THE CONTRIBUTION OF GAMING SIMULATION TO MARKET MODEL DESIGN

A GAMING SIMULATION CASE STUDY TO THE PREFERRED MARKET MODEL FOR THE CHARGING INFRASTRUCTURE FOR ELECTRIC TRANSPORT IN THE NETHERLANDS

MASTER THESIS REPORT

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PREFACE AND ACKNOWLEDGEMENTS

This report is the result of my Master Thesis project conducted at Accenture Strategy Netherlands, the final step in acquiring the MSc. Grade in Systems Engineering, Policy Analysis and Management at the Delft University of Technology.

During this project I was challenged in many fields; the difficult to grasp notion of market models, the uncertain but interesting future of electric transport, my skills in conducting a scientific research project and my skills as project manager to find the correct information, knowledge and supervision of all involved supervisors around the project from the TU Delft, the Accenture Strategy Department and the Accenture gaming simulation department. Though it took some time to find out and make valuable use of the different roles of the supervisors I have learned a lot of this process. Moreover, these results would not have been possible without the support of them.

Therefore, I would like to thank Paul Ubbink and Maarten Noom from the Accenture Strategy department, who have helped me to improve the content of this research by their professional support on electric transport and their reviews on my thesis. I hope that they are able to use the E-CITY 2020 simulation to their benefit.

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Last but not least I want to thank my nearest. Mom and dad, thank you for providing me the opportunity to finish this study. Above all thank you for the support in the past years I spend in Delft. Dad, thank you for

your time as corrector of my thesis report. Colette, thank you for installing the confidence in me, which was more than welcome during this project.

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I have enjoyed my study time in Delft, but all good things come to an end, and I am proud of the performed work that is reported in this thesis!

Sjoerd Helmer
Delft, March 2011.

EXECUTIVE SUMMARY

The charging of electric vehicles is a new market that is emerging, partially from existing markets. The emergence of such new markets requires the definition of new roles and responsibilities. Such a 'market model' describes the market roles (e.g. owner, operator etc) in terms of responsibilities and interactions between roles (processes). However, the development of an abstract market model for a future market is complicated since the dynamics of future markets are difficult to imagine, let alone understand. The methods used in the design process such as conceptual modelling, market consultation and traditional presentations and workshops do not suit to convey, understand and further develop these complex processes and dynamics of a market model. The use of simulation games is a proven method to deal with such complexities but is never applied on market model design. This problem statement led to the following main research questions:

1. ***What is the contribution of using gaming simulations for designing market models in the energy related sector?***
2. ***What recommendations can be made for game designing in uncertain circumstances such as the creation of a market model for a practically non-existing market?***

First a market model development framework is constructed to identify the market model design process, its challenges and the current methods that are used for market model design. A gap analysis on the current methods used in market model design is performed to identify gaps of the current methods in dealing with the market model design challenges. Next, the novel E-CITY 2020 simulation game is developed to examine the contribution of gaming simulation to market model design for Dutch energy related markets. The game simulates a preferred market model for the charging infrastructure in a fictive city in 2020. The design objective for this research was twofold:

Design, construct, test and evaluate a simulation game to:

1. ***Bring relevant market parties together and help them understand the interactions of the proposed market model for the electric vehicle charging infrastructure in order to develop follow up steps and requirements to make this market model work;***
2. ***Evaluate the contribution of gaming simulation to the market model design in energy related markets.***

The simulation game has resulted in:

- *Increased insight in the interactions of the proposed market model for the electric vehicle charging infrastructure*
- *A number of requirements for successful implementation of this market model, from the perspectives of different parties that have a role in the preferred market model. The two most important learning points on the market model are:*
    - *Price-setting and the distribution of risk between provider and Charge Spot Operator (CSO)*
    - *Process bottlenecks in the charge spot realization process*

Based on the findings the following is concluded on the contribution of gaming simulation to market model design:

- *Gaming simulation increases the understanding of the participant of the market model from different perspectives.*

- *Gaming simulation design increases the level of understanding of the market model of the designers.*
- *Gaming simulation helps in creating a shared understanding among the participants of a possible future for the market model.*
- *People seem to be better motivated to attend a simulation game than a traditional presentation or workshop.*

Reflections on the development of the E-CITY 2020 game are made to identify recommendations for game design in highly uncertain situations. The following recommendations are made:

- *Involve relevant primary industry stakeholders.*
- *Start with end-in-mind by deriving the purpose and objectives from the phases in the market model development framework.*
- *Take uncertainties into account and use a agile development method to start prototyping early.*
- *Create starting points for scenarios.*

In this thesis recommendations are also made to increase the value of E-CITY 2020 to further market model design. Finally, recommendations for further researching the contribution of gaming simulation to market model design are described.

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LIST OF ABBREVIATIONS

B2B	=	Business-to-Business
CSI	=	Charge Spot Installer
CSO	=	Charge Spot Operator
EDSN	=	Energie Data Services Nederland
EV	=	Electric Vehicle
ET	=	Electric Transport
ICE	=	Internal Combustion Engine
IEA	=	International Energy Agency
ISO	=	Independent System Operator
IS	=	Information systems
KPI	=	Key Performance Indicator
MPM	=	Market Process Model
PEV	=	Plug-in Electric Vehicle
TU Delft	=	Delft University of Technology
V2G	=	Vehicle-to-Grid

CHAPTER 1 - INTRODUCTION

Imaginary situation that defines urgency for an effective market model

Imagine that you have won a brand new electric vehicle in the sustainable lottery. You are living in an apartment on the third story, so you do not have the ability to charge your car on your private drive. What are you going to do? Where do you enter into a contract for charge spot access? Or where should you be for the realization of a new charge spot near your home?
Imagine that you are the owner of a beautiful new electric vehicle and after a year you switch your E-mobility contract to another provider. The first of august you had expected to be switched, but when you are about to start charging your car you are experiencing problems with your identification card and unfortunately you are not able to use the public charging infrastructure. You even experience that you are still getting billed by your former provider.
Or even worse, imagine that you are driving in your brand new sexy electric car. You are heading your way for your weekend holidays. Just after three hours driving you discover that you are in need for fuel (electricity). On your navigation panel you find the nearest public charging point. Glad that you have just made it, you scan your Eneco identification card, but no response. You experience that you cannot charge your car in Essent areas and you are stuck.
On your way back to - learned from you bad experience - you are glad to find a charging station which is compatible with Eneco drivers, however, about to start charging you find out that you can only pay by credit card, which you have forgotten to take with you.
These are experiences that a Plug-in Electric Vehicle (PEV) driver does not want. However, to prevent such situations and to accommodate a reliable and affordable PEV driving experience, agreements on standards, roles and processes should be made. These agreements on market roles and their corresponding responsibilities in processes should be covered in a market model.

This introduction first describes the cause for the study in section 1.1. Then section 1.2 describes both the practical and scientific relevance of the project. Section 1.3 sketches the scope. Section 1.4 presents the research questions and design objectives. Section 1.5 describes the research approach that is used for this thesis and finally the chapter ends with an outline for the thesis.

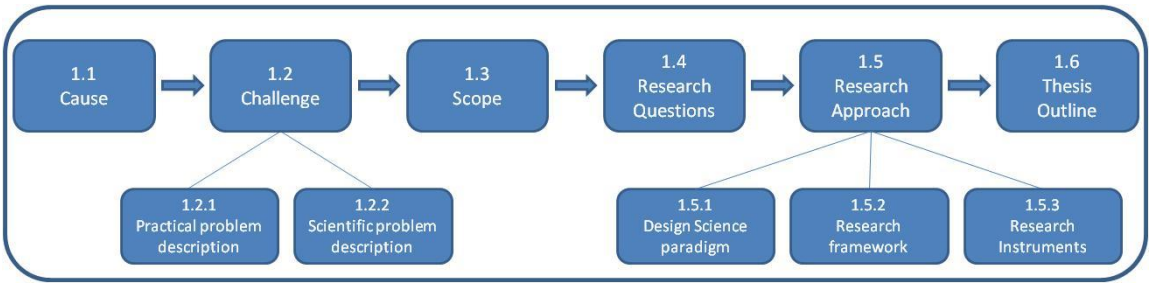

Figure 1.1 Chapter structure

1.1 CAUSE FOR MARKET MODEL CHARGING INFRASTRUCTURE ELECTRIC TRANSPORT

Transport sector drivers for electric vehicles

Increasing dependency on oil imports from unstable political regions, declining oil supplies, increasing local air pollution, in combination with the increasing awareness of the contribution of CO_2 emissions to the global warming processes is asking for a solution of world's largest oil consuming sector; the private transport sector (International Energy Agency (IEA) 2008). These drivers which are also depicted in figure

1.2. is rapidly driving innovations in this sector to electric driven vehicles (Guille and Gross 2009).

Electricity sector drivers

But not only is the transport sector facing changes, the energy sector is asking for a solution as well. Though CO_2 carbon capture and storage technologies can help mitigate CO_2 emissions it does not provide a new energy source and therefore still keeps us dependent on oil, gas and coal. Therefore, the energy sector will have to increase the amount of renewable energy sources, which is problematic. Due to the lack of storage possibilities for electricity it is difficult to manage to connect an increased amount of intermittent renewable electricity to the grid (Kempton and Tomic 2005; Andersen, Mathews et al. 2009). Most renewable energy sources such as wind are intermitted, meanings that they are irregular and difficult to predict.

The promise of electric vehicles

Plug-in Electric Vehicles (PEVs) can help solve the issues by preventing local air pollution and mitigating CO_2 emissions. In the end the Vehicle-to-Grid (V2G) concept might be the solution for both the electricity and transport sectors by converging the currently separated energy sector and private transport sector into one system. The basic concept of V2G services is that during idle parking time cars are able to deliver electricity back to the grid, which aggregated can serve as a generation and storage device (Guille and Gross 2009). Moreover, by organizing discharging during peak hours and charging of the PEVs during low demand times it can provide peak shaving and ancillary services, which help establish a stable and reliable grid, which is currently taken care of by conventional gas plants (Kempton and Tomic 2005).

(Policy) situation Netherlands concerning EVs

The Dutch government also acknowledges the strategic importance of electric transport for sustainable mobility. The Netherlands is especially eligible for electric transport, because of the solid power grid and the relatively short commuting distances (average 30 km) (Eurlings and van der Hoeven 2009). The ministry of Ministry of Transport, Public works and water management (in Dutch; 'Verkeer & Waterstaat') states in their mobility policy that electric transport will improve the Dutch energy position, because due to decreased oil dependency it will strengthen the economy and helps to solve the climate problems. One of their goals is therefore to make electric transport affordable and reliable in the coming years (Eurlings and van der Hoeven 2009). For this purpose they have established a platform of corporate and knowledge institutions and governmental organizations to create the prerequisites (Formule E Team 2010).

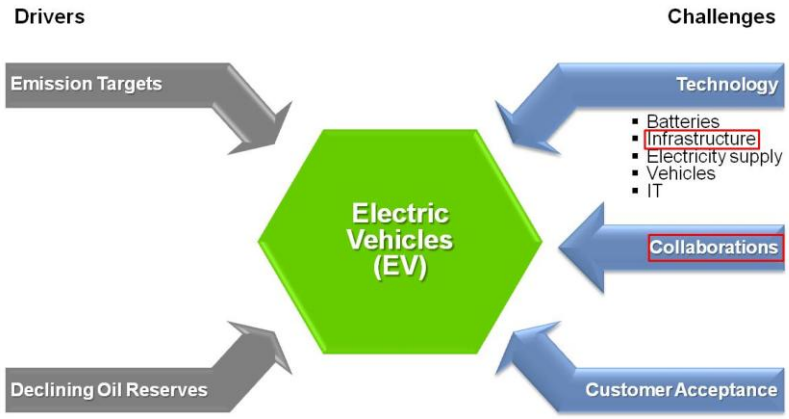

Figure 1.2 Drivers and challenges for Electric Vehicles. This study focuses on the red circled aspects; the market model charging infrastructure which is related to "collaboration aspects on the infrastructure"

Barriers

However, there are still many barriers to overcome in the fields of technology, customer acceptance and organisation. A few will be described.

Customer acceptance

First, the customer acceptance is not known yet. It is difficult to assess the system acceptance and there is always lack of knowledge as to which value propositions will be awarded by customers (van der Kar and Verbraeck 2008). Behavioural studies have proved that this might be a large impediment to invest in new technologies since "*consumers improperly assess future savings and discount rates*" in which discount rates are the rate at which consumers want to recover their investment (Sovacool and Hirsh 2009).

Sovacool and Hirsch even have identified that "*consumers felt they would need compensation exceeding $10,000 to deal with the inconvenience of owning an EV compared to a conventional vehicle*" (Sovacool and Hirsh 2009). Another practical issue is the combination of rather long charging times and limited battery capacity, which cause a limited range with present battery technology(Nielsen 1993). It will be hard for people to give up their mobility that they have gained during the petro-fuel decades, so there is a mismatch with consumer preferences (van Bree, Verbong et al. 2009).

Social Acceptance

There seem to be challenges related to social acceptance as well. Turrentine and Kurani (2007) discovered that vehicle purchasers do not only forget fuel cost in their vehicle examination when buying a new car, but that there is even a negative social stigma against more fuel-efficient vehicles. Because of their identification with cheap and small it becomes a 'loser' car for upper-class (Turrentine and Kurani 2007). Furthermore, "marketers for utilities and manufacturers learned that people tend to resist technologies they perceive *as untested, radical or different* " (Sovacool and Hirsh 2009).

Technical issues; ICT, grid impact

At the technical side, there is many uncertainty in the literature about to which extend grid and distribution nets should be modified to be adaptable to V2G and to handle the bi-directional power flow. Some studies show that only the distribution nets should be adapted (Kempton and Tomic 2005; Dickerman and Harrison 2010) and others thinks that heavy modifications are required (Turton and Moura 2008; Srivastava, Annabathina et al. 2010). Though it is uncertain to which extent upgrades are necessary, it is evident that there are compelling technical challenges ahead to provide the smart grids, operational systems and smart metering devices (Dickerman and Harrison 2010; Srivastava, Annabathina et al. 2010)

Essential will be the role of the ICT layer to compute, communicate, bill and store all bi-directional around the clock data transfers between aggregators, vehicles and Independent System Operators (ISOs) (Kempton and Tomic 2005; Turton and Moura 2008; Guille and Gross 2009). All components of such system itself can use proven technology, but to provide the interfaces will be very challenging.

Battery capacity and charge speed

Battery charging will be one of the biggest challenges for different stakeholders (Dickerman and Harrison 2010; Srivastava, Annabathina et al. 2010). Issues are related to charging time, vehicle range and the availability of charging stations, but probably the most stroking question is related to safety. Using extension power cords running from garages or roadside charging stations would result in dangerous and chaotic situations (Dickerman and Harrison 2010).

Thesis topic: effective charging infrastructure

One of the most important barriers to a large scale introduction to PEVs is an effective charging infrastructure. Charging infrastructure will have a central role in the development of electric driving. It is a pre-requisite for successful and convenient electric driving. The infrastructure is described in more details in Appendix C. The 'chicken-egg' problem, which describes the reluctance of car manufacturers to introduce alternatives for the Internal Combustion Engine (ICE) in the absence of infrastructure or the other way around slowed down the progressions on electric transport (van Bree, Verbong et al. 2009); Should there be more PEVs first in order to establish the necessary infrastructure? Or should there be an infrastructure first in order to get more PEVs? For this reason a cooperation of grid companies have set up the E-laad.nl foundation which has the goal to develop 10.000 charging points till 2012 to speed up the roll out (E-Laad.nl 2010).

Urgency for market model agreements on roles, responsibilities and processes

To ensure a reliable and affordable market for the charging infrastructure, parties should make agreements on roles, responsibilities and processes. Agreements on clear roles and process are very important in a market which is partly regulated and has to deal with much information exchange between different market roles such as the grid company and the energy supplier. High public interest as are involved and such an infrastructure bears the characteristics of a natural monopoly. Such infrastructural markets with many public interest involved, such as insurance of supply, are indicated as critical infrastructure by the Dutch government. The Dutch electricity sector has experienced the need for a market model after the liberalization of the Dutch power sector in 2004. They have experienced the consequences of a new market without an effective market model. This caused problems resulting in amongst others delayed, missing and incorrect billing, wrong switches and increased costs. (Boston Consultancy Group and Fabrique 2004;

Programmabureau Marktmodel (PBM) 2009). The PBM mentioned the following reasons: complexity of the current market model, interdependencies of market parties, large diversity of processes and procedures, many possibilities to serve clients in different ways and problems around data traffic due to different standards.
The PBM therefore developed a new market model for the Dutch electricity sector which defines the roles, responsibilities and processes.

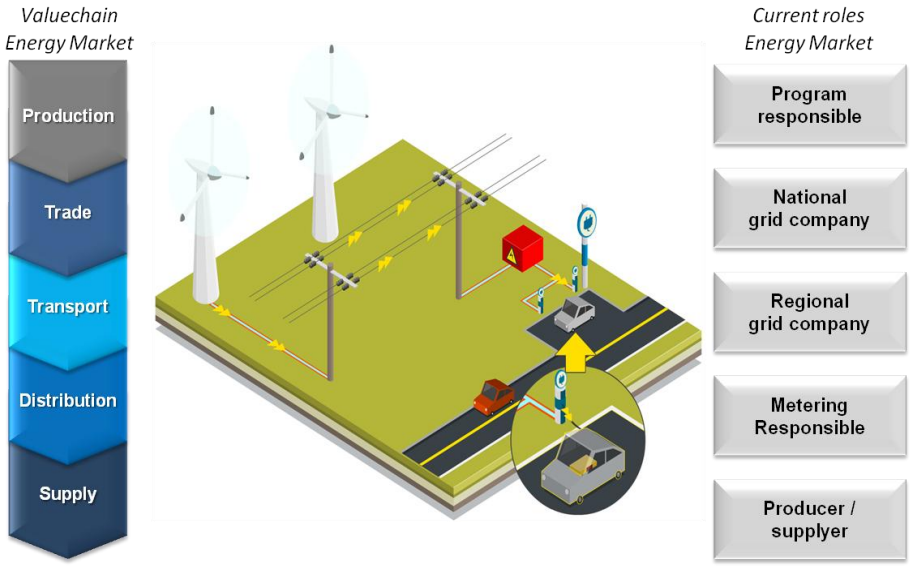

Figure 1.3 The Dutch energy has a market model with clear roles and responsibilities (Accenture 2010).

Market versus business model

A market model should not be confused with a business model or business case. The market model does not determine how money is earned, but it can determine how money is collected (Accenture 2010). This is in the Dutch energy sector where the supplier must charge the client for the transport costs of the grid company. A market model is facilitative to the market and contains agreements on market roles, responsibilities and processes. These agreements can be anchored on different levels, from formal law & regulation to informal agreements between market parties.

Reasons for a new market model; current energy market model does not fit public charging infrastructure

So why is a new market model needed? There are a few reasons why a new market model has to be developed. First, in 2009 it has become clear that the electric car does not fit very well in the current market model for the Dutch electricity sector. The current market model for the Dutch energy sector is based on customers who might switch energy supplier but who are not switching grid connection. The expectation is that an electric car driver wants to charge at different spots per day, such as at home, at work or at the gym, including public charge spots. Furthermore it is expected that a driver will pay directly. The current market model of the Dutch energy sector, whose roles and value chain are depicted in figure 1.3, does not facilitate these aspects for the public charging infrastructure. Public charging infrastructure is the infrastructure in the public area such as roadside parking charge spots and it is expected that public charge spots will play an important role in the Dutch electric car economy, since only a happy few will have the possibility for home charging (Booij 2010). The different public and private charging options are described in appendix C.

Many involved actors from different industries

Moreover, a market model will be of special interest for the charging infrastructure, because there are many stakeholders involved. A large amount of charging stations should be included into the power grid to realize the large-scale introduction of electric transport in the Netherlands. This asks for intensive cooperation between many market parties from different sectors. Sectors and market parties which

traditionally operate independently will meet each other in the domain of electric transportation. These are typical sectors with many parties and with mutual working arrangement to ensure proper functioning of the market, Actors involved might be actors from the electricity sector such as energy suppliers and grid companies; actors from the transport sector, such as fleet owners, gas stations and car suppliers, governments and new entrants such as suppliers of infrastructure. Figure 1.4 depicts possible involved actors which are included in the market consultation by Accenture (Accenture 2010).

