering in infrastructuurgebonden sectoren*. Utrecht: Lemma, pp. 179–213.
- UNESCAP (2001a) 'Anti-competitive Behaviour', in *The Economic Regulation of Transport Infrastructure Facilities and Services. Principles and Issues*. New York: United Nations, pp. 183–187. Available at: <https://www.unescap.org/resources/economic-regulation-transport-infrastructure-facilities-and-services-principles-and-issues>.
- UNESCAP (2001b) 'Competition Policy: Some Basic Concepts', in *The Economic Regulation of Transport Infrastructure Facilities and Services. Principles and Issues*. New York: United Nations, pp. 179–182. Available at: <https://www.unescap.org/resources/economic-regulation-transport-infrastructure-facilities-and-services-principles-and-issues>.
- UNESCAP (2001c) 'Regulating Infrastructure and Services: Key Issues', in *The Economic Regulation of Transport Infrastructure Facilities and Services. Principles and Issues*. New York: United Nations, pp. 56–81. Available at: <https://www.unescap.org/resources/economic-regulation-transport-infrastructure-facilities-and-services-principles-and-issues>.
- Urquhart, C. (1997) 'Exploring Analyst-Client Communication: Using Grounded Theory Techniques to Investigate Interaction in Informal Requirements Gathering', in Lee, A. S., Liebenau, J., and DeGross, J. I. (eds) *Information Systems and Qualitative Research: Proceedings of the IFIP TC8 WG 8.2 International Conference on Information Systems and Qualitative Research*. Dordrecht: Springer Science & Business Media, pp. 149–181.
- Urquhart, C. (2001) 'An Encounter with Grounded Theory: Tackling the Practical and Philosophical Issues', in Trauth, E. M. (ed.) *Qualitative Research in IS: Issues and Trends*. Hershey: Idea Group Publishing, pp. 104–140.
- Urquhart, C. (2013) *Grounded Theory for Qualitative Research. A Practical Guide*. London: Sage Publications.
- Urquhart, C. and Fernández, W. (2013) 'Using grounded theory method in information systems: The researcher as blank slate and other myths', *Journal of Information Technology*, 28(3), pp. 224–326. doi: 10.1007/978-3-319-29266-3_7.

- Urquhart, C., Lehmann, H. and Myers, M. D. (2010) 'Putting the "theory" back into grounded theory: Guidelines for grounded theory studies in information systems', *Information Systems Journal*, 20(4), pp. 357–381. doi: 10.1111/j.1365-2575.2009.00328.x.
- Vallet, N. (2003) 'Rapporteren over het analyseproces in kwalitatief onderzoek (Reporting on the analytical process in qualitative research)', in Wester, F. (ed.) *Rapporteren over kwalitatief onderzoek (Reporting in qualitative research)*. Utrecht: Lemma.
- Valletti, T. and Cave, M. (1998) 'Competition in UK mobile communications', *Telecommunications Policy* 1, 22(2), pp. 109–131.
- Van der Veen, C., Ederer, P., Fortanier, F., Rotileanu, A. and De Wit, B. (2009) 'Public Values versus Private Interests: an empirical comparison of business strategies in liberalized infrastructures', in Kunneke, R., Groenewegen, J., and Auger, J. F. (eds) *The Governance of Network Industries. Institutions, Technology and Policy in Reregulated Infrastructures*. Cheltenham, UK: Edward Elgar, pp. 167–192.
- Verhoest, P. (1996) *Openbare telecommunicatie (1834-1994). De rol van de Belgische overheid in het netwerkbeheer. (Public telecommunications (1834-1994). The role of the Belgian government in network management)*. Vrije Universiteit Brussel, doctoral thesis.
- De Vlaam, H., De Bruijn, H. and Ten Heuvelhof, E. (1997) *Interconnection disputes. Sweden, Great Britain and the United States*. Alphen aan de Rijn: Samsom, ITeR-reeks, no. 8.
- Voon, T. (2013) 'Discrimination in International Mobile Roaming Regulation: Implications of WTO Law'. University of Melbourne, Melbourne Law School (Melbourne Legal Studies Research Paper, no 616).
- Webster, J. and Watson, R. T. (2002) 'Analyzing the Past to Prepare for the Future: Writing a Literature Review', *MIS Quarterly*, 26(2), pp. xiii–xxiii.
- Weijnen, M. and Bouwmans, I. (2006) 'Innovation in Networked Infrastructures: coping with complexity', *International Journal Critical Infrastructures*, 2(2/3), pp. 121–132.
- Weijnen, M., Herder, P. and Bouwmans, I. (2008) 'Decisigning Complex Systems. A Contradition in Terms', in Eekhout, M. and Tomiyama, T. (eds) *Delft Science in Design 2*. Delft, the Netherlands: IOS Press, pp. 235–254.
- Wellenius, B. (2000) 'Extending Telecommunications beyond the Market', *The World Bank Group: Public Policy for the Private Sector*. Washington D.C.: World Bank, Communications and Information Technologies Department, Viewpoint, note no. 206, pp. 1–12. Available at: <http://documents.worldbank.org/curated/en/550961468767074082/Extending-telecommunications-beyond-the-market-toward-universal-service-in-competitive-environments>.
- Welsh, E. (2002) 'Dealing with Data: Using NVivo in the Qualitative Data Analysis Process', *Forum Qualitative Social Research*, 3(2, art. 26).
- Wiesche, M., Jurisch, M. C., Yetton, P. W. and Krcmar, H. (2017) 'Grounded Theory Methodology in Information Systems Research', *Government Information Quarterly*, 41(3), pp. 685–701.
- Wolfswinkel, J. F., Furtmueller, E. and Wilderom, C. P. M. (2013) 'Using grounded theory as a method for rigorously reviewing literature', *European Journal of Information Systems*, 22(1), pp. 45–55. doi: 10.1057/ejis.2011.51.

Wu, C. H. V. and Beaunae, C. (2014) 'Personal reflections on cautions and considerations for navigating the path of grounded theory doctoral theses and dissertations: a long walk through a dark forest', *International Journal of Social Research Methodology*, 17(3), pp. 249–265. doi: 10.1080/13645579.2012.729392.

Wymbs, C. (2004) 'Telecommunications, an instrument of radical change for both the 20th and 21st centuries', *Technological Forecasting and Social Change*, 71(7), pp. 685–703.

Xavier, P. (1995) *Universal Service obligations in a competitive telecommunications environment*. Paris: OECD/ICCP.

Xavier, P. (1997) 'Universal service and public access in the networked society', *Telecommunications Policy*, 21(9/10), pp. 829–843.

Xavier, P. (2001) 'Licensing of Third Generation (3G) Mobile: Briefing paper', *ITU Workshop on licensing 3G Mobile in Geneva*. Melbourne: Swinburne University of Technology, School of Business. Available at: http://www.itu.int/osg/spu/ni/3G/workshop/Briefing_paper.doc.

Yin, R. K. (1994) *Case Study Research. Design and Methods*. 2nd edn, *Applied Social Research Methods Series*. 2nd edn. Thousand Oaks, London & New Delhi: Sage.

Appendices

A. Contextual literature review

In this appendix we present the details of the contextual literature review of which the results are presented in section 2.4 to argument of the knowledge gap in research into regulation of the mobile telecommunications market. This literature review was last updated in September 2019. We used the following databases: Scopus, Web of Science, JSTOR and SSRN. For the search terms we used the online resource Synonyms.com to determine the synonyms to be used. The selection of the search terms is made in relevance to the domain of study: regulation of mobile telecommunications markets. The overview of search terms, based on the synonyms is presented in App Table 1.

App Table 1 Overview of search terms for the literature review in the domain of mobile telecommunications regulation

<i>To represent the regulatory activities:</i>	<i>To represent the object of regulation:</i>			<i>To represent the regulatory actor:</i>
regula* for:	wireless	market	telecom* for:	regulatory authority
regulatory practice	mobile	sector	telecommunications	regulatory agency
regulatory decision-making	GSM	domain	telecom	independent authority
regulatory process	GPRS	industry	telecoms	
regulatory activity	UMTS		telco	
regulatory action	2G		communication*	
regulatory procedure	3G		network*	
regulatory strategy	4G		infrastructure*	
regulatory governance	5G		system*	
regulatory decision				
regulatory execution				
regulatory intervention				
regulatory arrangement				
regulating				
regulation				
regularization				
regularisation				
decision making				
de facto regulation				
polycymaking				

The search strings for each database are presented in App Table 2 to App Table 5. The differences occurred due to the differences in the way in which search strings can be entered into the four databases. The four databases yielded a total of 192 references; the spread is presented in App Table 6

App Table 2 Search strings for key terms in SCOPUS

SCOPUS (Sept 25th 2019)	Full search string used:	No of references
	(TITLE-ABS-KEY ("wireless" OR "mobile" OR "GSM" OR "GPRS" OR "UMTS" OR "2G" OR "3G" OR "4G" OR "5G")) AND ((("regula*" OR "decision making" OR "de facto regulation" OR "policy making")) AND ("market" OR "sector" OR "domain" OR "industry")) AND ("telecom*" OR "telco" OR "communications*" OR network* OR " infrastructure* OR "system*" OR "service*")) AND ("regulatory authority" OR "regulatory agency" OR "independent authority" OR "regulatory" OR "regulator")	3.156
Exclusion based on science domain:	Agricultural & Biological Sciences/Biochemistry, Genetics and Molecular Biology/Chemical Engineering/Chemistry/Earth and Planetary Sciences/Economics, Econometrics and Finance/Energy/Engineering/Environmental Science/Health professions/Immunology and Microbiology/Materials Science/Mathematics/Medicine/Neuroscience/Nursing/Pharmacology, Toxicology and Pharmaceutics/Physics and Astronomy/Psychology/Undefined	1.061
Exclusion based on document type:	Short survey (e.g. Total Telecom as journalistic journal)/Conference review/Notes/Editorial/ Data paper/undefined	1.042
Exclusion based on key word relevance:	370 key terms not fitting with our research perspective nor with the market issues we analyzed were excluded	158
Manual assessment for relevance:	exclusion of articles that do not represent the perspective of a regulatory authority in the telecommunications market	52

App Table 3 Search strings for key terms in JSTOR

JSTOR (Sept 27th 2019)	Search strings used, consecutive runs:	No of references
	telecom* OR telco OR communications* OR network* OR infrastructure* OR system* OR service*	4.863.435
	"regulatory authority"	7.015
	market OR sector OR domain OR industry	6200
	wireless or mobile	1095
Limitation based on SUBJECT	Business/Communication Studies/Economics/Public Policy & Administration/Science & Technology Studies	218
Limitation based on year of publication	Articles from 1985 onwards; limitation is based on manual assessment of relevance of the pre-1985 articles	196
Manual assessment for relevance:	exclusion of articles that do not represent the perspective of a regulatory authority in the telecommunications market	26

App Table 4 Search strings for key terms in Web of Science

Web of Science (Sept 25th 2019)	Search strings and combinations used:	No of references
1	TS=(regula* OR "decision making" OR "de facto regulation" OR "policy making")	6,867,143
2	TS=(wireless OR mobile OR GSM OR GPRS OR UMTS OR 2G OR 3G OR 4G OR 5G)	3,067,504
3	combined 1 and 2	101,609
4	TS=(market OR sector OR domain OR industry)	6,154,748
5	combined 3 and 4	9,591
6	TS=(telecom* OR telco OR communications* OR network* OR infrastructure* OR system* OR service*)	44,629,261
7	combined 5 and 6	7,210
8	TS= ("regulatory authority" OR "regulatory agency " OR "independent authority" OR regulatory OR regulator)	1,480,065
9	combined 7 and 8	1781
Exclusion based on research areas:	Agriculture/Archaeology/Architecture/Area studies/Art/Arts humanities other topics/Automation control systems/Biochemistry molecular biology/Biophysics/Cell biology/Chemistry/Criminology penology/Developmental biology/Development studies/Education/Educational research/Endocrinology metabolism/Energy fuels/Engineering/Environmental sciences ecology/Ethnic studies/Film radio television/Food science technology/General internal medicine/Genetic heredity/Healthcare sciences services/Hematology/History/Imaging science photographic technology/Immunology/Instruments and instrumentation/Information science library science/International relations/Life sciences biomedicine other topics/Materials science/Mathematical Computational Biology/Mathematics/Medical informatics/Microbiology/Neurosciences neurology/Nuclear science technology/Nutrition dietetics/Operations research management science/Pharmacy/Pharmacology/Physiology/Plant sciences/Public environmental occupational health/Remote sensing/Science technology other topics/Sociology/Transportation/Psychiatry/Urban studies/	415
Exclusion based on language:	English, German, French, Dutch only	306
Exclusion based on absence of abstract:	26 articles did not include an abstract	281
Manual assessment for relevance:	exclusion of articles that do not represent the perspective of a regulatory authority in the telecommunications market	90

App Table 5 Search strings for key terms in SSRN

SSRN (Sept 27th 2019)	Search strings used, consecutive runs:	No of references
	"wireless" OR "mobile"	565
	regula* OR decision making" OR "de facto regulation" OR "policy making"	0
	regula*	0
Broadening the search	regulation	97
Manual assessment for relevance:	exclusion of articles that do not represent the perspective of a regulatory authority in the telecommunications market	25
Exclusion based on language:	English, German, French, Dutch only	24

App Table 6 Number of references selected, per database consulted

	no of references
Scopus	52
Web of Science	90
JSTOR	26
SSRN	24
Subtotal	192
Double mentions	2
Total	190

After sorting all 192 references, two double references were deleted, which led to 190 references for the coding for the literature review. A complete list of these references can be found in App Table 7.

App Table 7 Full overview of references for the domain literature review, in alphabetical order of (first) author

Author(s)	Year	Title	Source title	Vol.	Issue	First page	Last page
Abbas, Roba	2010	An Approach to Studying Location-based Services Regulation in Australia	Proceedings of the 2010 IEEE International Symposium on Technology and Society: Social Implications of Emerging Technologies			77	86
Abitbol, Michael; Muller, Pierre-Jean	2014	Licensed Shared Access an innovation in European radio spectrum policy	2014 IEEE International Symposium on Dynamic Spectrum Access Networks (DYSPAN)			259	262
Agiakloglou, Christos; Polemis, Michael	2018	Evaluating the liberalization process on Telecommunications services for EU countries	Economics and Business Letters	7	3	98	107
Alleman, James; Rappoport, Paul	2009	Next Generation Networks: The Demand Side Issues	Telecommunication Markets: Drivers and Impediments			397	415
Allison, Audrey L.	2017	Satellite Spectrum Allocations and New Radio Regulations from WRC-15: Defending the Present and Provisioning the Future	in: Pelton, Joseph N., Scott Madry and Sergio Camacho-Lara (eds.) Handbook of Satelliet Applications, 2nd ed.			383	411
Andersson, Kjetil; Foros, Oystein; Steen, Frode	2006	The SMS Bandwagon in Norway: What Made the Market?	Governance of Communication Networks: Connecting Societies and Markets with IT			187	201
Anker P., Lemstra W., Hayes V.	2010	The governance of radio spectrum: Licence-exempt devices	The Innovation Journey of Wi-Fi: The Road to Global Success			288	330
Arceneaux, Noah	2017	Monsoon Hungama' and the 2G Scam: Public interest and mobile spectrum policy in India, 1999-2012	Global Media and Communication	13	1	3	19
Armstrong, Mark; Wright, Julian	2009	Mobile Call Termination	Economic Journal	119	538	F270	F307
Baek S., Kim B.J.	2005	Digital multimedia broadcasting (DMB) in Korea: Convergence and its regulatory implications	Unwired Business: Cases in Mobile Business			270	284
Baek, Ji Won	2018	The Determinants of Prices in Mobile Voice Market: The Impact of Regulatory Policy and Market Structure	Journal of Industrial Economics and Business	31	5	1879	1903
Bai, Yunxia; Yan, Mengying; Yu, Feng; Yang, Jiaqin	2014	Does market mechanism promote online/mobile information disclosure? Evidence from A-share companies on Shenzhen Exchange Market	International Journal of Mobile Communications	12	4	380	396
Ballon P., Walravens N., Spedalieri A., Venezia C.	2010	The reconfiguration of mobile service provision: Towards platform business models	Promoting New Telecom Infrastructures: Markets, Policies and Pricing			197	215
Banerjee, A; Ros, AJ	2004	Drivers of demand growth for mobile telecommunications services: Evidence from international panel data	Global Economy and Digital Society			257	282