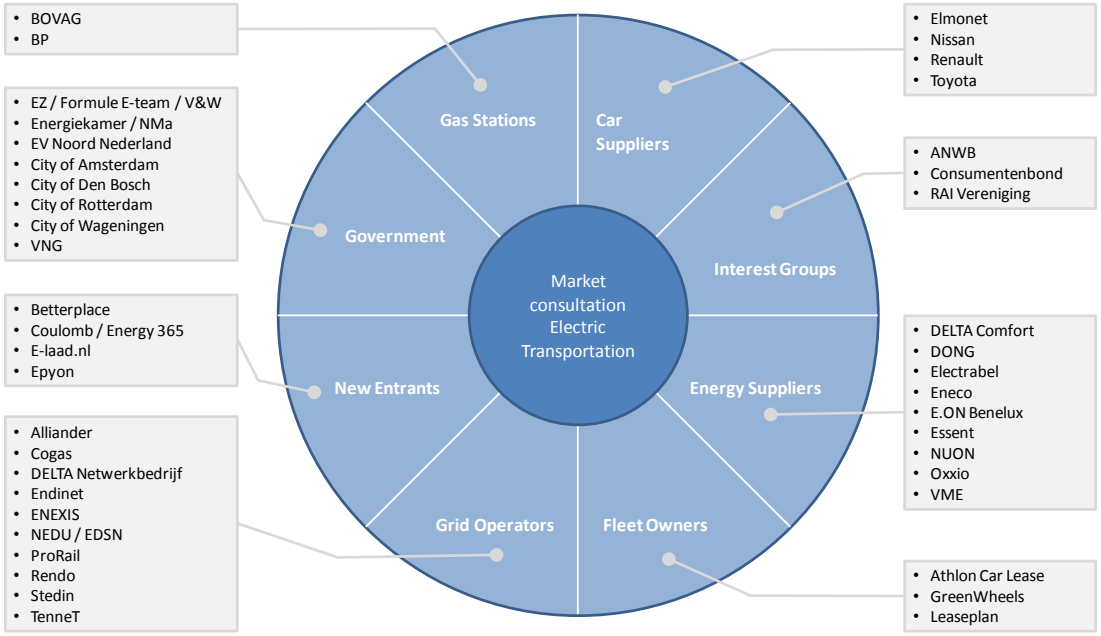

Figure 1.4 Possible involved actors, which are included in the market consultation for the study to the preferred market model (Accenture 2010).

Need for market model acknowledged; kick-off for dialogue

Netbeheer Nederland and EnergyNed have acknowledged the urgency to accommodate agreements for charging and payment for electric transportation in a market model. They commissioned Accenture to develop a proposal for a market model in the beginning of 2010 (Accenture 2010). Accenture has both performed an extensive research in current market models of the banking sector and telecom sector and performed an extensive market consultation. This research has resulted in three different proposals for the market model. Netbeheer Nederland and EnergieNed have selected a model, which from now on will be called the *'preferred market model'*. Accenture worked out processes, roles, responsibilities and information and resource flows for the preferred market model. These are presented in Accenture's report (2010) *'Study market model charging infrastructure for electric transportation'*, which is a kick-off for a dialog with all market actors to further develop a working market model.

1.2 Challenge

Subsection 1.2.1 describes the practical relevance of the project. It introduces the situation around the preferred market model and the complications on further effective market model development. Subsection 1.2.2 introduces the scientific background of this research.

1.2.1 Practical business problem description

Situation on preferred market model

The dialogue kick-off document describes the market roles, responsibilities and processes of the preferred market model. These are worked out on a high-level based on market consultations and a conceptual modelling paper exercise. The market consultation has indicated that there are still topics on which parties differ in their vision or do not have a clear vision yet (Accenture 2010). There are uncertainties with this market model on a more detailed level including issues like which parties should fulfil which roles and responsibilities, what should be the method for payment, what should be the type of contract that a client should engage in and more. It is for example uncertain what a market request for a new charge spot would look like. Are the local governments putting tenders in the market or would a car owner request a new charge spot? What should be arranged by whom and what information do the different market roles needs from each other? These are the type of questions that are not answered by the high-level proposed market model.

Complication

Moreover, Accenture wants the preferred market model to be diffused into the market in order to get wider support for and discussion on a new market model. However, they have experienced regularly that people do not understand the market model correctly and confuse it with business models. Accenture therefore wants a gaming simulation as an intervention to let people better understand the market roles, responsibilities and processes as proposed in the preferred market model and evaluate different possibilities and options.

1.2.2 Scientific problem description

"*Markets evolve, but they are also designed. Entrepreneurs and managers, legislator and regulators, lawyers and judges, all get involved, at least indirectly, in market design." (Roth 1999: pp.1)* In the case of the electric transportation market parties have started to actively design the market model to start up a new market. As introduced in the section above Accenture has provided a proposal for a new market model. The study to this proposal is based on a 'simple' market consultation and office sessions by Accenture consultants. Nevertheless, markets are very complex structures in which many different actors interact and behave strategically.

Technical-economical complexity

Mayer (2009, pp.20) labels these systems dealing with complex policy problems, such as transportation, climate change or healthcare as complex socio-technical systems. These systems have two faces of complexity. The first form is the technical-economical complexity which stems from the emergent complexity among the physical-technical-economical entities within the market (Mayer 2009). Decisions may have far-reaching consequences in the long term.

Multi-actor complexity

The second form of complexity stems from the fact that these systems are placed in a multi-actor network context resulting in multi-actor or social-political complexity. This complexity is the result of strategic interaction between different actors with different stakes who are interdependent on each other in realizing their goals (Bruijn and Heuvelhof ten 1999; pp.15; Roth 1999)

Gaming simulation can deal with complexity

Gaming simulation is one of the tools that can deal with this complexity (Mayer 2009). Gaming simulation, which is intricately connected to system complexity, therefore might be valuable during the design of market models. This expectation will be underpinned by the following paragraph on the application of gaming simulation.

A typical gaming simulation problem

Duke notes that the typical gaming simulation problem is a very complex real world situation characterized by: many variables interacting, no realistic basis for quantification of variables, no proven conceptual model and a socio-political context of decision-making where actions may be irrational (Duke 1980 : pp.364). The main goal of simulation games is to "*simulate the actors' decision-making process and to demonstrate the consequences within social systems*" (Kriz 2003: pp.496). These simulations can be used for different purposes ranging from effective knowledge transfer to the means of knowledge creation about how markets are developing or about strategies or policies that should be pursued to drive high performance (Wenzler and Higgins 2009).

Gaming simulation

Simulation games contain actors, rules and resources and therefore there is not only communication between actors, but also linked to technical and material processes mimicking a systems' resource flows (Kriz 2003). Interaction in simulation games has a central role, which makes them interesting to create insights into the interaction between parties and the results of this interaction on the market. In addition to other research methods such as traditional case studies, gaming simulation provides an interesting experimental environment for identifying strategic behaviour in complex systems (Kuit, Mayer et al. 2005). Kuit et al. have used a gaming simulation for this purpose to identify potential strategic behaviour in a liberalizing electricity market.

Gaming simulation as application for market model design

A literature study shows that gaming simulation is more often used in the energy infrastructure, but never for the purpose of developing a *market model*. There is not much literature on market *model* design. Some literature though, can be found on the design of markets, which could be used for the design of *market* models. Neumann and Weinhardt for example, have developed *market engineering*, which is a structured approach for designing electronic markets. (Weinhardt, Holtmann et al. 2003; Neumann, Holtmann et al. 2006) They identify many methods which can be used during the design process, from survey, literature review to prototyping.

The application of gaming simulation as tool in the design process for market models is the scientific topic of this thesis.

1.3 Scope

Preferred market model as starting point

The starting point for the scope for the gaming simulation is the scope of the study towards the preferred market model. This means that the scope for the gaming simulation will be limited to the public charging infrastructure for electric transport. Privately owned charging sockets as in houses or offices are out of scope. This study provides insight into the roles, responsibilities and processes of a market model. Though business cases during the game might be needed as incentives or achievable goals for the participants, this is not the focus of the study towards a market model. The game is focused on the pre-charging, charging and post-charging processes as identified in the process model in the '*Study market model charging infrastructure for electric transportation'* provided by Accenture. The process model is enclosed in appendix E. The supporting processes are out of scope.

Energy related markets and conceptual design phase

The project is further demarcated in section 2.4, because the case study approach and involved interview experts limit the generalisibility of the case study. Therefore, the topic to be evaluated has to be specific. The scope of this thesis is therefore limited to the evaluation of the contribution of gaming simulation to the *high level design phase of energy related market models*. This demarcation is explained in section 2.4.

1.4 Research Questions

The previous section covers the problem description and scope. This section introduces the research questions and design objectives of this thesis. The design objectives are related to the design of the market model game for the charging infrastructure; E-City 2020. This game is used as evaluation tool for the research questions on the contribution of gaming simulation.

1.4.1 Research questions

The main research question is:

1. ***What is the contribution of using gaming simulations for designing market models in the energy related sector?***
2. ***What recommendations can be made for game designing in uncertain circumstances such as the creation of a market model for a practically non-existing market?***

The main research questions are answered by describing a market model framework and its challenges and gaps used during market model design. Thereafter a role for gaming simulation is identified. The novel E-CITY 2020 simulation game is developed to examine the contribution of gaming simulation to market model design for Dutch energy related markets. By reflecting on the design process the second research question is answered.

1.4.2 Main Design Objective

Accenture's desire is to have a tool or intervention that enables relevant stakeholders understand the proposed market model and identify follow up steps and requirements to make this market model work. At the same time this gaming simulation is used as case study to evaluate the contribution of gaming simulation to the design process of market models (research question 1).
Therefore, the main design objective of the thesis is:

Design, construct, test and evaluate a simulation game to:

1. ***bring relevant market parties together and help them understand the interactions of the proposed market model for the electric vehicle charging infrastructure in order to develop follow up steps and requirements to make this market model work.***
2. ***evaluate the contribution of gaming simulation to market model design in energy related markets***

To accomplish the main design objective a simulation game is constructed and tested using the five steps design process of Wenzler (Wenzler 1997), which contains the following steps:

1. Determine the specifications for the gaming simulation
2. Develop a conceptual map of the preferential model
3. Transform the conceptual model into gaming elements
4. Build and test the game
5. Implement and evaluate

The next section will provide the research approach that is used for this thesis.

1.5 RESEARCH APPROACH

This section describes the research approach that is used for this thesis. The section starts in 1.5.1 with describing the scientific paradigm in which this research is performed. Secondly, subsection 1.5.2 provides the research method for this thesis. Section 1.5 concludes by unfolding the research instruments that are used.

1.5.1 Philosophy of design science

Research must be viewed through a certain set of glasses called a 'paradigm'. A paradigm is in short an entire scientific outlook – a very general set of philosophical shared assumption, beliefs and values - giving

important implications on how the world is perceived. A paradigm unites scientific communities and allows normal science to take place (Okasha 2002). A paradigm is used to describe thought patterns in any scientific discipline or epistemology. One example of a classic paradigm is the analytical science, which is the place of experimental research in laboratories (hard approach) (Klabbers 2006). Another example is the more soft interpretive approach in which actors and decision-making plays an important role.

The scientific field considered for this research is a fundamentally problem solving paradigm called: Design Science research. Design science comes from the field of engineering and concentrates on changing existing systems. *"Design science is active with respect to technology, engaging in the creation of technological artefacts that impact people and organizations. Its focus is on problem solving but often takes a simplistic view of the people and the organizational contexts in which designed artefacts must function.* (Hevner, March et al. 2004)

Gaming simulations are experiential learning environments that contain actors, rules and resources. There is not only communication between actors, but also linked to technical and material processes mimicking a system's resource flows (Kriz 2003). The fact that interaction in simulation games has a central role makes them interesting to create insights into the interaction between parties and the results of this interaction on the market. These characteristics of gaming simulation fit perfectly in this design science field and therefore this thesis places, like Klabbers, the gaming simulation approach in the design sciences. (Klabbers 2006)

1.5.2 Research framework

This section covers the research framework that is used to answer the questions in this thesis. The research and design objectives need a structure to deal with challenges. Therefore a research framework is constructed to provide structure to the thesis and process of this research project. The method is based on a framework for Information Systems (IS) in combination with a design method for gaming simulation design.

Research framework Part I; Information Systems Framework

The research framework for this thesis is based on a framework for Information Systems (IS) research by Hevner (2004). There are two reasons for using this framework. The first reason is that this is a design science framework and research in the issue-driven science of design approach puts the emphasis on the usability of the gaming simulation. This means that gaming simulations in the design approach are studied with the aim of supporting and evaluating their development and use in practical context (Kriz and Hense 2006). This is exactly what this thesis project is aimed at; to design a gaming simulation that creates more knowledge on the business need from Accenture (environment) on the one hand and to deliver a scientific contribution to the field of gaming simulation (knowledge base) on the other hand. The IS framework is designed to deal with both of these problems.

Second, the field of IS research is at the convergence of people, organizations and technology. Developing a gaming simulation for a market model engages in these fields as well; many organizations have to reach agreements in a complex market with technical-economic complexities.
For these reasons, the approach for this research perfectly matches the framework for the design of an information system. The paper and design framework of Henver (2004) is therefore consulted to help to structure, conduct and evaluate this design-science research.

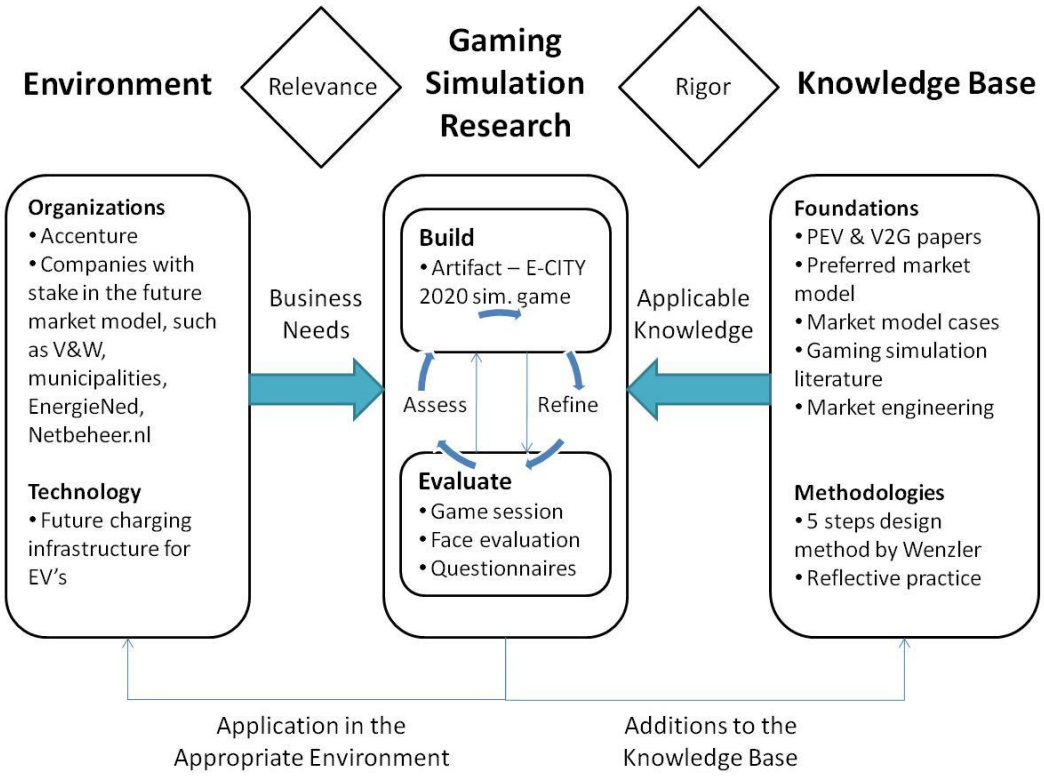

Figure 1.5 Part I of the research framework adapted from Henvers' (2004) Information Systems Research Framework.

First the framework, which is depicted in figure 1.5, is briefly introduced. For the sake of good understanding, it is important to realize that design is a verb and a noun which stands for respectively a process (set of activities) and a product (artefact). (Hevner, March et al. 2004) The design process is a sequence of activities that will lead to an artefact. The artefact can then be evaluated to provide feedback for better understanding of the problem and to improve both the process and the artefact.

Environment & Business Needs

The environment defines the problem space which is composed of people, processes, organizations and technologies. It contains problems, goals and opportunities that define business needs of the clients. Defining the environment will recover the game specifications. Framing research activities to address business needs assures the *relevance* of the project. *(Hevner, March et al. 2004, pp.7)*

Knowledge Base

The knowledge is composed of both foundations and methodologies. Foundations contain reference materials from the for the research relevant disciplines such as frameworks, models and theories.
Methodologies provide guidelines for the building and evaluation of the game, such as data gathering methods or evaluation tools. The correct application of existing foundations and methodologies is called *Rigor.*

It is very important that the artefact is solving the relevant and existing problem; so to say that is it applied to the correct environment. Furthermore, design science research addresses unsolved problems in unique or innovative ways. It should contribute something to the knowledge base. (Hevner, March et al. 2004)

Gaming Simulation Research

Design science addresses research through the building and evaluation of artefacts designed to meet the identified business needs. (Hevner, March et al. 2004) The artefact of this thesis is a gaming simulation.

Research framework Part II; Game design method

The design of the gaming simulation in this thesis is structured along the *'five steps design process'* of Wenzler (1997). This design process is based on the design process by Duke and helps to manage a game design project. The five steps are 1) development of design specification; 2) system analysis; 3) transformation of conceptual model into a gaming simulation model 4) development of the prototype; and 5) development and implementation of final product (Wenzler 1997).

The construction and testing of the gaming simulation can identify weaknesses or misunderstandings of the conceptual model. Building and testing the artefact is therefore performed in iteration cycles of building and refinement.

Overview integrated research framework

Figure 1.6 presents the integrated research framework which is the combination of IS framework the iterative game design method. It depicts the research method and points out which research questions or which design steps are performed and or answered in which phase. In phase 1 the analysis is performed. In this phase the knowledge base is created and the conceptual model of the game design problem is developed. In Phase II, through a number of iterations, the conceptual model is transformed into a game. Phase III contains the evaluation. In phase III, the gaming simulation is played and evaluated. Also the hypotheses on the contribution of gaming simulation to the market model design process are evaluated and added to the knowledge base.

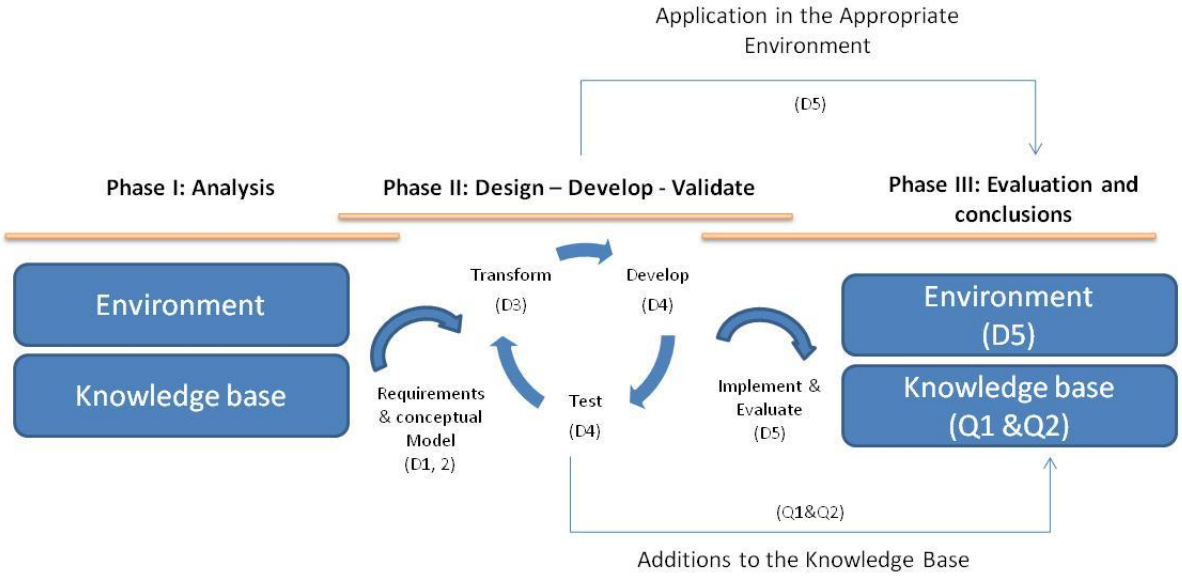

Figure 1.6 Research Method (The Q's and D's refer to the corresponding research questions and design steps.)