Author(s)	Year	Title	Source title	Vol.	Issue	First page	Last page
Beltran, Fernando; Gutierrez, Jairo A.; Melus, Jose Luis	2011	How Evolving Network Access and Network Management Technologies are Redefining the Competitive Wireless Markets	International Journal of Business Data Communications and Networking	7	3	51	69
Bernal, Pilar; Garrido, Elisabet; Rios, Pablo	2016	If you can't beat them, join them: Analysis of mergers in european mobile telecommunications	Universia Business Review		51	130	147
Bhutto, Arabella; Abro, Qazi Moin-Uddin	2009	Does Regulations always contribute positively towards technology evolatuions in the Eupoen mobile industry?	International Journal of Innovation and Technology Management	6	4	341	361
Binmore, Ken; Harbord, David	2005	Bargaining over Fixed-to-Mobile Termination Rates: Courtnevrailing byer power as a constraint on monopoly power	Journal of Competition Law and Economics	1	3	449	472
Blankart C.B., Knieps G., Zenhäusern P.	2007	Regulation of new markets in telecommunications: Market dynamics and shrinking monopolistic bottlenecks	European Business Organization Law Review	8	3	413	428
Bohlin, Erik and Caves, Kevin W. and Eisenach, Jeffrey A.,	2013	Mobile Wireless Market Performance in Canada: Lessons from the EU and the US	report				
Boliek, Babette	2011	Wireless Net Neutrality Regulation and the Problem with Pricing: An Empirical, Cautionary Tale	Michigan Telecommunications and Technology Law Review	16	1	1	52
Boulos, Maged N Kamel; Brewer, Ann C; Karimkhani, Chante; Buller, David B; Dellavalle, Robert P	2014	Mobile medical and health apps: state of the art, concerns, regulatory control and certification.	Online journal of public health informatics	5	3	229	
Bouwman, Harry; Carlsson, Christer; Molina Castillo, Francisco Jose; Giaglis, George M.; Walden, Pirkko	2010	Factors affecting the present and future use of mobile data services: comparing the Dutch, Finnish and Greek markets	International Journal of Mobile Communications	8	4	430	450
Burns, Scott	2018	M-PESA and the 'Market-led' Approach to Financial Inclusion	Economic Affairs	38	3	406	421
Butcher, Catherine Curran	1996	Telecommunications in the European Union	Administrative Law Review	48	4	451	462
Cable, J; Henley, A; Holland, K	2002	Pot of gold or winner's curse? An event study of the auctions of 3G mobile telephone licences in the UK	Fiscal Studies	23	4	447	462
Camponovo, G; Cerutti, D	2005	WLAN communities and Internet access sharing: A regulatory overview				281	287
Cardinali R., Hunt D.	1994	Growth and implications of network systems: technological and legislative issues	Computer Communications	17	8	611	618
Cave, M; Prosperetti, L	2001	European telecommunications infrastructures	Oxford Review of Economic Policy	17	3	416	431

Author(s)	Year	Title	Source title	Vol.	Issue	First page	Last page
Cave, Martin; Genakos, Christos; Valletti, Tommaso	2019	The European Framework for Regulating Telecommunications: A 25-year Appraisal	Review of Industrial Organization	55	1	47	62
Chen, James Ming	2003	Subsidized Rural Telephony and the Public Interest: A Case Study in Cooperative Federalism and its Pitfalls	Journal on Telecommunications and High Technology Law, Minnesota Legal Studies Research Paper No. 06-40	2		307	375
Chivandire, Grant; Botha, Ilse; Mouton, Marise	2019	The Impact of Capital Structure on Mobile Telecommunication Operators in Africa	Journal of Private Equity	22	4	96	110
Cho, Daegon and Ferreira, Pedro and Telang, Rahu	2016	The Impact of Mobile Number Portability on Price, Competition and Consumer Welfare	report				
Chochliouros I.P., Spiliopoulou-Chochliourou A.S.	2005	Visions for the completion of the European successful migration to 3G systems and services: Current and future options for technology evolution, business opportunities, market development, and regulatory changes	Mobile and Wireless Systems Beyond 3G: Managing New Business Opportunities			342	368
Chowdary, T.H.	2000	Telecom Demonopolisation: Policy or Farce?	Economic and Political Weekly	35	6	436	440
Chowdary, T.H.	2002	Telecom: Policy Response to Change	Economic and Political Weekly	37	32	3317	3318
Chowdary, T.H.	2002	Interconnection Dispute: Basic Considerations	Economic and Political Weekly	37	41	4184	4186
Chowdary, T.H.	2003	Managing Radio Frequency Spectrum: Some Issues	Economic and Political Weekly	38	17	1626	1628
Cohen, Tracy	2003	Rethinking (Reluctant) Capture: South African Telecommunications and the Impact of Regulation	Journal of African Law	47	1	65	87
Cowhey P.F.	2004	Accounting rates, cross-border services and the next WTO round on basic telecommunications services	The WTO and Global Convergence in Telecommunications and Audio-Visual Services			51	82
Crandall R.W.	2005	The rapid growth of wireless telecommunications	Competition and Chaos: U.S. Telecommunications Since the 1996 Telecom Act			94	110
Dabbah, Maher M.	2011	The Relationship between Competition Authorities and Sector Regulators	The Cambridge Law Journal	70	1	113	143
Daubs, Michael S.	2014	Hindsight in 2020? New Zealand's 'Wait and See' approach to mobile broadband regulation	Medi International Australia		151	171	179
Davidson, Charles M.; Santorelli, Michael J.	2014	Federalism in Transition: Recalibrating the Federal-State Regulatory Balance for the All-IP Era		29	2	1131	1204
Dewenter, Ralf; Kruse, Joern	2011	Calling party pays or receiving party pays? The diffusion of mobile telephony with	Information Economics and Policy	23	1	107	117

Author(s)	Year	Title	Source title	Vol.	Issue	First page	Last page
		endogenous regulation					
Di Pillo, Francesca; Cricelli, Livio; Gastaldi, Massimo; Levaldi, Nathan	2010	Asymmetry in mobile access charges: is it an effective regulatory measure?	Netnomics	11	3	291	314
Donovan K.P., Martin A.K.	2014	The rise of african sim registration: The emerging dynamics of regulatory change	First Monday, online article	19	2	n.p.	n.p.
Duso, Tomaso; Seldeslachts, Jo	2010	The political economy of mobile telecommunications liberalization: Evidence from the OECD countries	Journal of Comparative Economics	38	2	199	216
Effendi, M. Ridwan	2016	Regulatory Incentives in Indonesia	2016 10TH International Conference on Telecommunication Systems Services and Applications (TSSA)			n.p.	n.p.
Ehrlich, Everett and Eisenach, Jeffrey A. and Leighton, Wayne A.	2009	The Impact of Regulation on Innovation and Choice in Wireless Communications	Review of Network Economics			1	44
Ezzat, Riham Ahmed	2015	Paving the Way for Better Telecom Performance: Evidence from the Telecommunication Sector in MENA Countries	Review of Network Economics	14	3	157	199
Falch M., Henten A., Tadayoni R.	2009	International roaming: Is there a need for EU-regulation beyond 2010?	Info	11	4	19	33
Faulhaber, Gerald R.	2009	A National Broadband Plan for Our Future: A Customer-Centric Framework	International Journal of Communication	3		742	779
Faulhaber, Gerald R.; Farber, David J.	2010	The Open Internet: A Customer-Centric Framework	International Journal of Communication	4		302	342
Fuentelsaz L., Maicas J.P., Polo Y.	2012	Switching costs, network effects, and competition in the european mobile telecommunications industry	Information Systems Research	23	1	93	108
Funk, Jeffrey L.	2006	Mobile Phone Industry: A Microcosm of Deregulation, Globalization, and Technological Change in the Japanese Economy	Japanese Telecommunications: Market and Policy in Transition			65	87
Garcia-Murillo, Martha	2007	Number Portability in Central America	Info	9	4	25	37
Genakos C., Valletti T.	2010	Mobile regulation and the 'waterbed' effect	Promoting New Telecom Infrastructures: Markets, Policies and Pricing			284	300
Genakos, Christos; Valletti, Tommaso	2011	Testing the Waterbed Effect in Mobile Telephony	Journal of European Economic Association	9	6	1114	1142
Grzybowski, Lukasz	2005	Regulation of mobile telephony across the European Union: An empirical analysis	Journal of Regulatory Economics	28	1	47	67
Grzybowski, Lukasz	2008	The Competitiveness of Mobile Telephony across the European Union	International Journal of the Economics of Business	15	1	99	115

Author(s)	Year	Title	Source title	Vol.	Issue	First page	Last page
Gupta, Rajni	2002	Telecommunications Liberalisation: Critical Role of Legal and Regulatory Regime	Economic and Political Weekly	37	17	1668	1675
Gupta, Rakesh; Gupta, Vivek; Rajamanickam, Ramya	2017	e-Governance to m-Governance in Telecom Sector Through Regulatory Body	2017 2nd World Congress on Computing and Communication Technologies (WCCCT)			203	206
Gupta, Subhashish	2012	Cellular Mobile in India: Competition and Policy	Pacific Affairs	85		483	510
Hamza, Abdelbaset S.; Deogun, Jitender S.; Alexander, Dennis R.	2019	Classification Framework for Free Space Optical Communication Links and Systems	IEEE Communications Surveys and Tutorials	21	2	1346	1382
Hasan, Shaddi; Heimerl, Kurtis; Harrison, Kate; Ali, Kashif; Roberts, Sean; Sahai, Anant; Brewer, Eric	2014	GSM Whitespaces: An Opportunity for Rural Cellular Service	2014 IEEE International Symposium on Dynamic Spectrum Access Networks (DYSPAN)			271	282
Hazlett, Thomas W., Oh, Sarah and Skorup, Brent	2014	Natural Experiments in Mobile Phone Regulation: Estimated Effects of Prohibiting Handset Bundling in Finland and Belgium	George Mason Law & Economics Research Paper No. 14-17.			1	34
Hazlett, TW; Spitzer, ML	2006	Advanced wireless technologies and public policy	Southern California Law Review	79	3	595	665
Hewitt P.	2000	3G licence allocation: Why an auction was best for the UK	Info	2	4	341	345
Hoeffler, Felix	2009	Mobile termination and collusion, revisited	Journal of Regulatory Economics	35	3	246	274
Hou L.	2014	A review of telecom markets in the EU: What did the European Commission learn or not from the past?	Computer Law and Security Review	30	6	710	719
Hou, Liyang	2014	A review of telecom markets in the EU: What did the European Commission learn or not from the past?	Computer Law & Security Review	30	6	710	719
Hukill Mark A.	1994	The privatization and regulation of singapore telecom	Asian Journal of Communication	4	2	121	131
Jho W.	2007	Liberalization as a development strategy: Network governance in the korean mobile telecom market	Governance	20	4	633	654
Jiang, Yun; Gille, Laurent	2006	Toward the take-up of converged mobile TV service: Attributes of mobile TV and regulatory concerns	Fifth Wuhan International Conference on E-Business, Vols 1-3: Integration and Innovation through Measurement and Management			292	298
Jobodwana, Z. Ntozintle	2009	Telecommunications Liberalisation in Africa: Proposed Regulatory Model for the SADC Region	Journal of Digital Forensics Security and Law	4	4	73	94
Jobodwana, Z. Ntozintle	2009	E-commerce and mobile commerce in South Africa: Regulatory challenges	Journal of International Commercial Law and Technology	4	4	287	298

Author(s)	Year	Title	Source title	Vol.	Issue	First page	Last page
Jogova, Maria; Shaw, James; Jamieson, Trevor	2019	The Regulatory Challenge of Mobile Health: Lessons for Canada.	Healthcare policy = Politiques de sante	14	3	19	28
Kaminski M.E.	2016	When the default is no penalty: Negotiating privacy at the NTIA	Denver University Law Review	93	4	925	949
Kariuki Nyaga, Joseph	2014	Mobile Banking Services in the East African Community (EAC): Challenges to the Existing Legislative and Regulatory Frameworks	Journal of Information Policy	4		270	295
Kathuria R.	2000	Telecom Policy Reforms in India	Global Business Review	1	2	301	326
Katsianis D., Rokkas T., Varoutas D., Spicopoulos T., Harno J., Welling I.	2007	3G mobile virtual network operators (MVNOs): Business strategies, regulation, and policy issues	Strategies and Policies in Digital Convergence			50	69
Kemp, Richard	2013	Mobile payments: Current and emerging regulatory and contracting issues	Computer Law and Security Review	29	2	175	179
Kensi, Ahmed; Barka, Hafid; Hajji, Nasr	2019	Switching Behavior in Mobile Phone Sector: The Case of Mobile Number Portability in Morocco	International Journal of Computer Science and Network Security	19	5	53	61
Kerf, Michel; Geradin, Damien	1999	Controlling Market Power in Telecommunications: Antitrust vs. Sector-Specific Regulation: An Assessment of the United States, New Zealand and Australian Experiences	Berkeley Technology Law Journal	14	3	919	1020
Kongaut C., Bohlin E.	2014	Impacts of mobile termination rates on retail prices: The implication for regulators	Info	16	2	80	93
Koski, H; Kretschmer, T	2005	Entry, standards and competition: Firm strategies and the diffusion of mobile telephony	Review of Industrial Organization	26	1	89	113
Koutroumpis, Pantelis; Cave, Martin	2018	Auction design and auction outcomes	Journal of Regulatory Economics	53	3	275	297
Kruse J.	2004	Competition in mobile communications and the allocation of scarce resources: The case of UMTS	The Economics of Antitrust and Regulation in Telecommunications: Perspectives for the New European Regulatory Framework			185	212
Kuo, Yaw-Wen; Li, Cho-Long	2017	Design of a long range wireless 3-axis accelerometer module for environmental monitoring	Proceedings of the 2017 2nd Workshop on Recent Trends in Telecommunications Research (RTTR)			7	10
Kwon Y., Nam C.	2007	Mobile payment issues and policy implications: The case of Korea	Strategies and Policies in Digital Convergence			88	101
Laakso, Kimmo; Rubin, Anita; Linturi, Hannu	2012	The role of regulation in the mobile operator business in Finland	Foresight	14	2	154	167
Laura Hosman; Philip N. Howard	2014	Telecom Policy Across the Former Yugoslavia:	Journal of Information Policy	4		67	104

Author(s)	Year	Title	Source title	Vol.	Issue	First page	Last page
		Incentives, Challenges, and Lessons Learned					
Lee S.-W., Park M.-C., Kim D.J.	2008	Mobile number portability in an asymmetric telecommunications market: Korea case	Handbook of Research on Information Management and the Global Landscape			298	321
Lehr, William H.; Chapin, John M.	2010	On the convergence of wired and wireless access network architectures	Information Economics and Policy	22	1	33	41
Lembke J.	2001	Harmonization and globalization: UMTS and the single market	Info	3	1	15	26
Lembke, J	2002	EU regulatory strategy for mobile Internet	Journal of European Public Policy	9	2	273	291
Levi-Faur, David	1999	The Governance of Competition: The Interplay of Technology, Economics, and Politics in European Union Electricity and Telecom Regimes	Journal of Public Policy	19	2	175	207
Li, BH; Lu, TJ	2005	The regulation choice analysis of 3G standards in China	Performance Challenges for Efficient Next Generation Networks, Vols 6A-6C	6A-6C		2527	2533
Lin, JT; Wan, Y	2003	Telecommunications in China	APOC 2003: Asia-Pacific Optical and Wireless Communications; Mobile Service and Application	5283		XIX	XXIX
Lin, Trisha T. C.	2012	Prospect of mobile TV broadcasting in China: socio-technical analysis of CMMB's development	Chinese Journal of Communication	5	1	88	108
Lodge, Martin; Stirton, Lindsay	2001	Regulating in the Interest of the Citizen: Towards a Single Model of Regulatory Transparency?	Social and Economic Studies	50	2	103	137
Luis Lopez, Angel	2011	Mobile termination rates and the receiver-pays regime	Information Economics and Policy	23	2	171	181
Macintosh I.	2003	Regulating the new economy: Implications of WTO accession for telecommunications and e-commerce in China	China and the World Trading System: Entering the New Millennium			263	282
Macmillan, Rory	2005	Reflections on Regulation and Dispute Resolution in the Indian Telecommunication sector	Journal of the Indian Law Institute	47	1	29	52
Madden, Gary; Ahmad, Hasnat	2013	3G spectrum auction aftermarket network deployment	Applied Economics Letters	20	3	300	303
Madden, Gary; Bohlin, Erik; Thien Tran	2013	Spectrum Licensing and Flexilbe Beauty Contest Designs	Annals of Public and Cooperative Economics	84	3	309	321
Madden, Gary; Bohlin, Erik; Tran, Thien; Morey, Aaron	2014	Spectrum Licensing, Policy Instruments and Market Entry	Review of Industrial Organization	44	3	277	298
Madden, Gary; Morey, Aaron	2013	Regulator flexibility and the administrative allocation licensing of 3G spectrum	Applied Economics	45	13	1713	1718