1.5.3 Research Instruments

Research instruments help to conduct research during the research steps as defined in the former chapter. This thesis will use four different research instruments; desk research, workshop, interviews and case study.

Desk research

Desk research, also known as secondary research, involves the summary, collation and/or synthesis of existing research. It differs from primary research, where data is collected from, for example, research subjects or experiments (Crouch and Housden 2003). Phase I will predominantly be based on literature review and expert interviews. This has forms the knowledge bases as explained in the former chapter. The knowledge base consists of literature from the field of gaming simulation, cases from the field of market model design and interviews with experts on market model design from Accenture and the Delft University of Technology.

Interviews

Interviews are a rather efficient way to recover knowledge from field experts and are therefore used in this thesis. The interviews are predominantly qualitative. Qualitative interviewing is based on conversation with the emphasis on the researcher asking questions. These interviews tend to be more constructionist, since it will help the researcher construct a point of view on a certain topic (Holstein 2001).

Workshops

Workshops are an elementary part of the gaming simulation design process. Workshops are held with relevant people from within Accenture and the client. They are used to validate and create knowledge during the design steps. Every design step in the game design process contains at least one workshop to check whether the deliverables are in line with the expectations and to create a better fundament for the game.

Simulation Game as Case Study

A case study focuses on a single project. This is not a formal experiment, because it is not possible to have a formal experiment without replication (Kitchenham, Pickard et al. 1995). Case studies can be used for different purposes: to provide description, test theory or generate theory (Eisenhardt 1989).
Case studies typically combine data collection methods such as interviews, questionnaires, and observations, which can be qualitative and / or quantitative (Eisenhardt 1989). These methods are used according the reflective practice in this thesis as well to evaluate the game. Behaviour is observed during the game play, a group debriefing is held after the game and questionnaires are taken before and after the intervention to obtain participants' knowledge.

In this thesis the simulation gaming case study is used to evaluate hypotheses on the contribution of gaming simulation to the design process of market models, because case studies help to evaluate benefits of tools and methods in a cost effective way (Kitchenham, Pickard et al. 1995).

However, there are also disadvantages to case study research. Case studies are harder to interpret and generalizability of the results is rather low (Kitchenham, Pickard et al. 1995; Yin 2003). It is possible to evaluate the technique in a typical situation, but it is not possible to generalize it to every situation. Although case studies cannot achieve the scientific rigor of formal experiments that are replicable, they can help you judge on the applicability of the gaming simulation in market model design (Kitchenham, Pickard et al. 1995). This is taken into account in setting up the case study.

1.6 THESIS OUTLINE

This chapter has introduced the problem, research questions and approach. The structure of the rest of the thesis is presented in figure 1.7. The study contains the following:

- An analysis of market models and the different forms they come in is performed. Moreover, based on the interviews, a market model framework is constructed. The market model design phases I and II of the framework has been zoomed in on and finally the research is scoped further. The results are described in chapter 2.
- An analysis of the challenges in market model design, the current methods used for market model design has been performed. The gaps in the current methods with regard to requirements are identified. Furthermore, a literature review on gaming simulation has been performed and the characteristics of gaming simulation have been matched to the gaps. This has resulted in expected contributions of gaming simulation to market model design. The results are described in chapter 3.
- The expectations for the contribution of gaming simulation are transformed into hypothesis to be tested by the simulation game on the charging infrastructure electric transport. The set-up of the simulation game case study and the developed E-CITY 2020 are the topic of chapter 4.
- The results of the play session of E-CITY 2020 are described in chapter 5. Also the meaning of the observations, debriefing and questionnaires results on the hypothesis is evaluated.
- The results of the research are discussed. Also reflections have been made on the development of the E-CITY 2020 game. These are described in chapter 6.

Based on the findings and results in this research final conclusions and recommendations for further research and game development are provided in chapter 7.

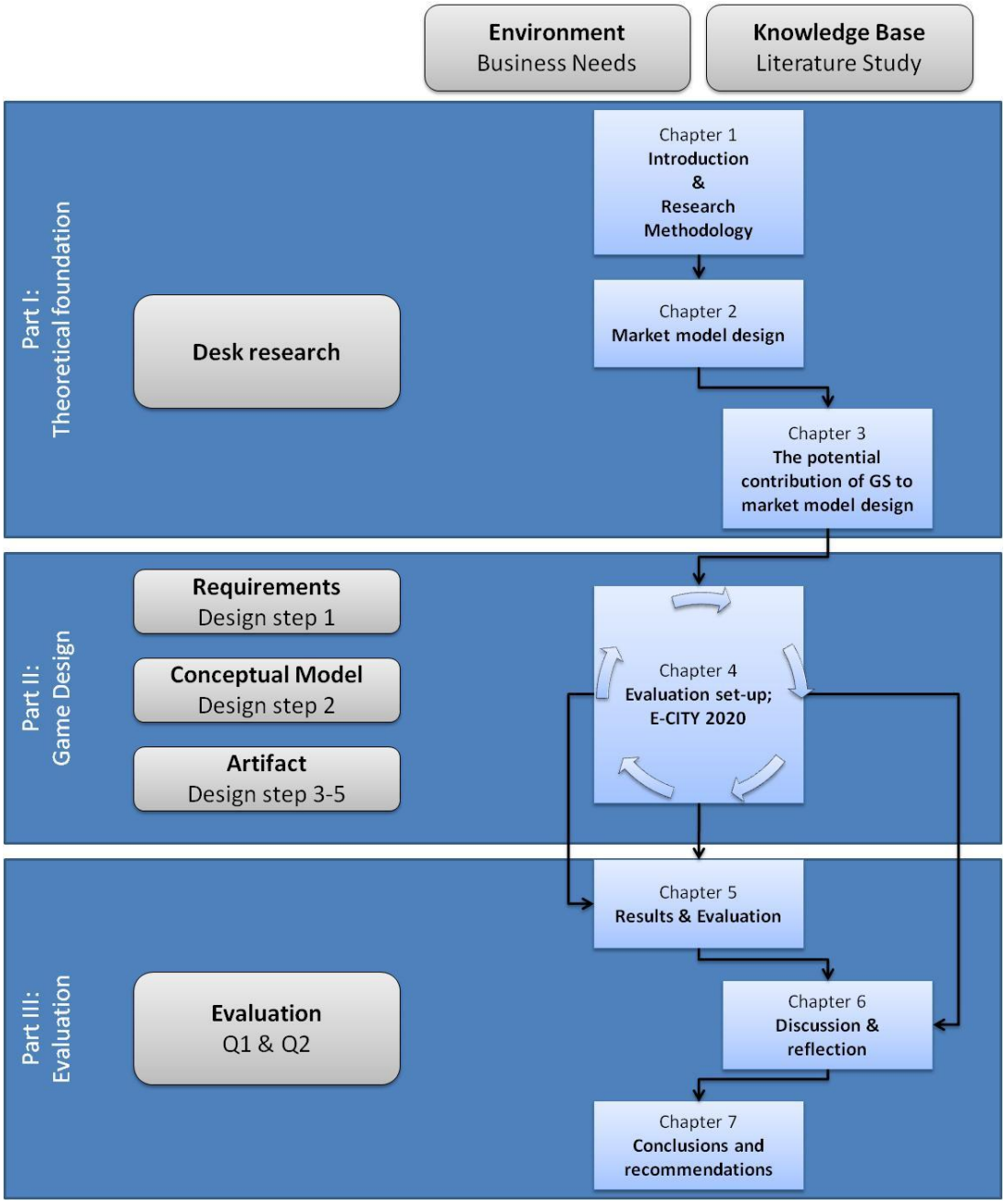

Figure 1.7 Thesis structure

CHAPTER 2 - MARKET MODEL DESIGN

Chapter Structure

A market model is facilitative to the market and contains agreements on market roles, responsibilities and processes to facilitate coordination. It sets preconditions under which a market can function given objectives. The term market model is generic and often confused with business models for example. Therefore this chapter first elaborates in section 2.2 on what is defined as a market model before moving on to the description of the market model design process in section 2.3. Finally, in section 2.4 the scope is narrowed down by analysing in which phase of the design process the market model for charging infrastructure is proceeding at the moment. Chapter 2 starts with describing the interview approach that is used to describe market model design.

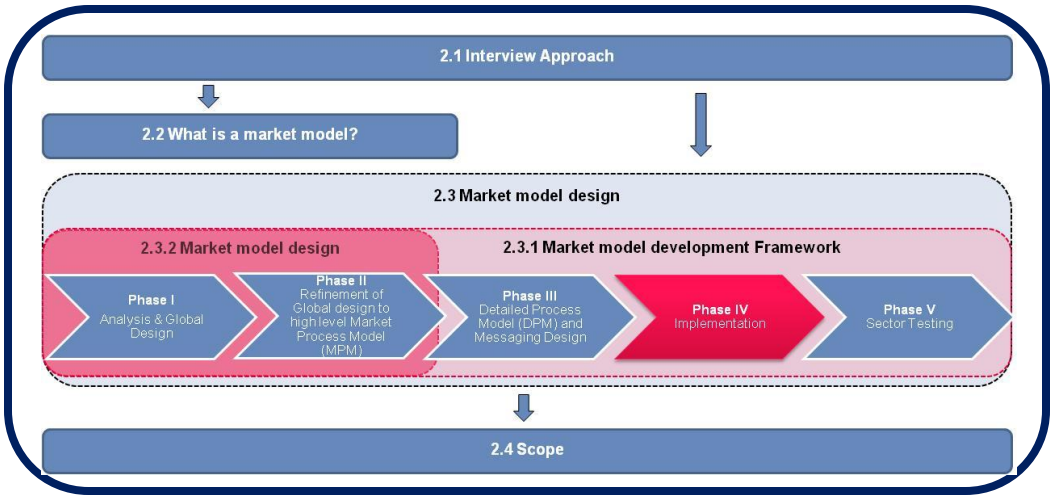

Figure 2.1 Chapter Structure

2.1 INTERVIEW APPROACH

Since there is not much literature on market model design, the available literature is complemented with knowledge from expert interviews. Eight experts on market model design are interviewed to reconstruct the definition of a market model is and its development process.

3 purposes

The market model framework is constructed for three purposes:

1. To find out how market models are developed.
2. To identify the phase in which market model design for the charging infrastructure in the Netherlands is at the moment.
3. To identify challenges and requirements to methods used in this phase.

Restricted group of interviewees

Eight people from Accenture, UC Partners and the TU Delft have been interviewed. These experts are carefully selected based on their back ground and experience. Most experts have been involved in market model design after the liberalization of the Dutch energy market in 2003-2005. Their background is included in the interview summaries in appendix A. Also interviews have been held with experts in communication and high-tech, financial and products markets to identify the role and design of market models in that

sectors. However, the interviews with a financial expert and an interview with a senior expert on products have been ended premature and were not included in this final research, since they could not clearly vision market models in their sectors as later in this thesis is discussed.

Still, the number of interviewees is confined to a small group, because the purpose of this research is not to perform extensive research to a market model design framework. Though, it has to be noted that the experts who have been interviewed are having lots of experience with market model development in the Dutch energy market. Fens (Interviewee number 7, Appendix A) for example, has ten years of both pragmatic and scientific experience in the energy market and has researched the entire implementation process of market models in the Dutch energy sector after the liberalization.

Chapter aim

The purpose of this chapter is not to identify a perfect design framework, but to asses methods and challenges to which gaming simulation can provide a valuable contribution. For the research purpose, the results based on the experience of the experts in former market development trajectories are regarded sufficient to find challenges on which gaming simulation can contribute.

Qualitative interviews

The interviews are constructed of qualitative questions and have an adaptive character. The interviews are adaptive in the way that output from interviews was directly processed and has been used as input to give direction to following interviews. An adaptive approach is used in order to test improvements or changes made to the design process framework and to guide the interview to recover lacking information.

Interview construction

The introduction for the interview respondents consisted of a suggested definition of market models and an interpretation of the market model design framework based on desk research to market model design. No specific framework for market model design has been found in the literature. However, Weinhardt has constructed a Market Engineering framework for constructing electronic markets (Weinhardt, Holtmann et al. 2003). His framework in which he identifies process steps and methods and tools that can be used is the basis for the introductory framework as proposed to the interviewees. The interview set-up as used can be found in appendix A.

Interview validation

To be sure that the respondents are understood and interpreted in the right way, they were asked to validate an interview summary and a suggested market model development framework. The interview summaries can be found in appendix A.

2.2 What is a market model?

For the sake of the rest of the thesis, this section describes and clarifies what a market model is. The term market model is generic and open for more than one interpretation. The term market model as considered in this thesis should not be confused with a business model or business case. A business model is based on a market model. Market players develop their own business models and services in which a business model describes the different elements of their business operation and the corresponding revenue and cost models (Marques 2010). Market parties can operate their specific business models, because there is a market which is shaped by market model agreements on aspects such as roles, responsibilities and processes.

2.2.1 Description of a market model

Roles, responsibilities and processes

A market only exists if there are suppliers and buyers. To facilitate the market there should be coordination on how market parties operate and communicate with each other and the customer. This is the function of a market model, which contains preconditions under which a market can function given the objectives for

certain market (Interview 3, 5). It therefore describes market roles, responsibilities of the different market roles and the interactions between roles and processes (such as commodity, service, money or information exchange) (Marques 2010). The market model tries to remove barriers which might be in place between roles, inter-organizational processes, data and messaging for the sake of the development of well-functioning liquid markets and proper provision of customer services (Interview 1,4) (Eurelectric 2007). The market model does not determine how profit is made, but it determines and defines roles and responsibilities (Accenture 2010).

Market models are anchored by law & legislation, sector wide agreements, bilateral contracts between market parties and behaviour of market parties (Interview 1,2,3,5) (Accenture 2010). This all happens under certain regulation and economic market forces (Marques 2010). Depending on national characteristics, technical specifications and objectives of the market, agreements are made on what domains should be regulated by law and what is left to agreements between market parties their selves.

2.2.2 Different types of market models

All markets do have a market model, but there can be large differences between market models. Technical specifications of the current infrastructure and national regulatory environment will largely determine the form of the market model (Marques 2010).

Free markets

Sectors which are dominated by free markets such as the fast moving consumer goods will not have much explicit regulation which defines roles and processes, otherwise it would not be a free market. However, even free markets need some agreements on aspects such as decision rights, property rights, competition policy, guarantees, liability, and safety norms etcetera. These agreements will mostly arise by an organic process in which market parties have stakes to develop roles in order to support their businesses (Interview 7). These agreements are called 'implicit *organically emerged market models'* (Interview 6, 7).

Critical infrastructure markets

Sectors with public functions that are supporting or safeguarding public values, such as the water or energy sector, have mostly been regulated governmental owned sectors in the past. Governments use the term critical infrastructure for these sectors to describe assets that are essential for the functioning of a society and economy. These sectors that had to start up new markets due to liberalization and privatization trends (e.g. liberalization of the energy, post, telecom or healthcare markets) of last decades will mostly result in markets with more '*explicit highly regulated market models'.* This is also the case when new infrastructural markets have to be created due to the introduction of disruptive new technologies which is the case with the Electric Vehicle charging infrastructure at the moment. In this case it is important to establish and arrange which parties will or should take up which roles (Interview 6).

2.3 Market model Design

Developing a market model from a trigger to final implementation is a very long process. The design part is just an element of the wider development framework towards implementation. To give a wider context of market model development than just design, this section will start in subsection 2.3.1 by providing an overview of the overall from start to tail framework for market model development (Phase I-V).
From subsection 2.3.2 onwards this thesis

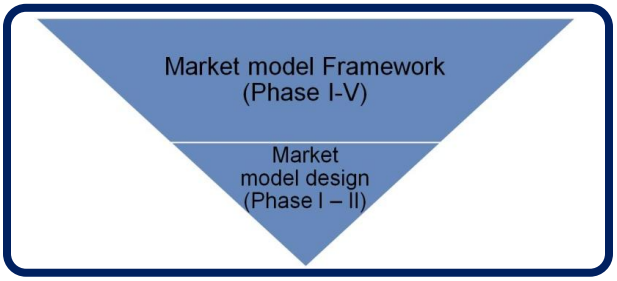

Figure 2.2 Structure used in this section to narrow down the topic from the complete framework to the design phases.

focuses on the design phases (Phase I & II) which are labelled as '*market model design'*. The section structure is indicated in figure 2.2.

2.3.1 Describing the market model development framework

As stated in section 2.1, the market model framework is constructed for three purposes:

1. To find out how market models are developed
2. To identify the phase in which the market model for the charging infrastructure in the Netherlands is proceeding at the moment
3. To identify challenges and requirements to methods used in this phase

Market model development framework

Section 2.1 also describes how the framework is constructed. Picture 2.3 sketches the end-to-end development framework for a new market model. On the left side the triggers for developing a new market model can be found. On the right side the output is a tested and implemented market model.

Iterative process

A few important notes on the framework are explained before the design phases are described in more detail. First, the development process is depicted as a linear process for the sake of clarity of the picture. Though it should be noted that market model development is a very iterative process and is continuous under refinement (Interview 1, 3, and 7). The iterative character is indicated by the circular flow on the background in the framework.

Technological and institutional environment

Second, the development of a market model for a critical infrastructure market, such as the energy market, is related to the development of technology and institutions. Following Hodgson we may, without doing much violence to the relevant literature, define institutions as "*systems of established and prevalent social rules that structure social interaction*. *Language, money, law, systems of weights and measures, firms are thus all institutions*" (Hodgson 2006: pp. 2). Institutions shape the behaviour of individuals and groups which are pursuing their individual or joint interest and goals. Institutions come in different forms from the level of slow changing institutions of social embedding where culture and traditions are located to the fast changing level of contracts and resource allocation by incentives (Williamson 1998). Williamson is clearly explaining the different forms of institutions in his paper *'The institutions of governance'*. The Institutional environment in this framework is mainly referring to formal institutions as political rulemaking such as law and regulation.

The interaction between market model development and institutions is the result of public interests related to the infrastructure, such as the principle for universal access and the risk on natural monopolies. Therefore the development process is depicted under continuous interaction with its institutional and (infrastructural) technological environment.