Author(s)	Year	Title	Source title	Vol.	Issue	First page	Last page
Makulilo, Alex B.	2015	Privacy in mobile money: central banks in Africa and their regulatory limits	International Journal of Law and Information Technology	23	4	372	391
Malala J.	2017	Law and Regulation of Mobile Payment Systems: Issues arising 'post' financial inclusion in Kenya	Law and Regulation of Mobile Payment Systems: Issues Arising 'Post' Financial Inclusion in Kenya			1	278
Mangold, S; Zhong, Z; Challapali, K; Chou, CT	2004	Spectrum agile radio: Radio resource measurements for opportunistic spectrum usage	GLOBECOM '04: IEEE Global Telecommunications Conference, Vols 1-6			3467	3471
Marsden, Christopher T.	2010	European Law and Regulation of Mobile Net Neutrality	European Journal of Law and Technology	1	2		
Massaro, Maria	2019	Between Integration and Protection of National Sovereignty in the European Union's Radio Spectrum Policy: Uncovering Potential Research Avenues	Journal of Information Policy	9		158	197
Melody W.	2010	Wi-Fi in developing countries: Catalyst for network extension and telecom reform	The Innovation Journey of Wi-Fi: The Road to Global Success			197	229
Minges M., Männistö L., Kelly T.	1999	The future is bright, the future is mobile	Info	1	6	485	496
Moore K.L.	2011	Spectrum policy in the age of broadband: Issues for congress	Spectrum Issues for the New Communications Age			37	76
Moss, T	2003	Rewriting the rules	Mobile Communications International		100	35	37
Mukherji, Rahul	2009	Interests, Wireless Technology, and Institutional Change: From Government Monopoly to Regulated Competition in Indian Telecommunications	The Journal of Asian Studies	68	2	491	517
Navio-Marco, Julio; Hernandez, Fernando; Perez-Leal, Raquel	2017	Reshaping the broadcast sector: Regulation, business rules and the potential for evaluation of new policies	Revista de Evaluacion de Programas y Politicas Publicas		8	54	70
Nyaga, Joseph Kariuki	2014	Mobile Banking Services in the East African Community (EAC): Challenges to the Existing Legislative and Regulatory Frameworks	Journal of Information Policy	4		270	295
Obutte, PC	2014	ICT laws in Nigeria: planning and regulating a societal journey into the future	PER: Potchefstroomse Elektroniese Regsblad	17	1	1	35
Okazaki S., Li H., Hirose M.	2009	Consumer privacy concerns and preference for degree of regulatory control: A study of mobile advertising in Japan	Journal of Advertising	38	4	63	77
Olla P.	2005	Incorporating commercial space technology into mobile services: Developing innovative business models	Mobile and Wireless Systems Beyond 3G: Managing New Business Opportunities			82	113
Peel D., Lloyd G.	2010	Mobile telephony, public and private planning and regulation: A UK perspective	ICTs for Mobile and Ubiquitous Urban Infrastructures: Surveillance, Locative			150	169

Author(s)	Year	Title	Source title	Vol.	Issue	First page	Last page
			Media and Global Networks				
Peltzman, Sam; Levine, Michael E.; Noll, Roger G.	1989	The Economic Theory of Regulation after a Decade of Deregulation	Brookings Papers on Economic Activity. Microeconomics			1	59
Pereira, Joao Paulo Ribeiro	2013	Effects of NGNs on Market Definition	Advances in Information Systems and Technologies	206		939	949
Phillips J.G., Ostojic P., Blaszczyński A.	2011	Mobile phones and inappropriate content	Mobile Phones: Technology, Networks and User Issues			227	242
Plaidy, Cecile; Wellstein, Linda M.; Wakhariya, Shabbir; Papandrea, John; Worlton, Amy; Yoo, Chin; Paoletta, Patricia	2003	Telecommunications Law and Policy around the World	The International Lawyer	37	2	457	471
Prasad, Rohit; Sridhar, Varadharajan; Bunel, Alison	2016	An Institutional Analysis of Spectrum Management in India	Journal of Information Policy	6	1	252	293
Ribeiro Morettini, Felipe Tadeu; Gabardo, Emerson	2015	The Case of 4G Technology in the Brazilian Telecommunication Law	A&C – R. de Dir. Administrativo & Constitucional	15	61	13	41
Riccardi, Delphine; Ciriani, Stephane; Quelin, Bertrand	2009	Does Regulation Impact the Entry in a Mature Regulated Industry? An Econometric Analysis of MVNOs	Telecommunication Markets: Drivers and Impediments			283	305
Robb, Genna; Tausha, Isaac; Vilakazi, Thando; Klaaren, Jonathan; Roberts, Simon; Valodia, Imraan	2017	Competition and regulation in Zimbabwe's emerging mobile payments markets	Competition Law and Economic Regulation in Southern Africa: Addressing Market Power in Southern Africa			215	233
Rokkas T., Varoutas D., Katsianis D., Smura T., Renjish K., Heikkinen M., Harno J., Kind M., von Hugo D., Monath T.	2009	On the economics of fixed-mobile convergence	Info	11	3	75	86
Ruhle E.-O., Freund N.	2014	Electronic communications services in the world of apps: Regulatory challenges	Telecommunications: Applications, Modern Technologies and Economic Impact			1	28
Saha D., Sridhar V.	2011	Emerging areas of research in business data communications	International Journal of Business Data Communications and Networking	7	4	52	59
Sandbach J., van Hooff L.	2010	Using on-net/off-net price differential to measure the size of call externalities and its implications for setting efficient mobile termination rates	Promoting New Telecom Infrastructures: Markets, Policies and Pricing			264	283
Scaglione, Miriam; Giovannetti, Emanuele; Hamoudia, Mohsen	2015	The diffusion of mobile social networking: Exploring adoption externalities in four G7 countries	International Journal of Forecasting	31	4	1159	1170
Scherer J.	2000	Toward a new regulatory framework	Info	2	3	313	328
Schwartz, Marius and Mini, Federico	2007	Hanging Up on Carterfone: The Economic Case Against Access Regulation in Mobile	report				

Author(s)	Year	Title	Source title	Vol.	Issue	First page	Last page
		Wireless					
Selvarajah K.	1999	Telecoms transition in Sri Lanka: a model for small countries?	Info	1	1	77	83
Shelanski H.A.	1997	The bending line between conventional "broadcast" and wireless "carriage"	Columbia Law Review	97	4	1048	1080
Shelanski, HA	1997	The bending line between conventional "broadcast" and wireless "carriage"	COLUMBIA LAW REVIEW	97	4	1048	1080
Shim, Woohyun	2016	Policy Constellation Matters: Evidence from Investment in the Telecommunications Industry in European Countries	International Telecommunications Policy Review	23	1	1	28
Sivasankari, S. V.; Sagar, Mahim; Agrawal, D. P.	2009	Spectrum Auctioning and Licensing in Telecom Industry	Economic and Political Weekly	44	3		20
Somdyala, Bomkazi; Rananga, Seani; Mfupe, Luzango; Masonta, Moshe; Mekuria, Fisseha	2017	Spectrum Regulation for Future Internet Networks in Developing Economies	2017 IST-Africa week conference (IST-AFRICA)			1	12
Srinuan C., Srinuan P., Bohlin E.	2011	Entry relaxation and an independent regulator: Performance impact on the mobile telecoms industry in Asia	Infrastructure Regulation: What Works, Why and How Do We Know?: Lessons from Asia and Beyond			83	108
Steen, Hakon Ursin	2009	Technology convergence, market divergence: fragmentation of standards in mobile digital broadcasting carriers	Information Systems and e-Business Management	7	3	319	345
Sung, Nakil	2014	Market concentration and competition in OECD mobile telecommunications markets	Applied Economics	46	25	3037	3048
Suryanegara, Muhammad; Mirfananda, Ahmad Salaam; Asvial, Muhammad; Hayati, Nur	2018	5G as Intelligent System: Model and Regulatory Consequences	In: Bi Y., Kapoor S., Bhatia R. (eds.) Proceedings of SAI Intelligent Systems Conference (IntelliSys) 2016. Lecture Notes in Networks and Systems vol. 15 (2018)	15		893	902
Sutherland E.	2010	What lies beyond the second roaming regulation?	Info	12	3	16	29
Sutherland E.	2011	International mobile roaming in the Arab states	Info	13	2	35	52
Sutherland E.	2017	The implications of Brexit for the governance of telecommunications markets in the United Kingdom	Digital Policy, Regulation and Governance	19	1	2	20
Sutherland, Ewan	2007	The Regulation of the Quality of Service in Mobile Networks	Info	9	6	17	34
Sutherland, Ewan	2009	What Lies Beyond the Second Roaming Regulation?	Info	12	3	16	29
Sutherland, Ewan	2010	International Mobile Roaming in the Arab World	"draft for comments"				
Sutherland, Ewan	2010	The EU Roaming Regulation Upheld and Reviewed	Computer and Telecommunications Law		8	212	213