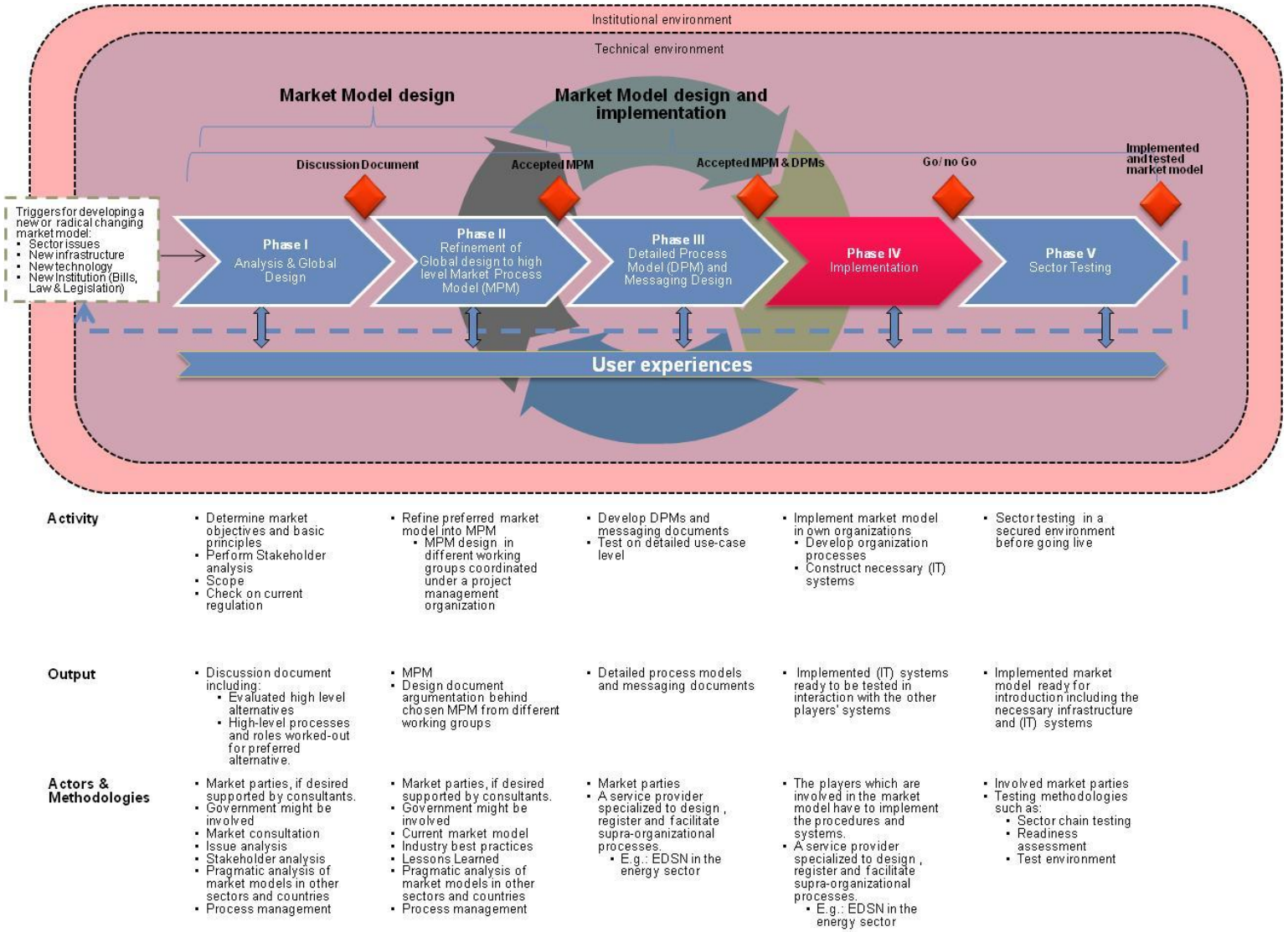

Figure 2.3 Market model development framework (Phase IV is pink, because this phase takes place within organizations themselves while the other phases are dominated by supra- and inter-organizational activities)

Two parallel flows

Third, there are two parallel flows depicted indicating that a market model is shaped by two concurrent development flows which are influencing each other. The upper flow which is divided into six development phases depicts the design and test pathway of a market model. Under each phase activities, outputs, involved actors and methodologies used are depicted to give an idea of the activities in that particular phase.
The second path is one of discovery by experiences of first mover customers or pilots. Experiences of current electric vehicle owners are an example of this group (Interview 3). This flow is about user experiences. For example the fact that a user establishes the urgency for public road side charging infrastructure when he or she almost have tripped over a set of electric cables used for car charging. Or an electric vehicle driver who experienced blowing stops when charging his vehicle in his or her garage (interview 3).
Platforms might be organized to share user experiences with policy makers and designers. User experiences might lead to changes or improvements in the market model design, while at the same time market model progressions are influencing user experiences. In this way both flows together shape a market model.

Triggers for market model development

The framework for market model development is briefly described above, but what are the triggers for designing a new market model and what parties will be triggered to take initiative in market model design?

Institutional triggers

Starting with the institutional environment, changes in law or legislation can trigger the need for a new market model. The changes in law that that were the basis for the liberalization of regulated sectors are an example of a trigger from the institutional environment. However, not only changes in the institutional environment lead to new market model design, but since market model development happens in the context of a regulatory regime, changes in the market model sometimes also result into changes in law and regulation (Interview 1, 3, 7). It is therefore that one of the interviewees indicated that he experienced during his work in the energy sector that market supervisors and legislators are carefully listening to input from the sector as well (Interview 2). For example, sector agreements in the *'Stroomopwaarts'*[1] program, which is a program that has guided the development and implementation of new market models, such as the '*capaciteitstarief*' market model, in the Dutch energy sector last couple of years, have resulted in changes in law. (Interview 2)

Technological triggers

The second category of triggers stems from the technological environment. Progression in technology can be a trigger which asks for new market models. This is the case with electric transport in which new vehicle technology is asking for a new market for charging infrastructure. In this new market there are existing roles which are already participating in the current energy sector, such as the energy supplier and grid operator. At the same time there are new roles such as the charging spot operator which need to be in place with corresponding responsibilities in certain processes.

Initiators

Triggers alone do not immediately lead to market model design. There should be parties who get triggered and therefore take the initiative for developing a new market model. However in many cases there is a chicken-egg problem or there is no party authorized to empower a market model, leaving it open which parties will take initiative (Accenture 2010).

[1] The energy sector launched a comprehensive program to achieve a better functioning market model for the retail segment called 'Stroomopwaarts'. The program has a number of pillars to realise improvements, such as capacity tariff, supplier model, meter market model and more (Programmabureau Marktmodel 2009).

In the case of the electric transport sector there is a chicken-egg problem between the charging infrastructure and vehicle adoption, so who will pick-up the trigger and initiate the development of a market model?

The interviews have resulted in different possibilities. Initiative can be taken by governmental and market parties or both. Who will initiate the development of a market model depends on the trigger (Interviews 1,3,5,7):

- ***Market parties*** take initiative to develop a market model if they feel that new markets or technologies have an impact on their business performance. Market parties will have special interests if they see chances and opportunities to gain a competitive advantage for a new product or service market. In that case they might encounter the urgency for agreements or a dialog with the government (Interview 5). This has for example recently happened in the 3D television market, where market parties have taken the initiative to develop agreements on standards.

  It might also be the case that market parties or sectors need to lobby and start the dialog with the government to help them stimulate developments by subsidies or tax benefits.
- ***Governments*** take the initiative to formulate objectives for a new market model in order to start-up markets or change markets to achieve policy aims such as the Lisbon goals (Interview 7). The GSM market is an example that shows that in Europe the government had decided to take the lead in developing a standard (GSM) while in the US they had left this to the market which has resulted in different standards (Interview 5).
- ***Market parties and government*** also both can feel the urgency to develop a market model. In the case of the '*Stroom opwaarts'* program it were the ministry of economic affairs and current market parties who have initiated the improvement of the market model (Interview 1). This is also the case with electric transport at the moment. Both EnergieNed and NetBeheer Nederland are examples of parties who felt the urgency to start developing a market model with the purpose to be in lead (Interview 1).

When parties are triggered and have taken the initiative to start developing a new market model they should start with a high level analysis and design phase (Phase I-II), which is the topic of next subsection.

2.3.2 Market model design

Two phases

This section zooms in on the different steps of and the methods used during market model design (Phases I and II of the market model development framework) in order to give a more detailed view of what kind of activities have to be performed. Phases I and II contains different smaller steps which are depicted in the figure on 2.4. Phase I is divided into the four steps and phase II into three steps.

Phase I; Analysis and global design

Purpose

The purpose of phase I is to construct a vision on the market for a first version of a market model (VREG 2006).

Step I.A Analysis

The first step is an extensive analysis which lead to the definition of requirements for the market (Interview 5) (Weinhardt, Holtmann et al. 2003). Requirements are objectives, preconditions, criteria and constraints. Given the complexities it is important to pay attention to the technological and economic viewpoints and many involved parties when defining the purpose. Different requirements from technical and economic viewpoints may lead to different and often conflicting objectives (Weinhardt, Holtmann et al. 2003). An environmental analysis is therefore essential to understand which stakeholders are involved and to consider the different influences that arise from technical and physical architecture, potential user requirements, business constraints and economic objectives during this stage (Interview 5) (Weinhardt, Holtmann et al. 2003). The analysis also contains a pragmatic analysis of existing market models from other sectors and countries to identify parallels and possibilities.

In the analysis step it is also important to deduct design requirements such as performance criteria, evaluation criteria and constraints. Infrastructural sectors and networks are bearing the risk to result in natural monopolies. Furthermore, it is necessary to perform an analysis on whether there are critical functions or public interest that should be supported in order to determine whether market functioning is possible and under which preconditions such as regulation (Interview 5). In the case of electric transport one could think of load management or the economical settlement system for electricity supplies. It is therefore important to think about the influence and preconditions of the physical technical infrastructure when developing a market model.

Step I.B Develop alternative market models

Different market model studies show that the next step (I.B) in the design process is to develop alternative market models which are evaluated in the next phase (VREG 2006; Accenture 2010; Marques 2010). In this phase high level ideas for a market model are constructed, given the stated requirements in the first step.

Step I.C Evaluation of alternatives

In step I.C the alternatives are evaluated against the criteria as set in the analysis step. In the case of the study to the market model charging infrastructure by Accenture a steering group by EnergieNed and Netbeheer Nederland was formed. The steering group has subsequently evaluated the alternatives and decided on a preferred market model.

Step I.D Global design

The last step of the analysis and global design phase is to work out the preferred market model into a global design. Roles, responsibilities and processes are defined on a high level and published in a discussion document as kick-off for a dialog with relevant market parties.

Phase II; Refinement of global design to high level Market Process Model (MPM)

Purpose

The input for phase II is the discussion document with a global design of a new market model. This document is produced by a single or just a few stakeholders. A market model however should be accepted by all relevant stakeholders to be effective. It is therefore important to find a dialogue with other stakeholders to refine the market model and ultimo arrive at an accepted market model that is addressing all the issues (VREG 2006 : pp. 8; Accenture 2010).

Activities

Phase II is therefore aimed at discussing, refining, finding consensus and settling the developed market model. Recommendations from phase I are worked out in further detail and an activity plan and project structure should be established to continue to the implementation phase.
The first step is to present or communicate the discussion document to key stakeholders from the market in order to start-up interaction and refinement (VREG 2006: pp.26). Also a structure of work trajectories should be established. Steering and advice committees should be established to refine all market model elements. It important to ensure a multidisciplinary approach, because IT, system technical and financial analysis should be performed, both from a business economic and macroeconomic perspective (VREG 2006 : pp.95)

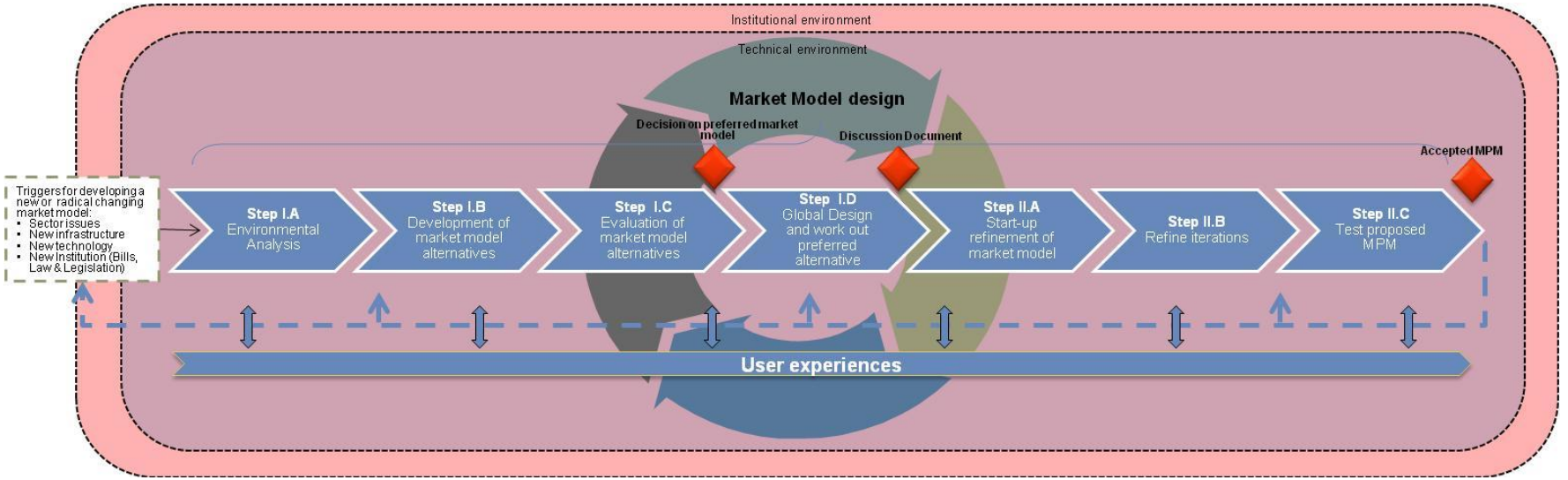

Figure 2.4 Market model design. Phase I and II are divided into multiple steps.

Methods

Purpose

The identification of used methods to design market models is included in the interviews with the purpose to identify the potential contribution of gaming simulation on capabilities that the current methods are lacking to deal with market model design challenges as described in the next chapter.

Conceptual and pragmatic

The most significant aspect of the current methods that many interviewees pointed out is the fact that market model design is a conceptual design process which is a very pragmatic activity based on many discussions (Interview 1, 3, 4). Market models are not designed using explicit scientific books, tools or theories, but are conceptually designed by involvement of many parties and workgroups. Important methods which are used are market consultation and pragmatic analysis of industry best practices and lessons learned from market models in other sectors and countries (Interview 1, 3, 4, 7). Weinhardt describes methods, such as survey, interview, SWOT analysis and literature review as methods for the comparable phase of his market engineering framework (Weinhardt, Holtmann et al. 2003; pp.2).

Traditional tools such as presentations

Traditional methods are used to communicate the output of phase I and to create support. The output of phase 1 is a discussion document which contains the vision and proposal for the preferred market model, sometimes accompanied by presentations to try to create support with the key stakeholders (VREG 2006: pp.26).

2.4 FINALIZING THE SCOPE

This chapter has elaborated on what a market model is and pointed out that market models can take different shapes for different types of market. It also discussed the market model framework and design phases. The interviews made clear that it is important to be concise on the type and scope of the market model that is dealt with in the thesis. This is also very important for the sake of time and the ability to generalize the results of the case study. It is therefore that this chapter concludes with further narrowing down the scope of this research by first setting boundaries on the type of market models addressed and second the phases of the market model design framework that are considered in the rest of this thesis. The revision of the scope of this thesis is based on the case study for this thesis which is a simulation game for the charging infrastructure electric transport.

2.4.1 Type of market model

Boundary 1; energy related markets

The study is scoped on two dimensions of the type of market model design; the type of market and the novelty of the market model to be designed. The first boundary is that the market model design framework considers the development process for a market model for an energy related critical infrastructure market such as the energy sector or electric transport sector. There are a few reasons to set the scope in this way. The first reason is that, as explained in section 2.2, critical infrastructure sectors normally have a more regulated market model than free e.g. fast moving consumer goods markets. The energy market is a relative highly regulated sector with many data flows and actors and in which many public interests are involved. The development of a market model in a free market is different, since there are less public interests, no infrastructural characteristics and therefore less central regulating forces and data and information exchange between actors. There are fewer hurdles on these topics that have to be explicitly anchored in a market model. These different characteristics make it difficult to generalize the results of the case study, which is about the charging infrastructure, to the market model design in free markets. Therefore market model design for free markets is not included in the scope. Furthermore, the development framework is largely based on interviews with experts from the energy field. It is therefore difficult to say whether this development process is valid for fast moving consumer goods markets as well.

More new market models in the energy sector are expected

The second argument for this scope is that the relevance of understanding market model design and the role of gaming simulation for this sector is high, because it is expected that due to new technologies and decentralization in the energy markets more new market models have to be developed in the near future (Interview 4).

Boundary 2; new market model design

The second dimension which many interview respondents mentioned as important to delineate concisely is the fact that the development process as discussed considers the development of a 'new' market model and not the refinement of small issues of an existing market model (interview 2, 3, 4). Design for 'new' market models is triggered by a disruptive change such as the liberalization of a sector or the introduction of new technology such as electric transport. The latter category of small issue refinement is a continuous process, since current market models are under continuous consideration for improvement (Interview 2, 3, 4). In the energy sector the EDSN (Energy Data Services Nederland) has a large role in issue refinement. The EDSN is a service provider specialized to design, register and facilitate supra-organizational processes in the energy sector (Energie Data Services Nederland 2010). The EDSN has issue clubs who meet on a monthly basis to discuss sector issues (Interview 2).

2.4.2 Market model design Phase II

Boundary 3; Phase II

The market model design framework contains the end-to-end development process of a market model. This thesis focuses on the role of gaming simulation in phase II and does not address the whole development framework for two reasons.

The first reason is that the high level design phase is a total different discipline than the detailed design of messaging codes and the implementation of IT systems. The development of a market model is a very long process, which consist of different disciplines. High level market model design is driven by conceptual thinking, while the latter part is driven by IT implementation. The IT design and implementation system is more the field of IT modelling than the field of gaming models.

The second reason for this delineation is that the development of the market model for electric vehicle charging infrastructure, which is the case study for this thesis, is currently proceeding in the market model design phase II. The design phase in which the market model design is proceeding at the moment determines the level of information, the type of game and therefore also sets constraints to the testability of the hypotheses.

The vision document by Accenture is the start for Phase II

The study performed by Accenture commissioned by the industry bodies EnergieNed and Netbeheer Nederland has resulted in a discussion document called 'kick-off for dialog'. This discussion document was the end of phase one as depicted in figure 2.3. The document contains the vision on the new market model for the charging infrastructure and the chosen preferred market model is worked out on a high level. This means that the development of this market model is in the beginning of the discussion and refinement phase (Phase II) of the market model design process. It is important in this phase to communicate the vision and preferred market model and to include relevant market parties. The next step is to further detail the processes, use knowledge and experiences from pilot projects and that the market model can be enhanced from a customer and market demand point of view. It is also important to participate in international forums to connect the Dutch market model with international agreements in other European countries.

2.4.3 Final scope

So the final scope for this thesis is the *market model design phase II* of market models for *non-existing or developing infrastructural* markets. In this phase there are no clear agreements yet. Consensus should be found by involving relevant stakeholders. It is about a market model that is game changing while there is a lack of information since the future market is still very uncertain.

The next chapter describes the indentified gaps in the current methods used for market model design and to opportunities for a contribution of gaming simulation to these gaps.

CHAPTER 3 - THE POTENTIAL CONTRIBUTION OF GAMING SIMULATION TO MARKET MODEL DESIGN

Chapter Structure

The potential contribution of gaming simulation is identified along the following approach. Section 3.1 describes the situation in and complexities of market model design. These complexities lead to certain challenges which are identified with the help of expert interviews and presented in section 3.2. In section 3.3 these challenges are converted to requirements that market model design poses on the design.

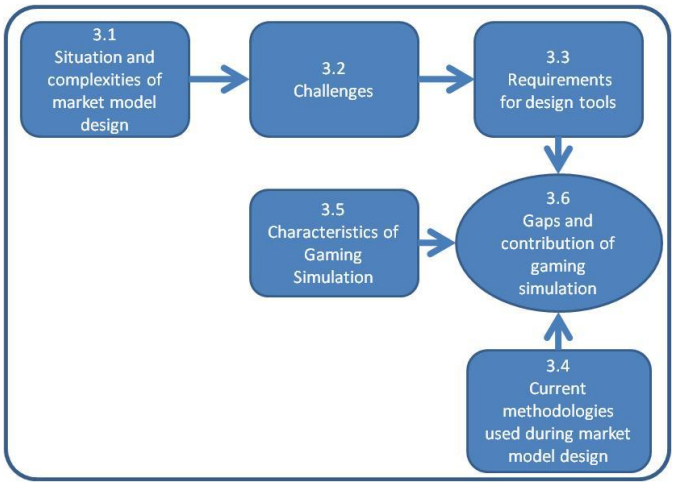

Figure 3.1 Research structure chapter three

Section 3.4 and section 3.5 respectively describe the current methods used in market model design and the characteristics of the gaming simulation method. Finally, section 3.6 presents the identified gaps. The current methods are contrasted against the requirements and analysed to which extend they fulfil these requirements. Based on the characteristics of gaming the possible contribution of this method to solve these gaps is presented in 3.6 as well.

3.1 Situation and Complexities of Market Model Design

Market model design for non-existing or developing markets like the charging infrastructure is a challenging process due to complexities in and uncertainties about the future market. This section describes the uncertainties and complexities related to market model design.

No clear agreements yet and uncertain future

Market model design for new markets is performed under many uncertainties due to two reasons; lack of information about the future and lack of agreements between market roles. The market model is game changing and there is no proven conceptual model yet. The market for charging infrastructure is currently practically non-existent. The development of the EV-market towards 2015 is very uncertain.

It is therefore very difficult to have an idea of what such a future market will look like and how it will develop. Furthermore, in this phase of market model design there are no clear agreements yet. Consensus can be found by involving relevant stakeholders.

Process dominated

Markets are complex structures in which different actors interact and can behave strategically. As elaborated before a market model describes the roles, responsibilities and processes of a complex systems in which the system performance is a result of, sometimes unexpected, tight interactions and interdependencies among stakeholders and technology. It is therefore that a market model, representing many processes, roles and challenges, is difficult to convey via a paper exercise.

Technical-economical complexity

Mayer (2009, pp.20) labels these systems dealing with complex policy problems, such as transportation, climate change or healthcare as complex socio-technical systems. These systems have two faces of complexity. The first form is the technical-economical complexity which stems from the emergent complexity among the physical-technical-economical entities within the market. Decisions may have far-reaching consequences in the long term.

Multi-actor complexity

The second form of complexity stems from the fact that these systems are placed in a multi-actor network context resulting in multi-actor or social-political complexity. This complexity is the result of strategic interaction between different actors with different stakes who are interdependent on each other in realizing their goals (Bruijn and Heuvelhof ten 1999; pp.15; Roth 1999). These complexities make it challenging to design a market model and therefore ask for tools that can deal with this complexity. The next section will discuss the challenges during market model designing.

3.2 Challenges in market model design

Stakeholder management is important

There are many market parties who are affected by the impact of a market model and therefore have a stake in the market model design. The development of a market model in the scoped phase -in which there are no clear agreements on the market model- asks for participation of all these parties to refine a market model concept in order to finally arrive at consensus on a market model that should be implemented. Such a setting in which a couple of actors having different stakes and who are dependent on each other with regard to their goals is called a network (Bruijn and Heuvelhof ten 1999: pp. 15). Realizing your goals in a network setting asks for managing relations, stakes, expectations and the process which can be called stakeholder management or process management.

6 challenges

This thesis does not cover all the process management aspects, but in line with the theory of using process management aspect to realize goals in networks almost all interview respondents have stipulated the challenging aspect of stakeholder or process management (Interview 1,2,3,4,6,7).
Since market design is a complex and therefore challenging process, the experts are asked to mention the most important challenges that they have experienced during market model design. This has resulted in the following list of challenges.

1. *The challenge to involve parties and to start-up interaction, because trust in the process and understanding of the impact is needed.*
   During the development of a market model for a practically non-existing market (e.g. electric transport) where parties coming from traditional different sectors will meet, it is very challenging to bring these parties together, start-up interaction and to let them trust each other (Interview 1, 4, 6).
   This is because on one hand they need to have trust in the process towards a market model to ensure that actors give their input and that they will be happy with the outcomes (Interview 4). One of the core values of a process design is therefore that parties should commit to the process rather than the results (Bruijn, Heuvelhof ten et al. 2002; pp.47).On the other hand they also need to understand each other on the content (which might be different in their traditional separated sectors). According to knowledge-based trust theorists one accumulates trust-relevant knowledge through experience with others (McKnight, Cummings et al. 1998).

2. *The challenge to manage different actors with different stakes and to let them gain the needed understanding in order to get trust in the proposed model, often resulting in long decision making processes.*
   Not every company or organization has the same structure and therefore organizations have their own preferences for and stakes in a certain market model. Actors will have their own ideas on what their role

in the market model should be (Interview 3, 7). Different stakes make it challenging to arrive at consensus and to ultimo arrive at an accepted market model.
Strong leadership is needed to align all interest. It is challenging and will cost a lot of effort and time to convince each other and to gather agreement for a market model option. The different actors should define solutions and problems in interaction in the form of 'negotiated knowledge'(Bruijn and Heuvelhof ten 1999; pp.130). The design process therefore might be rather long, but time is needed to gain trust and understanding. One cannot always force a quick solution without losing organizations' support (Interview 2).

3. *The challenge to communicate effectively to keep all actors involved and on the same information level.*
   It is not only challenging to involve actors, but also to keep the different actors involved. Therefore it is important to keep all parties up to date and on the same information level. Informing and communicating parties is important and challenging (Interview 2).

4. *The challenge to stay high level in this phase of the market model design process.*
   In this phase in which actors are getting used to each other and to the concepts the debate concentrates on the high level concepts of the market model. The risk is that actors who are everyday involved in detailed processes tend to go in too much detail in this phase already. It is important to let these actors gain confidence in the process and let them realize that experts and operational colleagues are going to design these detailed processes in follow up phases (Interview 2). A pragmatic design approach is desired which starts with designing the market model on high level without starting to design the detailed exceptions (Interview 3).

5. *The challenge to avoid complexity in the market model.*
   It is important to keep a market model as simple as possible. A simple market model will help to make a large group really understand the market model. An interviewee experienced during the 'Stroomopwaarts' program that there were only a few people left who understood the market model (Interview 2). A market model should be kept simple in its concept. It is challenging to try to minimize the amount of agreements. One should try to leave as much as possible to organizations themselves and to try to only set agreements on the content that are really needed to solve a certain design issue (Interview 4).

6. *The challenge to think from a customer's perspective.*
   There is only a market when there are customers and there are only customers when it is attractive for them to participate in the market. The new market services should fit into the everyday life. A service or a product will not be accepted if it does not fit with a customer's others systems and existing way of workings (Beyer and Holtzblatt 1998; pp.1). It is important that the market model is convenient from a customer's perspective. In the case of electric transport, the electric vehicle driver needs a good charging experience (Interview 3). However it is indicated that it is difficult for involved actors to think from other perspectives such as from a customer's perspective. Members of different communities cannot simply adopt the meanings of another (Boland and Tenkasi 1995; pp.362). Worlds with different funds of knowledge and systems of meaning cannot easily share ideas, and may view one another's central issues as esoteric (Boland and Tenkasi 1995; pp.351). Playing another or construct a god's eye view would help to anticipate how another perceives a phenomenon (Ackermann 1996; pp.25)

The next section will describes the approach and methodologies that are used during this phase in the market model design process.

3.3 REQUIREMENTS FOR MARKET MODEL DESIGN METHODS

The identified complexities of market model design and the forthcoming identified challenges result in requirements that market model design poses on tools and methods to deal with these challenges. This section lists and describes identified requirements to be fulfilled by a method to deal with the challenges of market model design.

1. *The method should facilitate in creating a sense of urgency with the stakeholders*
   The first step towards consensus between parties is to really get people on board to participate and commit to a process (Challenge 1). The first step of getting parties on board is already very challenging. This can be due to many individual aspects such as contradicting stakes, but the most important is that parties need to have a sense of urgency and know that there is something in it for them in order to be willing to participate (Bruijn, Heuvelhof ten et al. 1998).

2. *The method has to be attractive to help attract stakeholders for participation*
   A sense of urgency is very important to get people to commit themselves to a process (Challenge 1), but besides the importance of urgency, we believe that attractiveness of the form of intervention increases motivation and help bringing stakeholders together for a first time.

3. *The method should facilitate easy communication between many parties*
   If parties are involved it is important to keep them up to date and to keep them on the same information level to prevent parties to feel harmed in their core values which might lead to exiting the process. Therefore the methods should facilitate interventions and communication to many parties.

4. *The method should facilitate in creating a shared experience of the future*
   A lack of information on a practically non-existing market creates many uncertainties and a future which is hard to understand or imagine. The complex interaction between technologies and a multi-actor environment makes it difficult to experience what the future should bring. Due to the many uncertainties and lack of accurate predictions it is difficult to imagine a certain future and the risk is that participants will form different images of a possible future. This makes it hard to create a shared understanding among the participants or audience of a possible future. However, it is important to get a shared understanding of the future among stakeholders, since they have to arrive at consensus on a market model (challenge 2).

5. *The method should facilitate in the creation of understanding of the dynamics of a future market model in a situation with little information available which means:*
   - *Creation of understanding of the interdependencies between parties*
   - *Creation of understanding of the processes and (resource) flows of the market model*
   - *Creation of understanding of the roles and responsibilities*

   It is assumed that to avoid complexity in the market model (challenge 5), to stay high level (challenge 4) and to create trust into the proposed model (challenge 2), it is important for the stakeholders to have a shared understanding about the uncertain future and the proposed market model. The complex interaction between actors, flows, technology and economic entities should be clear. Understanding of the dynamics of a system is important to let parties experience problems or issues that have to be resolved to feel a sense of urgency to participate. Not understanding the dynamics of the market model makes it difficult to focus on the essential elements of the market model which prevents the market model agreements to be as simple as possible.
   However, there is an information problem, since there is little information available on how a future market for e.g. electric transport will look like in 2025. Therefore the methods used in the design process should deal with this information problem and help to create understanding on the processes, roles,

interaction, interdependencies and resulting dynamics of the market model without much information available.

6. *The method should facilitate in creating a safe experiential environment in which parties try to think from different perspectives*
   The problem here is that entities are self-interested and this makes it difficult to take distance from own stakes in the discussion and to think for example from an end-user perspective. It is difficult for humans to step out of their own role and imagine other entities perspectives. Therefore it is important that the method should create an environment in which stakeholders feel safe an trust each other (challenge 2) and are forced to think from other perspectives (challenge 6).

3.4 Current methods used

The identification of used methods to design market models is included in the interviews with the purpose to identify the potential contribution of gaming simulation on capabilities that the current methods are lacking to deal with the above described market model design challenges. In chapter two the design process is sketched already, this section will briefly recall the used methods and structure.

Conceptual and pragmatic

The most significant aspect of the current methods that many interviewees pointed out is the fact that market model design is a conceptual design process which is a very pragmatic activity based on many discussions (Interview 1, 3, 4). Market models are not designed using explicit scientific books, tools or theories, but are conceptually designed by involvement of many parties and workgroups. Important methods which are used are market consultation and pragmatic analysis of industry best practices and lessons learned from market models in other sectors and countries (Interview 1, 3, 4, 7). Weinhardt describes methods, such as survey, interview, SWOT analysis and literature review as methods for the comparable phase of his market engineering framework (Weinhardt, Holtmann et al. 2003; pp.2).

Traditional tools such as presentations

Traditional methods are used to communicate the output of phase I and to create support and understanding. The output of phase 1 is a discussion document which contains the vision and proposal for the preferred market model, sometimes accompanied by presentations to try to create support with the key stakeholders (VREG 2006: pp.26).

3.5 Gaming simulation

It is relevant to understand the concept of gaming simulation and its characteristics to pose expectations on the contributions of this methodology to market model design. This section therefore describes the characteristics of gaming simulation which makes this method powerful. The section first describes what gaming simulation is, then how simulation games work and finishes with describing limitations of simulation games.

3.5.1 Simulation games

Interactive

A widely accepted definition of gaming simulation is given by Mayer (2009; pp. 825) who defines gaming simulation as "*experimental, rule-based, interactive environments, where players learn by taking actions and by experiencing their effects through feed-back mechanisms that are deliberately built into and around the game. It is based on the assumption that the individual and social learning that emerges in the game can be transferred to the world outside the game.*"

Experiential learning environment

According to Wenzler simulations and games are *'experiential learning environments engaging decision makers in playing different roles, making real business decisions, and exploring possible future results of their actions'*. (Wenzler 2010; pp. 7)

Two levels of design

Depending on the nature of the problem at hand there are different types of simulation games that can be used, such as market simulation, policy simulation or a day-in-a-life simulation (Wenzler 2008). Though, from extremely simple abstract games to multi-day-multi-player games they all are meant for practicing a role and learning new insights through experimentation and feedback (Meijer 2009).
Klabbers (2006) for example used gaming simulation for many issues where changes in a social system had to be designed. Therefore he distinguished between two levels of design. He used gaming simulations that were a design-in-the-small of the real-world situation that should be 'designed-in the-large'(Klabbers 2006). *In a 'design-in-the-small', solutions, future situations or problems can be enacted and analysed, leading to a hypothesized possible solution for the design-in-the large* (Meijer 2009 : pp.29).

A typical gaming simulation problem

Finally Duke notes that the typical problem for gaming simulation is a very complex real world situation characterized by: many variables interacting, no realistic basis for quantification of variables, no proven conceptual model and a socio-political context of decision-making where actions may be irrational (Duke 1980 : pp.364). The main goal of simulation games is to "*simulate the actors' decision-making process and to demonstrate the consequences within social systems*" (Kriz 2003: pp.496). These simulations can be used for different purposes ranging from effective knowledge transfer to the means of knowledge creation about how markets are developing or about strategies or policies that should be pursued to drive high performance (Wenzler and Higgins 2009).

3.5.2 The active substance of gaming simulation

This subsection describes how gaming simulations work in order to determine how they can be of value to market model design.

Actors, rules and resources

Simulation games contain actors, rules and resources and therefore there is not only communication between actors, but also linked to technical and material processes mimicking a systems' resource flows (Kriz 2003). Interaction in simulation games has a central role, which makes them interesting to create insights into the interaction between parties and the results of this interaction on the market. In addition to other research methods such as traditional case studies, gaming simulation provides an interesting experimental environment for identifying strategic behaviour in complex systems. (Kuit, Mayer et al. 2005) Kuit et al. have for example used a gaming simulation for this purpose to identify potential strategic behaviour in a liberalizing electricity market.

GS is able to address complexities

Gaming simulation is therefore one of the few methods which make it possible to address the technical-economical and multi-actor complexity. Real people are part of a gaming simulation model, not as a digital agent, such as in agent based modelling, but as real players with stakes, tacit knowledge, emotions, intuitions and so on (Mayer 2009).

Active substance

But what are the components or '*active substance'* in gaming simulations that help people learn and create insights in these complex situations? According to Wenzler and Chartier (1999) gaming simulation is very effective in enabling learning, because of the following four things (Wenzler and Chartier 1999):

1. **Understanding the big picture**; Simulations games are a method for visualizing and identifying critical elements of a complex problem. It is possible to create a future and to help us to get the 'big picture' of the change journey and its results. At a higher level of abstraction and a comprehension of number of problems games helps us understand the future. The result is an increased ability to deal with *complexity*.

2. **Memories of the future**; Simulation games allow for the exploration of alternative possible futures and permit us to experience and therefore test future alternatives in a condensed time frame and in a safe setting. The results are not only new insights in value-creating opportunities, but also an increased ability to adapt to the changing environment.
3. **Shared intelligence**; It is widely accepted that teams and groups have a higher capacity for learning than individuals. Gaming simulations can bring people in the same room and create a learning environment where people share experiences. *Communication* between participants is also facilitated by having them in the same room talking about the same topic (Duke and Geurts 2004). Since gaming simulations provide an overview (higher abstraction) they also stimulate communication of the big picture. The result is shared understanding, shared experiences and shared formulation of the problem and possible solutions in a safe environment where it is rather easy to look beyond the borders of traditional perspectives helping find *consensus*.
4. **Confidence in being successful**; Commitment to action is gained from the possibility to successfully enact a future state. By enacting the future simulation games enable us to understand the impact of change and our ability to be successful, increasing the confidence in one's ability to adapt and be successful in the future. Understanding and confidence will in turn increase motivation and *commitment.*
5. **Creativity**; Another important aspect of gaming simulation that is not explicitly mentioned by Wenzler, but by his colleagues Duke and Geurts is the function of gaming simulation on *creativity.* The safe setting, repeated trial and error experimentation and the presence of diversity in roles help people to think outside of their normal environment and creating out-of-the-box ideas (Duke and Geurts 2004).

Positive effect of designing a game

So far the value of a learning and motivation of participation in a gaming session is discussed, but gaming simulation has another valuable active substance. Druckman and Ebner (2008) have evaluated the effect of the design of a gaming or simulation exercise even more positive than participating in a game. By experiments they showed that participants in designing the game were even more motivated and had a better understanding of the concept than the participants of the game only (Druckman and Ebner 2008).

By designing one learns about reality

Learning through designing a game is regarded high by gaming developers, since the designers are forced to think in a structured manner such as processes and roles. Probably the synthesis part, which is learning about the relationships between different abstract concepts, is the best learning element accomplished by the game design process. For design one "*needs to have systemic understanding – seeing the connections among roles, goals, resources, constraints and contingencies*" (Greenblatt 1998). All knowledge blocks should be integrated, because the game is a test. Furthermore, it is an iterative process from problem to conceptual model to a game in which there are many learning cycles. So by designing a game the designers creates system understanding via synthetic learning and by playing the game they participants learn experiential about scenarios, move boundaries and refine the model.

In short, gaming simulations are fun and are experiential learning environments that "*provide us with the opportunity to create better understanding and knowledge, communicate more effectively, and make better decisions" (Wenzler 2008).* They provide us with a satellite view and may trigger new questions that can be addressed for further research (Mayer 2009).

3.5.3 Limitations of gaming simulation

Limitations are in relation to objective and compared methods

There are also limitations to gaming, which will briefly be mentioned in this section. But what are limitations? Limitations have to be seen in relation to the objective that one would like to achieve and to be compared to other methods. Often gaming is compared to hard computer simulation. Mayer (2009) has listed some limitations of gaming compared to computer simulations for example. First, he sketches that analogue gaming simulations are usually laborious and have a limited number of participants. Playing with large numbers of players is unthinkable, the options to replay are scarce, the option to examine the long-term consequences of actions is unavailable (Mayer 2009). This has its consequences on the validity of the findings. A second disadvantage according to Mayer of especially low-tech games is that they can only

handle a limited cognitive load. Very abstract games dominated by social interaction fall short in a reality check. The players can come up with much negotiated none-sense. This risk can be reduced by combining it with computer simulations (Mayer 2009).
However, for this thesis the limitations have to be seen in relation to a traditional intervention such as a presentation or workshop to provide the market model information to stakeholders and to the following objectives of the intervention. The intervention should:

- Bring stakeholders together;
- Help the stakeholders understand the market model;
- And facilitates new learning about the market model

The limitations are discussed with Wenzler, a gaming expert from the field of large business gaming simulations. A discussion summary can be found in appendix B. He does not see many disadvantages of gaming, since he and other gaming experts as discussed in section 3.5 are convinced of the power of gaming simulation to facilitate learning. Wenzler however does see limitations of gaming simulation, but thinks that these are not coming from the intrinsic characteristics of the game itself but from:

- *The acceptation of the users;* A problem with gaming that can occur is the fact that a game is not always accepted by the users, because not everybody is willing to play. The reasons can differ, but sometimes gaming simulation is not regarded as a serious intervention. In other cases the problem is that a game is on a higher abstraction level than reality. Some players are not able to think on this level and therefore do not accept it as reality. Furthermore, gaming simulation is often claimed as a safe environment. This is true for the fact that it is an experiential environment in which nobody is harmed or is going bankrupt. However, it is not always experienced as a safe environment from a personal relations perspective. Some people are scared to experience losing face, especially in very hierarchal cultures.
- *Costs;* a gaming simulation is more effective in learning but often also more expensive to develop than a presentation, because developing takes longer. The perception of value is not always seen, especially if costs are a hard requirement. If 1500 people should be involved it is possible, but might be challenging and expensive to use gaming.
- *Time***;** to let people experience many elements in an hour is difficult. However, presenting many topics in an hour is possible but also hard to remember for the audience.

Applicability depends on problem

Furthermore, gaming simulation is used for complex problems that have to be modelled on a certain abstraction level, so not every problem is suited for gaming simulation. For some problems a detailed simulation or even pilot is necessary. In that case gaming simulation will not fit. So the limitations of gaming simulation depend on the type of problem and the aims.

The next section describes expectations on the contribution of gaming simulation to market model design.

3.6 Gaps in current approach to deal with the market model design challenges & the contribution of gaming simulation

This section describes the gaps between the requirements defined in section 3.3 and the methods of the current approach. The gaps are identified by interpreting to which extend the current approach can fulfil the requirements. The next step is to find a contribution for gaming simulation based on the just above described gaming simulation characteristics. Four main gaps are identified and are presented below.

1. **The current methods seem to lack the attractiveness to motivate parties for first participation**

Description of and reasons for gap

Requirement 1 and 2 are requirements to the method that helps to attract participants and involve them in the process.

Creating a sense of urgency should be created by a proper process design, which for example makes the new market model a problem or opportunity for the concerning parties. However, this is not a specific gap in the current approach or a contribution of gaming simulation.

Requirement 2 asks for an attractive method or intervention which is able to pull stakeholders over the line to participate for the first time. Stakeholders should also be motivated to participate.