Author(s)	Year	Title	Source title	Vol.	Issue	First page	Last page
			Review				
Sutherland, Ewan	2010	International Mobile Roaming: Competition, Economics and Regulation	"draft for comments"				
Sutherland, Ewan	2010	The European Union Roaming Regulations	report			1	20
Sutherland, Ewan	2011	Lessons from 'Bill Shock' – Trans-Border Mobile Tariff Structures	EVUA Mobility Conference, 20-21 September 2011, Amsterdam			1	10
Sutherland, Ewan	2011	The Regulation of National Roaming	International Telecommunications Society, Budapest, 18-21 September 2011			1	24
Sutherland, Ewan	2011	Roaming III: Regulating International Mobile Roaming Charges to 2022	report				
Sutherland, Ewan	2011	International Mobile Roaming – An Update	Revised from the version of March 2011.				
Sutherland, Ewan	2012	A Review of International Mobile Roaming to December 2011	report			1	17
Sutherland, Ewan	2014	Mobile Telecommunications in Africa: Issues for Business, Government & Society	report				
Sutherland, Ewan	2011	Regulating Mobile Roaming Charges	Conference Report on Forum Europe, April 2011				
Taaffe, J.	2007	Big sticks	Total Telecom		Nov	10	11
Taaffe, J.	2008	Tuning in to revenues	Total Telecom		Sept	24	25
Tangeras, Thomas P.; Tag, Joacim	2016	International network competition under national regulation	International Journal of Industrial Organization	47		152	185
Tehrani, Roya H.; Vahid, Seiamak; Triantafyllopoulou, Dionysia; Lee, Haeyoung; Moessner, Klaus	2016	Licensed Spectrum Sharing Schemes for Mobile Operators: A Survey and Outlook	IEEE Communications Surveys and Tutorials	18	4	2591	2623
Tintor, Vladica; Milicevic, Vlade; Jankovic, Milan; Radunovic, Jovan	2009	Liberalization of the mobile telephony market in the Republic of Serbia	Technology in Society	31	4	384	398
Torngren, J	1998	Moll success stories: interoperability in telecommunications within a competitive, multiprovider, multicultural environment	Computer Standards & Interfaces	20	2-3	135	139
Troshani, Indrit; Hill, Sally Rao	2009	Linking stakeholder salience with mobile services diffusion	International Journal of Mobile Communications	7	3	269	289
Troshani, Indrit; Hill, Sally Rao	2011	Regulating Mobile Services: An Institution-Based View	International Journal of e-Business Research	7	1	52	70
Troshani, Indrit; Hill, Sally Rao	2013	Regulating Mobile Services: An Institution-Based View	Mobile applications and knowledge advancements in e-business			56	75
Trubnikov, Dmitrii	2017	Analysing the Impact of Regulation on Disruptive Innovations: The Case of Wireless Technology	Journal of Industry Competition & Trade	17	4	399	420
Turel O., Serenko A.	2010	Mobile telephony as a universal service	Encyclopedia of E-Business Development and Management in the Global	2		854	859

Author(s)	Year	Title	Source title	Vol.	Issue	First page	Last page
			Economy				
Ubacht J.	2016	A process perspective on regulation: A grounded theory study into regulatory practice in newly liberalized network-based markets	Competition and Regulation in Network Industries	17	1	78	97
van de Kaa, G.; Greeven, M. J.	2017	Mobile telecommunication standardization in Japan, China, the United States, and Europe: a comparison of regulatory and industrial regimes	Telecommunication Systems	65	1	181	192
Van Heesvelde E.	2000	Convergence between fixed and mobile communications	Info	2	3	271	275
Vesa, Jarkko	2006	Regulatory Framework and Industry Clockspeed	Governance of Communication Networks: Connecting Societies and Markets with IT			79	90
Virmani, Arvind	2000	A Communications Policy for the 21st Century	Economic and Political Weekly	35	23	1907	1910
Voon, Tania	2013	Discrimination in International Mobile Roaming Regulation: Implications of WTO Law	Journal of International Economic Law	16	1	91	117
West, Joel	2007	The economic realities of open standards: black, white, and many shades of gray	Standards and Public Policy			87	122
Whalley J., Curwen P.	2013	Unravelling complex organisational structures among mobile operators	Info	15	4	3	22
Xie, ZY; Xin, ZH	2005	Price regulation induced entry in China mobile telecom market	Performance Challenges for Efficient Next Generation Networks, Vols 6A-6C	6A-6C		1847	1854
Xu, Heng; Bagby, John W.; Melonas, Terence Ryan	2009	Regulating Privacy in Wireless Advertising Messaging: FIPP Compliance by Policy vs. by Design	International Symposium on Privacy Enhancing Technologies Symposium (PETS 2009)	5672		19	36
Yates, David & Jeff Gulati	2013	Understanding the Impact of Policy, Regulation and Governance on Mobile Broadband Diffusion in the Developing World	TPRC 41: The 41st Research Conference on Communication, Information and Internet Policy			-	-
Yeo, Yukyung	2009	Between Owner and Regulator: Governing the Business of China's Telecommunications Service Industry	The China Quarterly		200	1013	1032
Yoo, Christopher S	2013	Wireless Networks: Technological Challenges and Policy Implications	U of Penn, Inst for Law & Econ Research Paper No. 13-31			1	44
Zhang, Marina Yue	2016	Meso-level factors in technological transitions: The development of TD-SCDMA in China	Research Policy	45	2	546	559

B. Overview of empirical data sources

Within the Grounded Theory approach towards constructing our conceptual framework of regulatory practice, we used extensive empirical data from which the concepts for our core category and conceptual framework emerged. We chose to make an overview of all market issues in the mobile telecommunications market that the NRAs dealt with in the United Kingdom, the Netherlands and France, between 1997- 2002.

The reconstruction of the regulatory dossiers was done by means of a search for documents that constituted the regulatory dossiers, such as NRA guidelines, decisions, statements, market reviews etc. The empirical data sources are listed below.

OFTEL

Analysis of the market issues and regulatory activities by OFTEL was done on the basis of the digital publications on the OFTEL website and the following official publications:

- *Oftel News*, which was OFTEL's quarterly with reports on their activities, numbers 1- 54 (till December 2001);
- *Oftel Competition Bulletin* from June 1996 to December 2001, a quarterly publication that "contains details of developments in the competition and other regulatory enforcement casework handled by Oftel's Compliance Directorate";
- *Oftel Market Information*, also a quarterly, from November 1995 until December 2001;
- *Oftel Comparable Performance Indicator* reports from January 1996 until December 2001;
- *Oftel Annual Reports* from 1983 until December 2001.
- (Oftel, 1994, 1995c, 1997b, 1997k, 1997n, 1997j, 1997g, 1997c, 1997f, 1997d, 1997a, 1998a, 1995a, 1998f, 1998b, 1998g, 1998d, 1998h, 1998e, 1998c, 1999b, 1999a, 1999s, 1995b, 1999i, 1999e, 1999d, 1999l, 1999p, 1999c, 1999g, 1999t, 1999k, 1999h, 1996b, 1999j, 1999r, 2000d, 2000e, 2000a, 2000g, 2000f, 2000c, 2001f, 2001a, 1996a, 2001h, 2001m, 2001o, 2001l, 2001i, 2001g, 2001b, 2001j, 2001k, 2001d, 1997e, 2001c, 2001n, 2001e, 2002a, 2002b, 2002c, 1997m, 1997h, 1997i; Oftel & DTI, 1999; Oftel & OFT, 2000)

In addition the following publications by the Office of Fair Trading (OFT) were analyzed:

- *Fair Trading Magazine*, a quarterly starting in Autumn 1996, issues 14-31;
- Unfair Terms Bulletin;
- OFT annual reports 1996-2001.

OPTA

Analysis of the market issues and regulatory activities by OPTA was done on the basis of the digital publications on the OPTA website and the following official publications:

- *OPTA Connecties*, the monthly OPTA journal , 1997-2001
- *OPTA Collection*, the annual summary of OPTA activities, 1997-2002
- OPTA Annual Reports 1997-2002
- (OPTA, 1998b, 1998a, 1999b, 2000e, 2000h, 2000d, 2000g, 2000f, 2000a, 2000b, 2001h, 2001b, 1999a, 2001a, 2001f, 2001d, 2001c, 2001j, 2001g, 2001e, 2002a, 2002b, 2003, 1999f, 1999i, 1999h, 1999c, 1999d, 1999j, 1999g).