It is expected by the author that a 'traditional' workshop or presentation does not sounds interesting enough to attract people in many cases. A presentation or workshop might be again just one of those millions that people are engaged with.

Contribution of Gaming simulation

A gaming simulation creates an experimental learning environment in which people interact in a possible future themselves, which is fun to play and therefore is expected to better differentiate from other workshops or events. This should create better motivation for people to get involved for the first time.

2. **The current methods have difficulties in creating a shared experience of a future market which practically not exist yet**

Description of and reasons for gap

Requirement four asks for a method that is facilitating in creating a shared experience of the future to deal with the lack of information about a future which is unknown and uncertain and therefore hard to understand or imagine. A traditional workshop or presentation might present a scenario, but asks for much imagination and empathy of the participants or audience. Due to the many uncertainties and lack of accurate predictions it is difficult to imagine a certain future and participants will form different images of this future. This makes it hard to create a shared understanding of for example a possible future for electric transport in 2025 among the participants or audience.

Contribution of Gaming simulation

Gaming simulation enables participants to experience a simplified future (memories of the future) in a game. During the gaming simulation all role players are actively involved and mastering the simulated challenges creating confidence and trust and thus resulting in action (Duke and Geurts 2004)

It is possible to let participants e.g. experience an abstract scenario in 2025, to focus on the processes and to solve the information problem gap. The shared experience that the participants will get in the simulation game can help create trust.

3. **The current methods have problems in letting stakeholders understand the market model, because they have difficulties in visualizing the dynamics of the interaction between roles**

Description of and reasons for gap

A market model is a complex system with many actors and processes of which the system result is different to predict due to unexpected behaviour between stakeholders and / or between entities and technology. A workshop or presentation lacks the capability to let people easily understand the dynamics of such a complex system of processes and interactions in a network. Interactions among actors in which strategic behaviour and irrational behaviour can play a role are difficult to understand via a paper exercise like a workshop, expert discussion or presentation. People should experience it. The result of having a clear system overview is that working group sessions tend to get bogged down in detailed arguing and decay into discussions on the exceptions. This makes it hard to develop a market model at a high-level.

Contribution of Gaming simulation

Gaming Simulation is better able to present a complex real life system in a simplified model, which helps entities to understand the big picture and to see the most important issues which will have impact on their market and business. It allows even for experiencing the dynamics of the market model which makes it easier to grasp the dynamics of the market model. Gaming simulation can therefore help people to understand the interdependencies between roles, by learning of actions and from the results of actions of certain roles. Furthermore, compared with traditional classroom learning, simulations help participants master content and new behaviours 40-70 % faster (Wenzler and Higgins 2009).

The result, a better understanding on a more abstract level, might stimulate the involved entities to keep the discussion on a high level (Challenge 4). By letting players experience possible futures it helps them to see the essential issues of a market model. Understanding the essentials enables people to focus on the essence which might result in fewer and simpler agreement (challenge 5).

4. **The current methods lack the capability to move or even push stakeholders into other perspectives and roles**

Description of and reasons for gap

Requirement six is asking for a safe experiential environment which pushes or even enforces participants to think from other perspectives. The current methods are not enabling actively to let participants step into other roles to think from different perspectives. Members of different communities cannot simply adopt the meanings of another (Boland and Tenkasi 1995; pp.362). Worlds with different funds of knowledge and systems of meaning cannot easily share ideas, and may view one another's central issues as esoteric (Boland and Tenkasi 1995; pp.351). Playing another or construct a god's eye view would help to anticipate how another perceives a phenomenon (Ackermann 1996; pp.25)

Contribution of Gaming simulation

Gaming simulation helps to prevent accepting and pushing the first option that comes to mind (mostly one constructed from a self owned perspective) and helps to safely experience other roles and perspectives and experiment with new (out-of-the) box ideas (Duke and Geurts 2004). Since gaming simulation contain actors, people can play different roles and since interaction plays a central role, players will experience the other views in interaction between parties in a condensed time frame in the game.

3.7 CONCLUSIONS

Analyzing the market model design challenges and methods resulted in the following gaps:

1. The current methods seem to lack the attractiveness to motivate parties for first participation.
2. The current methods have difficulties in creating a shared experience of a future market which practically not exist yet.
3. The current methods have problems in letting stakeholders understand the market model, because they have difficulties in visualizing the dynamics of the interaction between roles.
4. The current methods lack the capability to move or even push stakeholders into other perspectives and roles.

The analysis of the characteristics of gaming simulation resulted in statements on expected value of gaming simulations to these gaps in market model design. It is expected, that gaming simulation can better convey the message of the preferred market model and create support with the key stakeholders compared to presentations and workshops, which are currently used to disseminate the preferred market model. This is mainly due to the fact that:

- A gaming simulation creates an experimental learning environment in which people interact in a possible future themselves, which is fun to play.
- Gaming simulation enables participants to experience a simplified future (memories of the future) in a game. During the gaming simulation all role players are actively involved and mastering the simulated challenges creating confidence and trust resulting in interaction and action (Duke and Geurts 2004).
- Gaming Simulation is better able to present a complex real life system in a simplified model which helps entities to understand the big picture and to see the most important issues which will have impact on their market and business. It allows even for experiencing the dynamics of the market model which makes it easier to grasp the dynamics of the market model.
- Gaming simulation helps to prevent accepting and pushing the first option that comes to mind (mostly one originating from a self owned perspective) and helps to safely experience other roles and perspectives and experiment with new (out-of-the) box ideas (Duke and Geurts 2004).

CHAPTER 4 - EVALUATION SET UP: E-CITY 2020

Chapter structure

In the previous chapter a gap analysis is performed to identify opportunities for a contribution of gaming simulation in the process of market model development. A simulation game on the charging infrastructure is developed to evaluate the contributions. This chapter describes the set-up of the evaluation in order to evaluate the identified potential contribution of gaming simulation by simulation game case study. To evaluate the identified contribution by a gaming simulation case study, the identified potential contribution is first converted to workable hypotheses and functional requirements that these hypotheses pose on the case study in section 4.1. Section 4.2 then describes the evaluation set up. The case study evaluation consists of two parts: evaluation during the design of the game and evaluation of the gaming session. Section 4.3 describes the specifications for the simulation game. Section 4.4 describes the developed simulation game on the Dutch charging infrastructure for electric transport called E-CITY 2020. The chapter finishes with a conclusive summary.

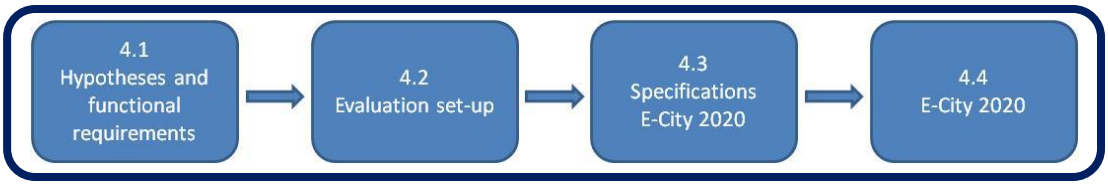

Figure 4.1 Chapter structure

4.1 HYPOTHESISES AND FUNCTIONAL REQUIREMENTS

Elements of a hypothesis

To better evaluate the contribution of gaming simulation the identified contributions in the previous chapter are transformed into a hypothesis. For a working hypothesis it is important to start defining the effect you expect the method will have. The definition must be detailed enough to make clear what measurements are needed to demonstrate the effect (Kitchenham, Pickard et al. 1995 : pp.55). This is necessary to identify, measure and collect the data needed to evaluate the effect. The needed data to evaluate the hypothesis and the characteristics of the case study determine whether it is possible to demonstrate the effect.

The market model context analysis has resulted on four gaps and potential contributions for gaming simulation. Together with the fact that gaming simulation is a method that might be beneficial to the designers and participants, theses identified contributions are transferred into four hypotheses which are described below. It should be clear what measurements or information is needed to be able to evaluate the hypotheses. Therefore, under every hypothesis its required information and requirements to the intervention are described.

1. Gaming simulation helps the participants to experience and therefore understand the interactions and dynamics of a market model from different perspectives

To evaluate this hypothesis it should be possible to identify increased understanding of dynamics and interactions of the participants. Furthermore, it must be able to identify that the gaming simulation helps the participants to understand the different roles and customer needs. Therefore:

- The game must be playable;
- The knowledge level on the future market model of the participant before the intervention must be known;
- The knowledge level on the future market model after the intervention must be known;
- The participants perception of customer's needs before playing the game must be known;
- The participants perception of the customer's needs after playing the game must become clear
- The game must increase understanding of the participant on the processes and interaction between roles.
- The game must increase understanding of the participant on the different roles of the market model.

2. Gaming simulation design increases the level of understanding on the market model of the designers

Measurement on the following criteria should be performed: amount of new insights and issues in the proposed market model gained during the design of the game. This should be measured during designing the game.

3. Gaming simulation helps to create a shared understanding among the participants of a possible future for the market model

To evaluate the hypothesis, information should be collected on the understanding of the future market model by the participants before, during and after the intervention. Therefore, the intervention should meet the following functional requirements:

- The game must be playable;
- Expectations and views of the participants on the future market model before the intervention must be known;
- Ideas and views of the participants on the future market model after the intervention must be known;

4. A simulation game is a better tool to motivate people to bring them together for a first meeting compared to traditional presentations or workshops

The hypothesis asks for data on the attractiveness of a simulation measured both before the intervention as well after the intervention.
Therefore, to evaluate this hypothesis the case study should meet the following functional requirements:

- The game must be playable;
- The perceived attractiveness of the gaming simulation compared to a presentation before playing the game must be known;
- The perceived value of the simulation game after playing must be known.

Overview of functional requirements

- The game must be playable
- The perceived attractiveness of the gaming simulation compared to a presentation before playing the game must be known
- The perceived value of the simulation game after playing must be known
- The knowledge level on the future market model of the participants before the intervention must be known
- The knowledge level on the future market model of the participants after the intervention must be known
- The game must increase understanding of the participant on the processes and interaction between roles
- Expectations and views of the participants on the future market model before the intervention must be known;
- Ideas and views of the participants on the future market model after the intervention must be known;
- The participant's perception of customer's needs before playing the game must be known
- The participant's perception of the customer's needs after playing the game must be known

The next subsection describes the set-up for the case study experiments to evaluate the hypotheses.

4.2 Set up case study: two evaluation experiments

The objective of the case study is to evaluate the hypotheses on the contribution of gaming to market model design as described in the former section. The hypotheses are evaluated on the basis of a single case study. It is, like action research, a dominated qualitative evaluation to identify elements of contribution. It is not a reproducible research. This set limitations to the generalisability of the result, so reflection is necessary.

The case study consists of two evaluation experiments:

- An evaluation of the contribution of gaming *during* designing of the game in order to evaluate hypothesis five.
- An evaluation of the gaming intervention

4.2.1 Evaluation of the contribution during game design

To evaluate whether designing a game increases understanding, new insights gained by the involved experts during game design should be considered. During the game design process workshops are kept regularly to set the requirements, to construct and validate the system model, to transform the system model into game elements and finally to develop and play test the game prototype.
New insights are predominantly expected during the construction of the conceptual system model and the construction of the gaming elements. The involved experts are interviewed when game design is finished to decide whether the experts have gained new insights.

4.2.2 Evaluation of the gaming intervention

There are different ways to capture information from the gaming intervention, such as observing, filming, (group) evaluating, interviewing participants or obtaining response to questionnaires from the participants. The requirements as described in section 4.1 ask for a measurement before, during and after the intervention. It is therefore that a combination of two evaluation methods is used: questionnaires and verbal group evaluation which is also camera recorded to review the evaluation.

To understand how the evaluation methods are used it is important to understand the elements of a gaming intervention. An intervention consists of three main parts: the introduction, the game and the evaluation (see figure 4.3). Furthermore, figure 4.2 presents the different elements of a gaming session.

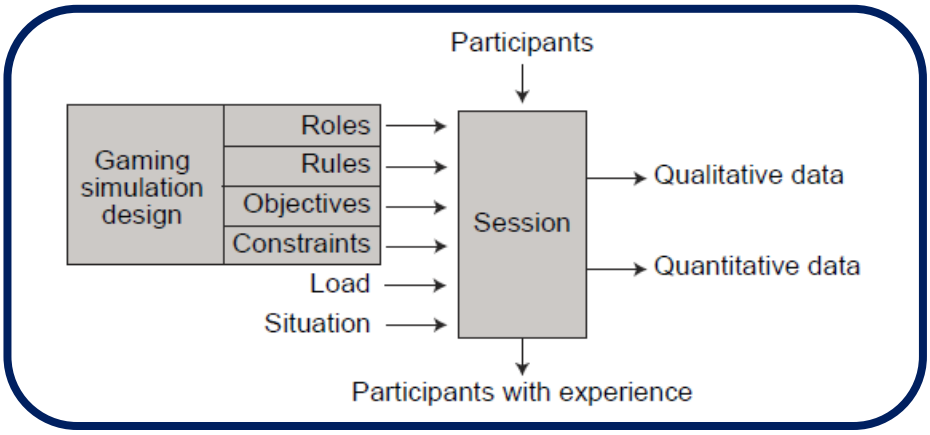

Figure 4.2 Inputs and outputs of a gaming session. (Meijer 2009 ; pp.27)

Questionnaires

So how and for what are the questionnaires used? The questionnaires are used to compare the experience of the participants after the game with the level of knowledge of the participants before playing the game. They are also used to collect general information, such as existing knowledge and background of the participants. In order to do this, the participants are asked to first fill in a questionnaire before the intervention starts and again when the intervention is finished.
The questionnaire as used is included in appendix G. The questions are clustered in four categories related to the hypotheses: attractiveness, knowledge, customer requirements and trust in electric transport and provider market model.

Camera recorded group evaluation

Furthermore, an effective verbal group debriefing and discussion is performed to determine learning points and new market model insights that are gained during the game. The debriefing is recorded by a camera which enabled the author of this thesis to look back upon the debriefing content. Figure 4.3 gives an overview of the evaluation methods used. The debriefing is structured around the objectives of the game. First, discussions are triggered to let the players work off steam. Questions used are e.g..; how did it go? And what were your strategies? When they have released their energy, discussions were triggered on the roles and responsibilities, processes and interaction and information requirements. Trigger questions are used to trigger discussion if the participants do not start discussing on a substantive level by themselves, such as: Did you understand what the customer wanted? What were your responsibilities? Did you think they are logical? What went well and what not in the game? How did your realization of charging spots processes worked out? Did you have the required information? Or which information would you like to have from other participants? Are there elements that should be refined or worked out to get this market

model working? These questions were used to identify market model bottlenecks which have to be refined further.

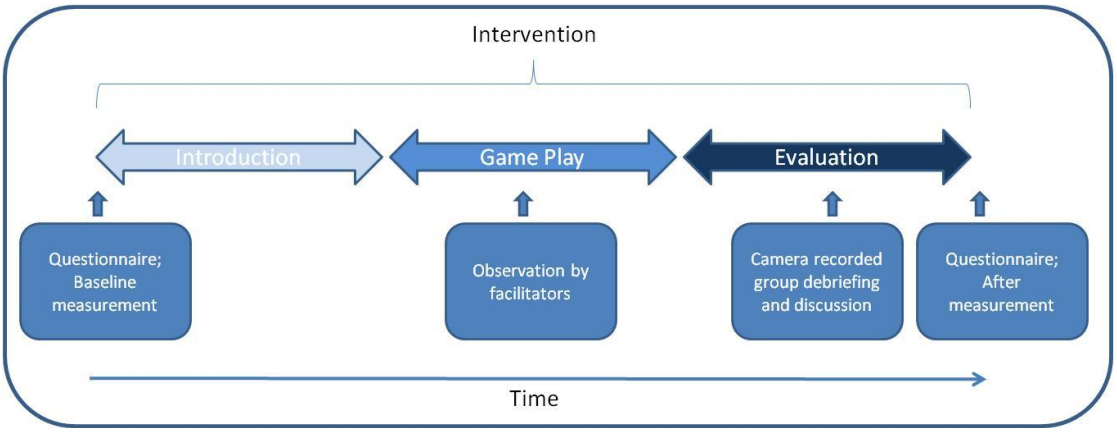

Figure 4.3 Overview of intervention and evaluation methods and moments

Now both evaluation experiments are described, the next section describes the game that is developed for the case study.

4.3 E-CITY 2020 SPECIFICATIONS AND DESIGN CHOICES

Client

The developed game is called E-CITY 2020. The gaming simulation is developed together with Rutger Deenen and Ivo Wenzler from the gaming simulation department of Accenture. Deenen and Wenzler are experts in the development of gaming simulations with a focus in the corporate world and with a transformational change purpose.
The client of the game during the development was the Accenture Strategy department represented by Paul Ubbink and Maarten Noom who have developed the preferred market model for the electric transport charging infrastructure. They are ever since involved in many electric transport studies and pilots. The preferred market model as proposed in '*Study market model charging infrastructure for electric transportation; a kick-off for dialog'* is the starting point of the developed gaming simulation.

Section structure

The purpose of this section is to give an overview of the specifications to the game and present the major design choices that are made. Section 4.4 then describes E-CITY 2020.

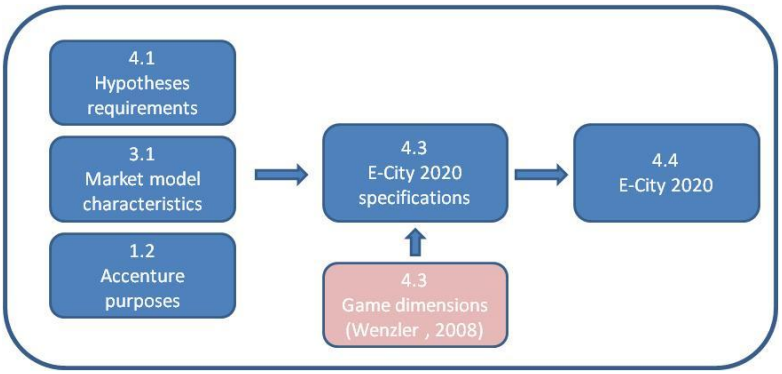

Figure 4.4 Section Structure

4.3.1 Type of game: Game specifications

The dimensions of Wenzler

The requirements of the hypotheses in combination with the business purpose of Accenture and the market model characteristics have shaped the specification (figure 4.4). The specifications are presented along the game dimensions of Wenzler which are depicted in table 1. Wenzler has developed these dimensions as a guide to gaming simulation development and to describe the elements that make a game work (Wenzler 2008). Each simulation game has four basic components which each are made of four dimensions. To cover all elements of a gaming simulation, the subsection is structured along the four basic components: context, participants, process and environment.

Table 4.1 Game specifications for E-CITY 2020 structured along gaming dimensions of Wenzler (2008a).

Component	Dimension	Specification
Context	*Problem*	It is difficult to understand the interactions of a complex market model from a paper exercise. The problem is still ambiguous and not well understood.
	Purpose	The game should therefore create a safe learning environment in which market parties come together, learn to understand the roles, responsibilities and processes of the preferred market model and create requirements for success for further market model refinement.
	Model	The main roles and processes of the conceptual model should be translated in the gaming simulation; simulation of key relationships.
	Story	The story of the game should be rather realistic on a medium abstraction level.
Participants	*Target*	The gaming simulation should be adjustable to groups which different level of foreknowledge.
	Level in organisation	The gaming simulation should fit people with some affinity with electric transport, but who do not understand yet what the market model is.
	Roles	The participants (min 4 – max. 8) should take up different roles. They should understand the customer needs.
	Culture	No specific requirement
Process	*Sequence*	The game should simulates a condensed time frame and should be playable in about 3 hours
	Interaction	The participants should experience dependencies and information conditions between different roles and should have degrees of freedom to give direction to the interaction
	Steps	There should be iterations in which the participants can reflect upon different events.
	Indicators	The indicators should be both quantitative and qualitative.
Environment	*Location*	The participants should play the game together at the same location.
	Place	The participants should be physically together.
	Material	The game material should be easily portable.
	Representation	The materials used in the gaming simulations should have a realistic abstraction level of representation.

In the remainder of this subsection all the dimensions will briefly be described what they are, why they are defined like this and how this has affected the game.

A. Context

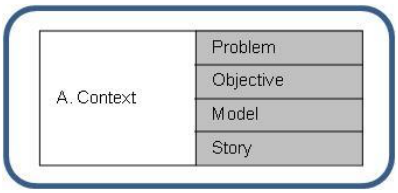

Figure 4.5 Dimensions within the context component.

Context is the first basic component which is the combination of the nature of the problem, the objective that should be achieved, the nature of the model, which is the basis for the game and the nature of the story that will be told. (Wenzler 2008; pp.44). The wider context of electric transportation and the charging infrastructure is already shortly introduced in chapter one. A more extensive background on electric transportation, the charging infrastructure market, its challenges and the preferred market model is provided in the introduction and appendix C.

Problem

Difficult to visualize the future

There are still many uncertainties around the new market for charging infrastructure with regard to technology, (customer) needs and institutions. The market is difficult to imagine, because the market for future charging infrastructure is not similar to the current market for fuel-stations. Where the current fuel market brings much flexibility due to the availability of a wide network of fuel stations where you can fill up your car within 5 minutes, this is differs for electricity. Charging and battery technology do not allow for this manner of refuelling. Recharging of a car's battery for instance is taking longer.

Challenging to let parties understand the dynamics of the new market model

The market model is designed at a high-level, which leaves room for different processes such as different request possibilities. The proposed preferred market model also contains three main new roles for this market: the provider, charge spot operator and the charge spot owner. These roles will be further introduced under roles. Though many uncertainties are present, the challenge now is to let many parties understand the roles, responsibilities, processes and resulting dynamics of the proposed market model in order to further develop the market model and start up the market for charging infrastructure. By making use of a gaming simulation it is possible to eliminate some uncertainties by creating a future scenario. This will help to bring the future market model alive and help people understand the new roles and processes.

Objectives

Purpose

The starting point for this game is that the provider model as proposed in the study by Accenture is the basis for the future reality that is created in the game. The purpose of the game is to bring relevant market parties together and help them understand the interactions of the proposed market model for the electric vehicle charging infrastructure from different perspectives (knowledge transfer) in order to develop follow up steps and requirements to make this market model work (knowledge creation). As the hypothesis has stated it is also important that the game helps the relevant parties to increase their understanding of the customer's needs.

Learning objectives

To realize the purposes learning objectives are formulated. A revision of blooms taxonomy is used to help formulate and structure the learning objectives (Anderson and Krathwohl 2001). According to this taxonomy for learning objectives human thinking skills can be broken down into six categories: remembering, understanding, applying, analysing, evaluating and creating. Asking people to think at higher levels, than just recall is an excellent way to stimulate thought processes. Gaming simulation and an effective evaluation of the game can help to reach these higher learning objectives. After playing this game the players should be able to:

1. Evaluate the roles and responsibilities of the different parties in the preferred market model as well as their decision criteria and restrictions;
2. Evaluate the charging infrastructure processes as defined in the preferred market model;
3. Evaluate the interactions between the parties that have a role within the preferred market model;
4. Develop the requirements for success and evaluate options and alternatives in processes for implementing this market model, from the perspectives of different parties that have a role in the preferred market model.

The learning objectives are accomplished by letting the participants experience the different aspects during the game play followed by an extensive debriefing and group evaluation.

Model

New market roles are central

The main roles and processes of the conceptual market model should be translated into the game to accomplish the set learning objectives. Since, there are many different roles it is decided to start designing the game by giving the new market roles a central role in the game.

Story

Medium abstraction level

Most people do not understand the new market model yet or have another opinion. This market is different from the current transportation market and therefore needs some imagination. Having some realism in the story will help the players understand this future market model. Too abstract will not fit the purpose, while a very detailed story on messaging of processes will not be viable due to the lack of information. As a result the story for the game should be rather realistic and on a medium abstraction level; simulation of key relationships.

B. Participants

The second basic component of games contains the dimensions related to the participants of the game. The participants can be defined in terms of the targeted players of the game, the organizational level of the players, the nature of the roles they will be playing and finally the organizational culture of the players.

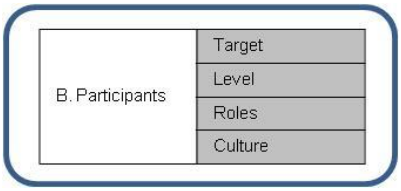

Figure 4.6 Dimensions within the participants component

Target

The game should bring stakeholders from different sectors together, such as:

- Grid operators;
- Utilities;
- Municipalities;
- Governments;
- Leasing companies;
- Market parties or government in other countries such as Belgium;

The game should therefore fit and be adjustable to groups with different levels of foreknowledge.

Level of organization

Business development employees

The delegated employees from the likely involved parties are expected to be business development employees who will have some knowledge of electric transport and maybe even on the preferred market model, but might still have difficulties to understand the market model. The gaming simulation is therefore aimed at people with some affinity with electric transport, but who have limited knowledge yet of what the market model is.

Roles

Different perspectives

One of the hypotheses is that participants are pushed to think from different perspectives. The participants (min 4 – max. 20) should therefore act different roles. They should amongst others understand the customer needs. Since, it is a practically non-existing market, the market roles are not assigned to or taken up by market parties yet. Participants can play different roles including roles that might be further away from their core business. For example, a participant from a grid operator can play the role of operator or customer. This will help to think from different perspectives.

Culture

Small Cultural differences

Local government actors might have a different organizational culture than those of leasing companies for example. However, these differences are expected to be small, so no big cultural issues are expected.

C. Process

The third basic component is the process and can be defined in terms of the sequence of the game, the interaction between players, the steps within the game and finally the nature of the style of the game and its performance indicators.

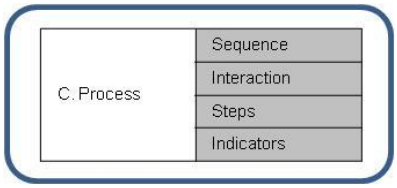

Figure 4.7 Dimensions within the process component

Sequence

The participants should experience the dynamics of the charging infrastructure market in the future. To provide feedback of their decisions, the game should simulate concentrated time. The game should be playable in about 2-4 hours, in order to easily take the simulation to clients.

Interaction

Experience dependencies

The participants should experience dependencies and information conditions between different roles. Since the exact processes are not determined yet and the players are allowed to discover possibilities, the game should have a rather open format in which the participants have degrees of freedom in organizing their processes and interaction. The rules and messages should shape their behaviour.

Steps

Iterations

To help evaluate the market model it is important the players can learn and adjust. Therefore, the game should have iterations in which the participants can reflect upon different events. This will enable them to learn from the previous round and adjust their strategies in the following round.

Indicators

Both quantitative and qualitative indicators

Quantitative indicators are needed to incentivize these actions by the players. The players have to find out which information they need from who and when. They also find out the preconditions that have to be fulfilled in order to realize the next elements of a charge spot. However, since little information about the future market is available, some general concepts should be introduced in a qualitative way, because they are hard to quantify. The indicators should therefore in the end be both quantitative and qualitative. The simulation game is dominated by information flows.

D. Environment

The fourth and final basic component of a gaming simulation is the environment. This component is the most practical one and is defined in terms of the location of the game, characteristics of the place, material and the level of realism in the presentation of the materials.

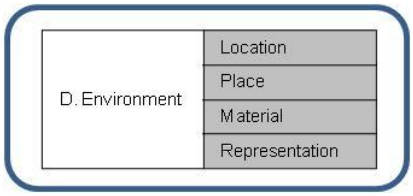

Figure 4.8 Dimensions within the Environment component

Location

Single location

Parties should come together to experience and evaluate the preferred market model together in order to create mutual trust and to start up interaction. Therefore they should be together at one single location at the same time.

Place

Physically together

As described above the location should be a location where players are physically together in a room, such as a conference room.

Material

Easy transportable

To involve many different stakeholders multiple sessions on different locations are expected to be held. The game material therefore should be easy to transport.

Representation

Realistic representation

It is difficult to imagine the future market for electric transport. To help visualize the future it would help if the game materials are rather realistic. Therefore, the materials used in the gaming simulations should have a rather realistic abstraction level of representation. The materials used in the game are between realistic and symbolic. Constructing a charge spot is of course not feasible within a game. Therefore, key elements that have to be completed in order to realize an active charge spot, such as applying for a government license, applying for a connection, contracting an energy supplier, should be represented by symbolic versions. This could be comparable to the idea of collecting wood and iron in Settlers of Catan for example.

This section described the specifications to E-CITY. The next section will describe design choices that are made to make a realistic, meaningful but also playable game.

4.3.2 Major Design Choices

This sub-subsection describes major design choices that have been made. Harteveld et al. have described the dilemmas and trilemmas that a game designer is facing when designing a game. Dilemmas and trilemmas arise between the play, meaning and reality. Play concerns the playability of the game, meaning concerns the purposes and reality reflects the degree of correspondence with the real world (Harteveld, Guimaraes et al. 2010). Sometimes, a designer for example should give up some degree of realness to improve the playability of the game, this is called a dilemma between the core design components play and reality.

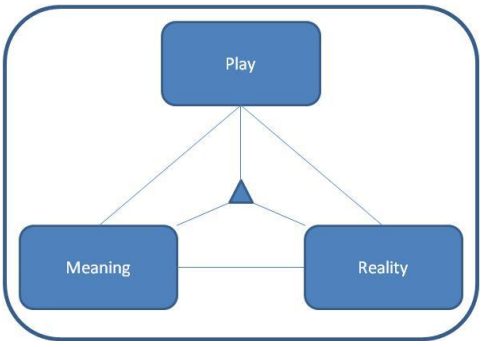

Figure 4.9 Design components according to (Harteveld, Guimaraes et al. 2010)

These trade-offs in design choices have to be made to make a game that is meaningful, realistic to a certain degree and which is also fun to play. Below major design choices for E-CITY 2020 and its impact on validity are discussed.

Roles

Focus on new market roles

With regard to the roles for the preferred market model, some major choices have been made in order to make a playable game within the given time. First, the focus has been put on the new market roles: the provider and Charge Spot Operator (CSO). The grid operator, energy supplier and local government are facilitated roles with few simplified action possibilities. It is decided to simplify exactly these roles since the starting point of the preferred market model, as concluded by an extensive market consultation, was to connect the new market model as much as possible to the current energy market. One of the preferences of the model is for example not to modify the current tariff structure for electricity transportation (Accenture 2010; pp.33).

Measure and program responsible not included

Secondly, the measuring responsible and program responsible parties are not included and the charge spot owner is presented as a charge spot installer which installs charge spots on a lease contract basis. Especially the last simplification is not necessarily in correspondence with reality, but the choice has been made to leave out the chicken-egg discussion on investment in infrastructure in order to stick to the meaning and focus of this game which is the market model and not the investment issues.

No business parties, just market roles

A third design choice is the fact that the game only simulates roles of the market model and does not allow for business organizations. This means that there are no consolidated or vertical integrated parties included from the start, but the game is fairly free format, so parties are not forbidden to integrate or cooperate. This is not completely in line with reality, but this enables the interaction between provider and CSO explicitly which is the purpose of the game. However, by making this decision the clearing & settlement process is less relevant in this game, which left out an important discussion point for further refinement of the market model.

Customer is simulated

A fourth simplification for the sake of playability is the simulation of the customer by the computer model. A request for charge spot by the customer himself is therefore not included in the game, while this might be interesting to find out further requirements on this aspect as well. However, the customer was chosen to be simulated, since the market demand is the trigger for actions and decisions by the players.

Simple customer segmentation

Finally, segmentation of customers is very simply included in the game. There is only a differentiation between private and business, which is not very realistic. More segmentation has to be included, however, this has no large impact on the validity of the game. Customer segmentation is not the purpose of the game and is only introduced to make differentiation for the parties possible in order to create competition.

Processes

Focus on pre-charge processes

The preferred market model classifies the processes into four categories; Pre-Charge, Charge, Post-Charge and secondary support processes. For the sake of time and playability not all processes are included. It is first decided not to include the secondary support processes, but start with the processes related to the central new market roles. When developing the conceptual model, it appeared to be unclear how the realization of the charge spot would work out. Therefore the game is focused on the pre-charge processes such as charge spot requests, realization and access contracting. The charge-processes, such as identification of customer, battery charging and measuring consumption are on a different time scale and therefore highly simplified in the game. The identification of a customer when charging is included by a computer model check, whether the customer is able to charge based on contract terms.

Furthermore, Post-Charge processes, such as billing, paying and settlement is taken into account by the computer model which provides feedback on income cost and other key performance indicators (KPIs).

The post-charge processes should be put actively in the game

The simplification of the post-charge process is reducing the value of the game, since all the interaction, and therefore active experience and learning on these processes, has been taken out of the game. While at the same time, payment and especially settlement between integrated parties will be important issues in the preferred market model. It is therefore highly recommended to include the post-charge processes actively in the next version of E-CITY 2020; which means that players have to pay each other and have to make agreements on payment terms.

Technology

Fast and slow charging only

As described in the introduction of this thesis there is still much uncertainty on the technology for this new market. Different technological possibilities for charging can be found in appendix C. Since the market model is related to its technological environment, the decisions on technology are discussed as well. First, a decision has been made to only include two technologies: fast and slow charging.

No Charge-Steering included

Another important design choice that is made is the fact that charge steering and Vehicle-to-Grid (V2G) is not included in the game. Charge steering is a great opportunity and will also ask for many information flows between roles. However, for the sake of time, this option is not included in this version of E-City 2020. Since, charge steering will definitely be an important element of electric transport it is recommended to include this in a next version of the game to let stakeholders also experience the impact on processes and responsibilities for the different roles of the market model.

Symbolic values but accurate presentation

Finally it should be mentioned that the electricity flow, prices and costs are represented rather realistic in the sense of variables, but symbolic in its units. It was chosen to put symbolic costs to charge spots, since accurate information is unavailable and therefore symbolic values prevent the participant to start discussing on the realness of the numbers. While still using realistic variables like euros and electricity the representation of reality remains.

Conclusion & Recommendation

High correspondence with reality on included elements

The similarity of alignment with the proposed reality of the study to the preferred market model has been tried to model as much as possible. To get a playable game and to help the participants accomplish their learning objectives, especially trade-offs have been made on not including all roles and processes of the market model, but to represent the roles and processes that are included relatively realistically. This is to ensure that the participant can feel the correspondence with reality and to have some predictive validity on the issues that are included.

But also many market model processes not included

The result is that some important elements of the market model are not included in the game. The most important elements which are left out are measurement processes and post charge processes such as payment and settlement.

The above described specifications and design choices have resulted in E-CITY 2020 which is described in the next section.

4.4 The E-CITY 2020 intervention

4.4.1 What is it?

E-CITY 2020 is a custom build market model simulation of a future preferred market model for the Dutch charging infrastructure for electric transport. The main purpose of the simulation is to involve important stakeholders and create insights into the dynamics of the preferred market model. It is a three hour simulation which combines a role-playing game with a setting that simulates a charging infrastructure market in the fictive E-City around 2020. Through stimulating government action, increased customer awareness for green transport and the breakthrough of attractive electric cars, the number of electric cars is expected to explode. E-CITY is fictitious conglomeration made up of six regions. There are fast and normal charge spots in E-CITY and private and business consumers. For every segment demand is known per region.

Course of intervention

A simulation game is an intervention. The course of the intervention is designed paying attention to the highlight of the reflective model of experimental learning by Kolb which concentrates around transferring information into knowledge by reflecting on experience (Kolb and Kolb 2009). Kolb's experiential learning cycle is depicted in figure 4.10.

Transferring information takes place when a participant reflects on his or her experience, tries to gain a general understanding of the concepts encountered during the experience and finally test his general understandings. This cycle is used in the intervention in multiple ways. First, Kolb's learning cycle is applied on the whole intervention in which the game provides the experience to the participants. The debriefing is used to reflect on the observations and also to gain a general understanding of the market model concepts. The learning points are transferred in recommendations for game improvement and requirements for success for further market model development.

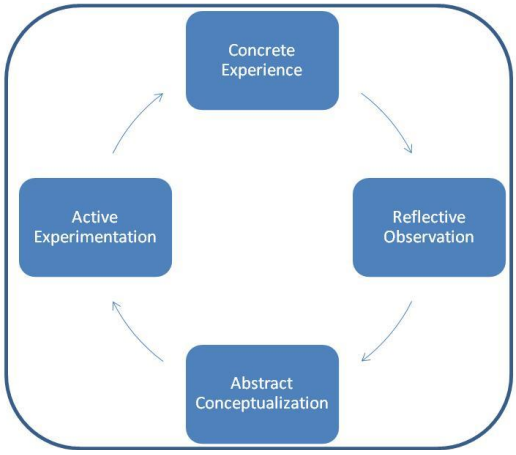

Figure 4.10 The experiential learning cycle based on (Kolb and Kolb 2009)

Second, Kolb is applied during the game by playing different rounds in which participants gain experiences, evaluate their results and try to improve their game results by implementing their learnings. This is especially designed into phase A and B as depicted in figure 4.11 in which the participants go through the valley of despair by first experiencing '*pain' in being unsuccessful to realize the desired performance, secondly they will learn* by experimenting with decision making to improve the performance and in the next years (C) they will experience success in improving their performance and enter the evaluation stage with a satisfied feeling (Wenzler 2008). Argyris and Schön also recognized this learning as double loop learning, which states that double loop learning involves the modification of personal objectives, strategies and to similar situations as the situation in which a practitioner or participant has experienced an error (Argyris and Schon 1974).

The E-City 2020 intervention consists of three main parts: the introduction (prior to playing), the game (A, B, C) and the evaluation (D, E). Furthermore a questionnaire is used to recover knowledge on the participants and their knowledge levels (1 and 2).

(1&2)Questionnaires

Before the participants dived into the intervention and are taken out of the real world into the modelled reality of E-CITY, they are asked to fill-in a questionnaire. The questionnaire is used to identify the motivation and learning of the participants in order to answer the question of this paper.

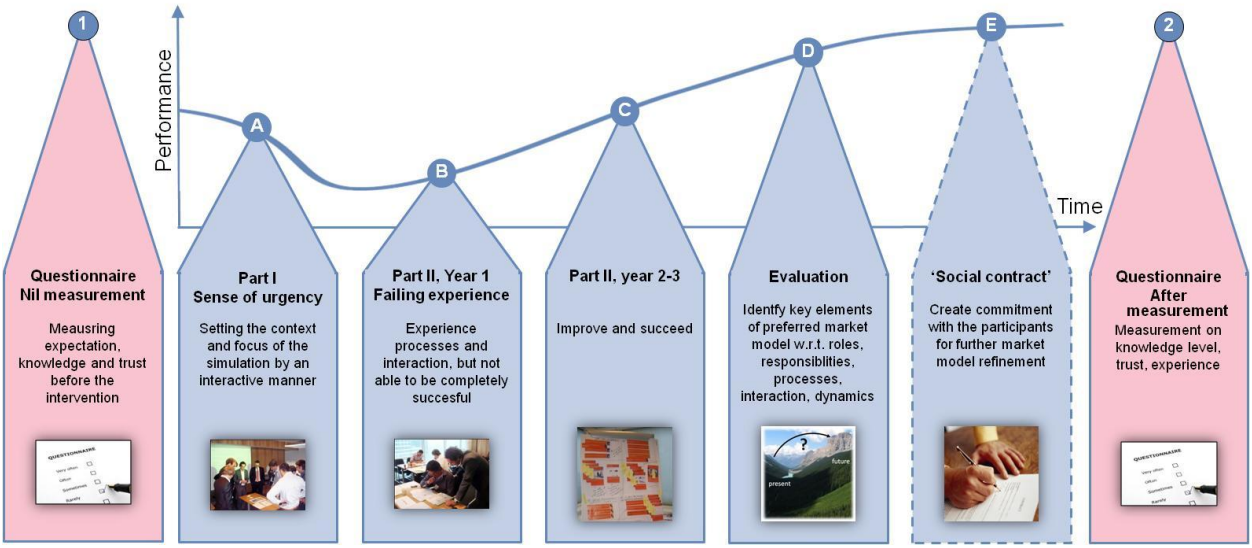

Figure 4.11 Design and course of E-CITY 2020 intervention

(A) Part I: In the role of the customer

After a brief presentation on electric transport they participants start with a brief warming up game to:

- Get the participants acquainted with E-CITY and the materials;
- And to let them think from a customer's perspective by engaging bottlenecks for electric car customers. This puts the participants in the right setting for the remainder of the intervention.