ART

Analysis of the market issues and regulatory activities by the ART was done on the basis of the digital publications on the ART website, within the electronic collections of:

- Les Grands Dossiers, 1997-2002
- Textes de Référence, 1997-2002
- Les Observatoires, 1997-2002
- Rapport Publique d'activité 1997-2000 on CD-ROM
- (ART, 1997a, 1997b, 1999a, 1999g, 1999h, 1999c, 1999d, 1999i, 1999j, 2000e, 2000a, 2000g, 1998a, 2000i, 2000b, 2000h, 2000c, 2000d, 2000f, 2001j, 2001c, 2001h, 2001e, 1998c, 2001i, 2001f, 2001g, 2001b, 2001d, 2001a, 2001k, 2002c, 2002b, 2002d, 1998d, 2002a, 2005, 1998e, 1998b, 1999f, 1999b, 1999e).

General

The national telecommunications laws were consulted and of all NRAs the official websites were frequently consulted²²:

- www.oftel.gov.uk
- www.opta.nl
- www.art-telecom.fr

In addition the licences for the mobile network operators of all three countries were consulted.

²² During our study the websites of OFTEL, OPTA and ART have undergone significant changes. OFTEL's website has been integrated into the OFCOM website <http://www.ofcom.org.uk> on which the former OFTEL website has been archived in its original format. The OPTA and ART websites have undergone a major structural change, as a consequence digital access to the original documents is subject to changes in the websites.

C. List of market issues

App Table 8 contains the numbers of the Primary Docs (PD) in Atlas.ti, the software in which we coded the empirical data in the open and selective phases of our Grounded Theory Approach. In the main text we use these PD numbers to refer to the market issues that we reconstructed. More details on the market issues are presented in Table 17.

App Table 8 Dossiers numbers of the market issues

PD	Country/NRA	Market Issue
1	The Netherlands/ OPTA	Consumer complaint handling
2		Mobile number portability
3		SIM Lock
4		Fixed to mobile termination tariffs
5		Transparency of end user terms
6		Infrastructure sharing 2G period
7		Infrastructure sharing 3G period
8		National roaming
9		Access to network intelligence
10		Introduction of indirect access
11		Retail promotions
12		Services based on roaming
13		Value added services
14		Wholesale terms and conditions
15	United Kingdom/ OFTEL	Consumer complaint handling
16		Mobile number portability
17		SIM Lock
18		Fixed to mobile termination tariffs
19		Quality of service
20		Transparency of end user terms
21		International mobile roaming retail tariffs
22		On net versus off net retail tariffs
23		Guidelines for interconnection & interoperability
24		Infrastructure sharing 2G period
25		Infrastructure sharing 3G period
26		Interconnection tariffs for originating calls to free phone numbers
27		Equality of mobile termination tariffs for international and national calls
28		Frequency of interconnection charge reviews
29		Customer network interface
30		National roaming
31		International rerouting
32		Routing of inbound international traffic
33		Access to network intelligence
34		BTs genie service
35		Claw back clauses
36		Connection of SMS platforms to the networks

PD	Country/NRA	Market Issue
37		Cross-subsidization
38		Services for charge card operators
39		General framework for mobile service provision
40		Introduction of indirect access
41		Personal numbering services
42		Resale price maintenance
43		Wholesale promotions
44		Services based on roaming
45		Unbranded and unstructured airtime for service provider
46		Value added services
47		Wholesale prepay mobile services
48		Retail promotions
49		Wholesale terms and conditions
50	France/ ART	Mobile number portability
51		Quality of service
52		Customer network interface
53		Equality of mobile termination tariffs for international and national calls
54		Infrastructure sharing 3G period
55		Jamming of mobile signals
56		Technical protocol for interoperability
57		Introduction of indirect access
58		Portal control
59		Retail promotions
60		Fixed to mobile termination tariffs
61		National roaming

D. Patterns in duration and intensity

In App Table 9 we present the full overview of the patterns in duration and intensity. The synthesis of this table is presented in section 6.2.

App Table 9 Full overview of patterns in duration and intensity

Categories	Sub categories		Properties	Market issue with labels	Source	Duration	Intensity
	ex post	Consumer interests	Complaint handling	Unsolicited SMS messages			
Social rationale: public values			Complaint handling	PD1 NL Consumer complaint	End user complaints	condensed	straightforward
			Terms of usage	PD2 NL MNP PD3 NL SIM lock PD5 NL transparency of terms PD16 UK MNP PD17 UK SIM lock PD50 FR MNP		extended	exploratory
	ex ante	Public interests	Tariffs	PD4 NL MTT PD18 UK MTT PD21 UK international mobile roaming PD22 UK on versus off net P60 FR MTT	NRA own initiative, EC request or Directive, Ministerial decree	extended	exploratory
			Quality of Service	PD15 UK consumer complaint handling PD19 UK quality of service PD20 UK transparency of user terms PD51 FR quality of service		continuous	straightforward
	ex post	Compliance	Jamming n.a.	PD55 FR Jamming of mobile signals PD11 NL Retail promotion	non-compliance with legal rule	extended condensed	exploratory straightforward
Economic rationale: fair competition	ex post	Dispute Settlements between market parties	Market party complaint handling or request for dispute settlement	PD26 UK Interconnection tariffs wholesale PD28 UK Interconnection terms PD31 UK International rerouting PD32 UK Routing inbound international traffic PD34 UK BT's Genie service PD35 UK Claw back clauses retailer PD38 UK Free phone services charge card operators PD42 UK Resale price maintenance PD43 UK retail promotions PD46 UK Value added service PD48 UK Wholesale promotions PD49 UK Wholesale terms & conditions PD52 FR Customer network interface service PD58 FR Portal control PD59 FR Retail promotions	request for dispute settlement or market party complaint	condensed	straightforward

			<p>PD14 NL SP wholesale terms</p> <p>PD27 UK Equality MTT</p> <p>PD41 UK Personal Numbering service</p> <p>PD53 FR Equality of national vs international tariffs</p> <p>PD7 NL Infrastructure sharing 3G</p> <p>PD8 NL national roaming</p> <p>PD25 UK infra sharing 3G</p> <p>PD54 FR infra sharing 3G</p> <p>PD6 NL Infrastructure sharing 2G</p> <p>PD23 UK interconnection</p> <p>PD24 UK Infrastructure sharing 2G period</p> <p>PD29 UK interoperability</p> <p>PD30 UK National roaming</p> <p>PD61 FR National roaming</p> <p>PD9 NL Access to Network intelligence/special access</p> <p>PD10 NL Indirect Access</p> <p>PD37 UK Cross-subsidization</p> <p>PD39 UK General framework for mobile service provision</p> <p>PD40 UK Indirect Access</p> <p>PD47 UK Wholesale prepaid services</p> <p>PD57 FR Indirect access on mobile networks</p> <p>PD36 UK SMS platform connection</p> <p>PD12 NL MVNO</p> <p>PD13 NL Value added services</p> <p>PD33 UK Access to network intelligence</p> <p>PD44 UK Services based on roaming (MVNO)</p> <p>PD45 UK Unbranded & unstructured airtime for SP</p> <p>PD56 FR Technical protocol</p>			
		Developing market conditions on the infrastructure level		EC	condensed	straightforward
		Supporting services innovation		EC or Ministerial policy	extended	exploratory
	Developing the institutional context			own initiative of NRA	extended	exploratory
ex ante					condensed	straightforward
					condensed	exploratory

E. Curriculum Vitae

Jolien Ubacht is an assistant professor in Institutional Aspects of ICT in the Information and Communication section in the department of Engineering Systems and Services at the Faculty of Technology, Policy & Management at Delft University of Technology, the Netherlands. She is also department manager of the Engineering Systems and Services department.

Her research focus is on the institutional aspects of the design of ICT-based innovation, digital platforms and services. She is specialized in the design of governance arrangements for complex socio-technical systems that require public, private and civic interests to be aligned. Her publications are on the governance of the telecommunications system, peer to peer platforms and blockchain-based applications.

Jolien presents her research at conferences such as ECEG, IFIP, CRNI, dg.o, EGOV-CeDEM-ePART. She is member of the programme committees for ECDG, dg.o and EGOV-CeDEM-ePART and acting as (co)chair of conference tracks on Social Media, Blockchain-based Applications and Panels. Peer reviewer for ~10 academic journals on a regular basis.

Jolien received the best paper award at the CRNI conference 2014. With co-authors she received a best paper award at the 15th IFIP Conference on e-Business, e-Services, and e-Society 2016 and a nomination for a best paper award with business implications at the dg.o 2019 conference.

In her teaching activities she supervised about 125 students in their BSc or MSc projects. Her interest in innovation in education has led to the development of courses in which online elements are incorporated. Currently acting as module manager of three MSc courses: Digital Platform Design, CoSEM Research Challenges and CoSEM Master Thesis Preparation, modules in which staff members from multiple disciplinary backgrounds cooperate to provide for an interactive learning environment. She also chaired working groups in educational programmes with interdisciplinary teams and was faculty project leader of ICT innovation within educational programmes.

Jolien received the 2007 Simon Peerdeman Award for an outstanding contribution to one of TPM's Educational Programmes. With Bertien Broekmans and Bert Enserink she received the 2nd Innovation in Teaching of Research Methodology Excellence Award at the 16th European conference on Research Methodology for Business and Management Studies in 2017.

In 2019 she co-organized the Lorentz workshop *Comprehensive Systems Innovation* in which a group of multidisciplinary (inter)national researchers explored the contribution of modelling to large scale transitions in society.

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List of Publications

(recent publications only)

Van Engelenburg, S.H., Rukanova, B.D., Hofman, W., **Ubacht, J.**, Tan, Y. & Janssen, M.F.W.H.A. (2020). "Aligning stakeholder interest, governance requirements and blockchain design in business and government information sharing". In: Pereira, G.V., Janssen, M., Lee, H., Lindgren, I., Bolívar, M.P.R., Scholl, H.J. & Zuiderwijk, A. (eds.) *EGOV2020: Electronic Government, Lecture Notes in Computer Science*, vol. 12219, pp. 197-209. Springer. https://doi.org/10.1007/978-3-030-57599-1_15.

Diran, Devin, Thomas Hoppe, **Jolien Ubacht**, Adriaan Slob & Kornelis Blok (2020). "A Data Ecosystem for data-driven thermal energy transition: Reflection on current practice and suggestions for re-design. In: *Energies*, 13, 2 pp. 1-28.

Tan, Y, B. Rukanova, S. van Engelenburg, **J. Ubacht**, M. Janssen. (2019). "Developing Large Scale B2B Blockchain Architectures for Global Trade Lane: Are the design principles derived based on the upscaling of the Internet applicable for upscaling global blockchain-enabled infrastructures? In: *Proceedings of the 6th innovation in information infrastructures (III) workshop*. University of Surrey, 8 pp's.

Allessie, D., Janssen, M., **Ubacht, J.**, Cunningham, S., Van der Harst, G. (2019) "The consequences of blockchain architectures for the governance of public services: a case study of the movement of excise goods under duty exemptions". In: *Information Polity*, 24, 4, pp. 487-499.

Segers, Lennard, **Jolien Ubacht**, Boriana Rukanova & Yao-hua Tan (2019) "The use of a blockchain-based smart import declaration to reduce the need for manual cross-validation by customs authorities". In: Fadi Salem, Anneke Zuiderwijk & Yu-Che Chen (eds.). *Proceedings of the 20th Annual International Conference on Digital Government Research: Governance in the Age of Artificial Intelligence*, dg.o 2019. Association for Computing Machinery (ACM). 2019, 196-203. <https://doi.org/10.1145/3325112.3325264>

Batubara, Rizal, **Jolien Ubacht**, and Marijn Janssen. (2019) "Unraveling Transparency and Accountability in Blockchain". In: Yu-Che Chen, Fadi Salem & Anneke Zuiderwijk (eds.). *Proceedings of the 20th Annual International Conference on Digital Government Research*. New York: The ACM International Conference Proceedings Series. 2019, 204. <https://doi.org/10.1145/3325112.3325262>

Ubacht, Jolien, Marijn Janssen, Boriana Rukanova & Yao-hua Tan (2019). "Workshop on Blockchain based applications". In: Yu-Che Chen, Fadi Salem & Anneke Zuiderwijk. (eds.). *Proceedings of the 20th Annual International Conference on Digital Government Research*. New York: The ACM International Conference Proceedings Series. 2019, 522-523, <https://doi.org/10.1145/3325112.3325272>

Haak, Elise, **Jolien Ubacht**, Marc van den Homburg, Scott Cunningham & Bartel van de Walle. (2018) "A Framework for Strengthening Data Ecosystems to Serve Humanitarian Purposes". In: Zuiderwijk-van Eijk, Anneke & Hinnant, Charles C. (eds.). *Proceedings of the 19th Annual International Conference on Digital Government Research: Governance in the Data Age*, dgo2018. Association for Computing Machinery (ACM). 2018. <https://doi.org/10.1145/3209281.3209326>

Batubara, F. Rizal, **Jolien Ubacht** & Marijn Janssen (2018) "Challenges of blockchain technology adoption for e-government: A systematic literature review". *Proceedings of the 19th Annual International Conference on Digital Government Research: Governance in the Data Age*, dgo2018. Association for Computing Machinery (ACM). 2018. <https://doi.org/10.1145/3209281.3209317>

Gordijn, Johanna, Bertien Broekmans, Kevin Dunn & **Jolien Ubacht** (2018). "Increasing the effect of peer review". *Proceedings of ICERI2018: 11th annual International Conference of Education, Research and Innovation. International Association of Technology, Education and Development (IATED)*. <https://doi.org/10.21125/iceri.2018.1811>

Meijer, David and **Jolien Ubacht** (2018) "The governance of blockchain systems from an institutional perspective, a matter of trust or control?". *Proceedings of the 19th Annual International Conference on Digital Government Research: Governance in the Data Age*, dgo2018. Association for Computing Machinery (ACM). <https://doi.org/10.1145/3209281.3209321>

Darusalam, Darusalam, Marijn Janssen and **Jolien Ubacht** (2018). "Towards generalized process patterns for detecting corruption within the government using open data". *Proceedings of the 19th Annual International Conference on Digital Government Research: Governance in the Data Age*, dgo2018. Association for Computing Machinery (ACM). <https://doi.org/10.1145/3209281.3209282>

Ølnes, Svein, **Jolien Ubacht**, and Marijn Janssen. (2017) "Blockchain in government: Benefits and implications of distributed ledger technology for information sharing". *Government Information Quarterly*. 2017, 34(3). 355-364. <https://doi.org/10.1016/j.giq.2017.09.007>

Ubacht, Jolien, Bertien Broekmans, and Bert Enserink "Developing Research Designs for Studies into Complex Socio-Technical Systems". Remenyi, Dan (editors). *Innovation in the Teaching of Research Methodology Excellence Awards: An Anthology of Case Histories*. Reading: Academic Conferences. 2017, 23-37.

Mahtab Aghamiri, Amineh Ghorbani, **Jolien Ubacht**, Igor Nikolic, and Paulien Herder. (2017) "Enabling Citizen Participation in Sustainable Collective Action In Smart Cities: The Case Of Buiksloterham". *IASC 2017 conference*. 2017, 1-27.

Van Loenen, Bastiaan, **Jolien Ubacht**, Wouter Labots, Anneke Zuidervijk. (2017). "Log File Analytics for Gaining Insight into Actual Use of Open Data". In: Borges, Vieira Dias Rouco, José Carlos (ed.). *Proceedings of the 17th European Conference on Digital Government*. Reading, UK: Academic Conferences. 2017, 238-246.

Werker, Claudia, **Jolien Ubacht**, and Andreas Ligtvoet (2017). "Networks of entrepreneurs driving the Triple Helix: two cases of the Dutch energy system". In: *Triple Helix*, 4(4). 3-25. <https://doi.org/10.1186/s40604-017-0047-z>

Ubacht, Jolien. (2016) "A Process Perspective on Regulation: A Grounded Theory Study into Regulatory Practice in Newly Liberalized Network-Based Markets". *Competition and Regulation in Network Industries*, 17(1), 78-98.

Setiya, Karan, **Jolien Ubacht**, Scott Cunningham & Sertac Oruc (2016). "Business intelligence from user generated content: Online opinion formation in purchasing decisions in high-tech markets". In: *Proceedings of the 15th IFIP WG 6.11 Conference on e-Business, e-Services, and e-Society, I3E 2016: Social Media: The Good, the Bad, and the Ugly. Lecture Notes in Computer Science*. Springer Verlag. 2016, 505-521. https://doi.org/10.1007/978-3-319-45234-0_45

Buda, Anamaria, **Jolien Ubacht**, Marijn Janssen, Robert-Jan Sips. (2016). "Decision support framework for opening business data". *Proceedings of the 16th European Conference on e-Government, ECEG 2016*. Academic Conferences. 2016, 29-37.

Westerbeek, Jakar, **Jolien Ubacht**, Haiko van der Voort & Ernst ten Heuvelhof (2016). "Studying the Effects of Peer-to-Peer Sharing Economy Platforms on Society". In: Scholl, Hans Jochem, et al. (eds.). *Proceedings of Electronic Government and Electronic Participation*. Amsterdam: IOS Press. 2016, 222-232. <https://doi.org/10.3233/978-1-61499-670-5-222>