E-CITY

Fictitious City; 6 regions

The E-CITY 2020 game is played in E-CITY, a fictitious conglomeration. E-CITY is made up of six regions and every region is made up of a couple of districts. The map of E-CITY can be found in Appendix F. There are fast and normal charge spots in E-CITY and private and business consumers. For every segment demand is know per region. There are two rural areas. This green area's are thinly populated and have a small demand for public charge spots. There is an office park and industry region in which many business consumers are demanding high-end fast charging services. The City centre is a densely populated region having large demands for public charge spots both in normal and fast charging. The shopping centre has a specific high demand for fast charging spots, to refill cars quickly when shopping.

Situation

2019

It is 2019. Between 2010 and 2019 has electric transport developed at a slow pace in E-CITY. Though, through stimulating government action, customer awareness of green transport and the breakthrough of attractive electric cars the number of electric cars is expected to explode in from 2019. However, to actually achieve this breakthrough it is of great importance to realize the appropriate charging services and infrastructure. There are six commercial organization who have to achieve this; three charge spot operators who already have some public charge spots been realized by the former management and three providers who already have some contracts with CSOs. Due to the slow developing electric transport sector, because of unattractive customer services, the management of all the companies has been kicked out to be replaced by a new management: the participants.

Role & Goal & Game play

In the shoes of a customer

However, before the participants step into the role of the new management in Part II of the game they have the chance to explore E-CITY by electric car. In part I, all the participants step into the "shoes" of an electric

car customer for one day.

Accomplishing agenda meetings

They all get a one day agenda with scheduled appointments in E-CITY. They have to attend as much agenda points as possible, because not attending at an agenda point they will get penalized. However, they have a limited range and can only refuel their car with electricity at a private charge spot or a public charge spot where they have access to via their provider. Furthermore, charging will cost time. How long it takes to refuel depends on the type of charge spot; normal or fast. The player with the least penalties is the winner.

Bottlenecks

During part I the participants experience the following bottleneck for a customer:

- The electric cars have a limited range
- Charging speed; slow charging might be problematic if large distances involved
- Electric car owners have a problem if there is no charge spot at the concerned location
- Electric car owners have a problem if the charge spot is occupied. This can regularly happen in the case of too few charge spots
- Electric car owner have a problem if they arrive at a charge spot, but cannot charge since their provider has no contract with the concerned CSO

End of the game

When all players had their turn to "drive" through E-CITY, the bottlenecks that they have experienced are discussed in a group evaluation, before moving onto part II, in which the participants will be the new management of the CSOs and providers in E-CITY.

(B & C) Part II: Infrastructure realization

The purpose of part two is to experience the dynamics, roles and interactions. The game simulates the period 2020-2023. Every year (round) is divided into trimesters. Trimester one is the strategy trimester in which they participants analyze the results of last year and rethink and reformulate their strategy. The second trimester is the 'action' trimester in which all the parties can interact, negotiate, realize infrastructure and make customer propositions. In the third trimester the facilitators make up the results with aid of the computer model.
The individual goal for every actor is to maximize profit and gain market share in the market for charging infrastructure in E-CITY by attracting customers to electric vehicles by offering attractive charging services. The attractiveness criteria are price setting, geographical coverage and occupancy rate. These criteria are calculated by the computer model.

In the first round (B) the participants are struggling with realizing their contracts, propositions and infrastructure. In this phase they have to go through the valley of despair; by first experiencing '*pain' in being unsuccessful to realize the desired performance, secondly they will learn* by experimenting with decision making to improve the performance and in the next years (C) they will experience success in improving their performance and enter the evaluation stage with a satisfied feeling (Wenzler 2008).

The charging infrastructure industry in the game comprises the most central roles of the preferred market model; charge spot operators (CSOs) and providers compete with each other for infrastructure and customers. The local government, grid company, energy supplier are facilitated roles, which pose constraints on the behaviour of the CSOs and providers from their framework in the current energy market. The preferred market model distinguishes various processes that are simulated during the game. These are the following:

- Pre-Charge Processes; These include process regarding the realization of charge spots and the conditions for access to charge spots, such as a request for a charge spot, the activation of a charge spot, closing a contract between CSO and provider on access terms.
- Charge-processes; such as identification of customer, battery charging and measure usage. These are highly simplified in the game. The identification of a customer when charging is included by a computer model check, whether the customer is able to charge based on contract terms.

- Post-Charge processes; All post charge-process such as billing, paying and settlement is taken account of by the computer model which provides feedback on income cost and other key performance indicators (KPIs).
- Support processes; these include processes regarding customer service and determine regulated tariffs. They are not included in the game.

Goal of the game

The overall purpose of the game is to attract as much customers as possible to electric transport by offering attractive charging services. The attractiveness criteria are price setting, geographical coverage and occupancy rate. These criteria are calculated by the computer model. The individual goal for every actor is to maximize profit and gain market share in the market for charging infrastructure in E-CITY.

Roles

7 Roles

There are seven game roles deducted from the full conceptual role model of the preferred market model. The complete role diagram of the market model including responsibilities for each role can be found in Appendix D. The translation to game roles is depicted in figure 4.12.

Three different types of roles should be distinguished:

- Active role; a central game role played by the participants
- Controlled role; a role played by facilitators with few freedoms to manoeuvre. A controlled role sets constraints and does not negotiate.
- Customer; simulated by the computer

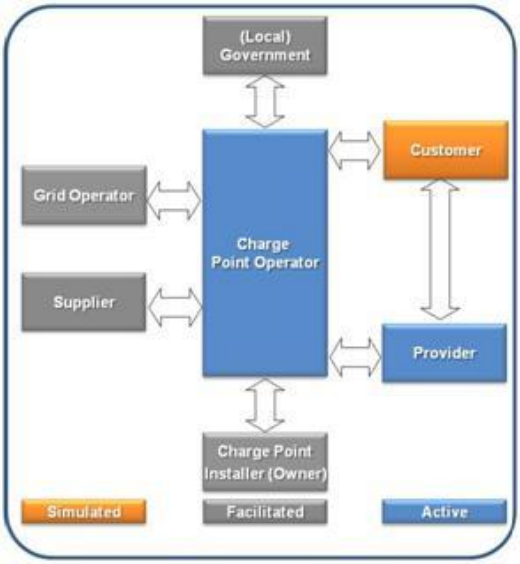

Figure 4.12 E-CITY 2020 game roles

Provider responsibilities

Providers (Active Role) - The provider is the 'single point of contact' and therefore contract partner of the electric vehicle driver. The provider delivers charging services and arranges access permits for the customer in return for remuneration. To provide the services to the client the provider makes appointments with CSOs to arrange access for the customers on their charge spots. They should make agreements on access and on which cost when to be charged.

Actions

The providers have the following possibilities in the game:

- They can provide customer propositions to attract customers;
- They can close contracts with CSOs;
- They can request a CSO to realize new charge spots.

Provider strategies

There are three providers; A, B, C. The strategy of the former management of provider A was to focus on the high-end business segment. These customers are expecting high quality fast charging services in expensive business regions, but are also willing to pay for these hotspots. Provider B had not a strong focus, but was a more all-rounder serving all types of customers for a mediocre price. The former management of provider C positioned its organisation as a price fighter.

CSO responsibilities

Charge spot operator (CSO) (Active role) - The CSO operates the charge spot. It is the pivotal role in the preferred market model for the electric transport charging infrastructure. The CSO has contracts with providers in order to provide their customers access to the infrastructure. On the other hand the CSO has contacts with grid operators and energy suppliers. They also request a charge spot in the public place.

Actions

The CSOs have the following possibilities in the game:

- They can realize charge spots by accomplishing all needed elements such as permit and grid connection;
- They can close contracts with providers to allow customers on their charge spots.

CSO strategies

There are three CSOs; red, blue and black. The strategy of the former management of CSO Red was focussed on high-end fast charge spots in densely populated areas. Blue was an all-rounder CSO focussed on urban areas and CSO black was a price-fighter strong in normal charging in the cheaper regions.

Charge spot installer (controlled role) – The charge spot installer (CSI) is the owner of charge spots. The CSI can install charge spots and lease them to CSOs.

Decentralized government (controlled role) - The decentralized government is the owner of the public arena. The government can therefore grant permits for charge spots in the public arena.

Grid operator (controlled role) - The grid operator is responsible for the connection to the charge spot and the transport of electricity. The grid operator provides connections against regulated tariff. The grid operator is responsible for the integrity and stability of the grid. The grid operator can therefore just allow a limited number of charge spots on its grid or otherwise has to invest in grid extension. The grid operator is furthermore responsible for grid losses and therefore need to see an energy supplier's contract before activating charge spots.

Energy supplier and program responsible (controlled role) - The energy supplier supplies energy to the charge spot conform the current market model of the Dutch energy sector.

Customer (simulated role) – The customer is simulated by the market model. There are two type of customers; private and business.

Progression of time

2020 – 2023

The game simulates the period 2020-2023. Every year is a round in the game and every year is divided into trimesters. Trimester one is the strategy trimester in which they participants analyze the results of last year and rethink and reformulate their strategy. The second trimester is the 'action' trimester in which all the parties can interact, negotiate, realize infrastructure and make customer propositions. In the third trimester the facilitators make up the results with aid of the computer model.

Computer model

A computer model supports the simulation game processes. It is a highly simplified Excel model of the future market, because the primary focus of the game is on learning dynamics and concepts of the market model rather than the operating or business results. Relations between the input and output variables are symbolic but logical. An example of the output of the Excel Model is depicted in appendix F.

Accounting and indicators

For each year the model shows the consequences of the decision made by the CSO' and providers for:

- their operating results such as turnover, lost sales, total cost, results and market share;
- and for the market result on KPIs such as attractiveness of the market, occupancy rate, average consumer price, average coverage
- the prognoses for the market size in the following year

Results of negotiations are fed into the model

The proposed customer propositions by the providers, the results of the negotiations between providers and CSOs and the contracts between CSO and government, grid operator, energy supplier and charge spot installer are fed into the Excel model, which calculates the outcome for the above mention criteria.

Attractiveness of the market

The attractiveness of the market, which is determined by average price, coverage and occupancy rate, influences the prognoses for the market size next year. If the market is attractive electric transport in E-CITY will grow faster than when the market parties have realized a less attractive market.
The indicators also tell the providers and CSOs how they are performing, which helps them to review their strategy.

Unrealistic values

Although the main purpose of the game is to help participants understand the process-dynamics of the market model, it was needed to introduce money to trigger action. There is, however, little information on all the cost aspects of electric transport and the computer model is highly simplified containing many assumptions and linear relationships. To prevent participants having discussions on unrealistic values or outcomes the value of all monetary elements and demand is therefore extremely unrealistic. A charge spot for example just cost a few Euros in the game, while these are very expensive in the real world.

How it is played

Setting

The simulation game is played in a large room. The map of E-CITY with the realized charge spots is in the centre of the room. CSOs and providers are divided through the room. The grid operator and charge spot installer are played by one facilitator and are placed at one side of the room and the local government and CSI are also played by one facilitator and placed at the opposite of the room.

Market prognoses

The consumers are simulated by the computer model. Therefore, at the start of every year market prognoses for the coming year are presented. On the basis of the market prognoses CSOs and providers can determine their strategy and take action.

Open game

E-CITY 2020 is an open game. The participants have a deliverable at the end of every trimester, such as delivering a strategy or a customer proposition. However, during the trimesters they mainly decide for themselves how the game is played. There are for example no standard procedures for realizing infrastructure. They have to find out themselves what they have to arrange and how to negotiate.

Process game

It is important to notice that the money and its related indicators are only introduced to trigger action. The operating result does not matter. The goal is to understand the processes and the resulting dynamics between roles.

In January 2011 the E-CITY 2020 game has been played by a representative delegation of senior Accenture employees from the resources, utilities and strategy groups. The results and findings are presented in the next chapter.

(D) Evaluation

The debriefing is used to let the participants share their experiences, identify learning points and to make the transfer to market model reality. The debriefing was triggered by questions related to the game objectives. The first questions were aimed at releasing stress of the players. The second type of questions was aimed at triggering discussion on roles and responsibilities. The third type was aimed at triggering discussion on processes and interaction and finally questions were posed to trigger the participants to share bottlenecks in the market model.

(E) Social contract

One of the aims of the intervention is to involve industry key stakeholders in the process of further market model refinement. It is therefore desirable that they commit themselves to further market model design and cooperation.

4.4.2 What does an E-CITY 2020 intervention enable?

The purpose of the game is to bring relevant stakeholders together to help them understand the interactions of the preferred market model for the electric vehicle charging infrastructure and create insight in requirements for success for further implementation of the market model.
The game is designed to enable the following aspects:

- Create shared insight in the roles and responsibilities, decision criteria and limitations of the different stakeholders in the preferred market model
- Create shared insight in the charging infrastructure processes as defined in the preferred market model
- Create shared insight in the interactions and dynamics between the different stakeholders within the preferred market model
- Create insight in requirements for success for implementing the market model

Whether the game was successful in enabling these aspects is described under results in chapter 6.

4.5 Conclusion

E-CITY 2020 is a custom built market model simulation of a future preferred market model for the Dutch charging infrastructure for electric transport. The purpose of the game is to bring relevant market parties together and help them understand the interactions of the proposed market model for the electric vehicle charging infrastructure from different perspectives (knowledge transfer) in order to develop follow up steps and requirements to make this market model work (knowledge creation). It is a three hour simulation which combines a role-playing game with a setting that simulates a charging infrastructure market in the fictive E-City around 2020. Through stimulating government action, increased customer awareness for green transport and the breakthrough of attractive electric cars the number of electric cars is expected to explode. E-CITY is a fictitious conglomeration made up of six regions. There are fast and normal charge spots in E-CITY and private and business consumers. For every segment demand is known per region.

The game is designed to enable the following aspects:

- Create shared insight in the roles and responsibilities, decision criteria and boundaries of the different stakeholders in the preferred market model
- Create shared insight in the charging infrastructure processes as defined in the preferred market model
- Create shared insight in the interactions and dynamics between the different stakeholders within the preferred market model
- Create insight in requirements for success for implementing the market model

The following hypotheses are tested by designing and playing the E-CITY 2020 intervention:

- Gaming simulation helps the participants to experience and therefore understand the interactions and dynamics of a market model from different perspectives.
- Gaming simulation design increases the level of understanding on the market model of the designers.
- Gaming simulation helps to create a shared understanding among the participants of a possible future for the market model.
- A simulation game is a better able to motivate people to bring them together for a first meeting compared to traditional presentations or workshops.

The gaming objectives and hypotheses are evaluated by questionnaires, observations during the game and a camera recorded group debriefing. The results are presented in the next chapter.

CHAPTER 5 - RESULTS AND EVALUATION

This thesis is constructed in the design science paradigm. The evaluation therefore also uses what Klabbers (2006) calls the design style of reasoning of which *"its methodology is focused on the intervention; on devising courses of action aimed at changing existing situations into preferred ones" (Klabbers 2003: pp.587).*

Gaming Session Accenture

On the 21st of January (2011) the intervention has taken place and E-CITY 2020 has been played with a representative delegation of senior Accenture employees from the Resources, Utilities and Strategy groups. Since the game was not played with business development employees of market parties, the participants had to be representative for this target group. The participants were carefully selected on their background and expertises. The final group of participants was a mix of people with extensive experience with electric transport projects, senior people with a high level of experience in the utilities industry and strategy analysts.

Two types of findings

The gaming session has delivered two main types of findings; an extensive debriefing and group discussion (camera recorded) and the results of the questionnaire. Furthermore, feedback on the game was collected, which is discussed under reflection in chapter 7. The programme and some impressions of the gaming session can be found in appendix F.

To transform the experienced challenges and acquired information into knowledge this evaluation is based on the reflective practice such as the experimental learning model by Kolb which is used to construct the intervention (Kolb and Kolb 2009). The reflective practice is about the capacity to reflect on action so as to engage in a process of continuous learning (Schön 1983). Therefore the debriefing of the gaming intervention is used to enhance the learning process (Kriz and Hense 2006). The debriefing is based on reflections. As Boud et al states about reflection: "*Reflection is an important human activity in which people recapture their experience, think about it, mull it over and evaluate it. It is this working with experience that is important in learning"* (Boud, Keogh et al. 1985; pp.19).

Schön introduced the definition *Reflection-on-action*. The idea is that after an experience the reactions to the situation and the consequences of the action of the participants are analysed (Schön 1983). This section presents these learning points. It presents the results on whether the participants were able to evaluate the stated objectives. It shows what participants have learned by presenting their evaluation discussions on roles, processes and interaction and more. To this end the main discussions and questions raised in the group debriefing are listed in next section to support arguments. The results and arguments are presented per hypothesis.

5.1 GAMING SIMULATION INCREASES THE UNDERSTANDING OF THE PARTICIPANTS OF THE PREFERRED MARKET MODEL FROM DIFFERENT PERSPECTIVES

5.1.1 Context

For the understanding of the preferred market model it is crucial in this phase to involve industry stakeholders to help further refine the proposed model and finally arrive at consensus. Simulations games

are already mentioned as a method for visualizing and identifying critical elements of a complex problem. At a higher level of abstraction they help to understand the big picture (Wenzler and Chartier 1999).

5.1.2 Evaluation and discussion

E-CITY 2020 has resulted in different indications that support the ability of a simulation game to increase the understanding of both participants and designers on the preferred model. The arguments for this are structured along the purposes and objectives of E-CITY 2020.

Successful transfer of knowledge on roles, responsibilities and interactions of the market model

The first purpose was to transfer market model knowledge on roles, responsibilities and the interactions in the processes to the participants.

Increased insight in the roles and responsibilities is supported by the questionnaire results and indications from the debriefing.

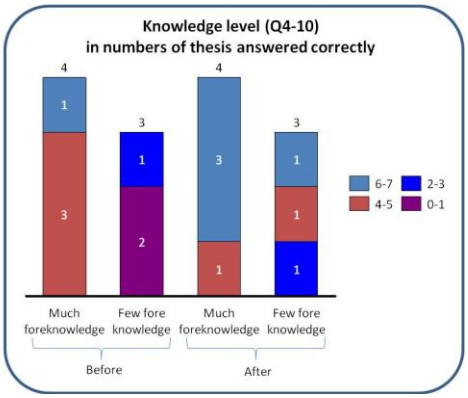

Figure 5.1 Results on knowledge questions

The questionnaire shows that the participants increased their knowledge on these questions as depicted in figure 5.1. The questionnaire included seven questions on roles and responsibilities of the preferred market model. The value of the questionnaire results, which are used to complete the findings from the debriefing, is arguable. Main reasons are: anonymity, number of respondents, and background of the respondents. The evaluation therefore mostly relies on the observations during the game and the discussions raised by the participants during the debriefing.

The level of substantive discussions that were raised in the debriefing of the intervention demonstrates the understanding of the roles, responsibilities and interaction between roles (processes). We will list a few discussions and questions from the debriefing to support this:

- The players realised that they were noticeably in need for clear frameworks for the different roles such as the grid operator, local government and energy supplier. They raised questions like: where should I go for permits, connections, information on customers? There were even participants who asked during the game where the grid operator was, while he was in the room. This can be translated to the real world, since in the real world it is even more complex to arrange things since not all roles are in the same room; where do I go to arrange a charge spot?
- The participants experienced that it is important for a charge spot operator (CSO) to quickly build relationships on the one hand and realise infrastructure on the other hand. In the game some CSOs only focussed on their revenue side by contracting providers. But when they started to realize that they had to construct infrastructure as well government limitations on permits were reached resulting in not being able to realize charge spots.
- The participants also discussed possibilities for differentiation of the providers.
- The participants experienced many dependencies between the provider and CSO:
    - The influence of the provider on the locations of charge spots; providers experienced the need for having influence on the locations of charge spots in order to be able to follow their strategy. Quotes from the debriefing: *"I would just buy a CSO next time, what are the possibilities for vertical integration actually?"*
    - The need for a CSO to perform a market analysis; the CSOs have experienced the need to perform a decent market analysis on number of customers and segmentation, since they

have to arrange their turnover on the one hand via the provider, while they have to take risk on the other hand by realizing infrastructure.
    - They experienced that the provider wants to be able to account the CSO for charge spot availability. Quotes from the debriefing: *"We as providers did have contracts with the CSOs, but they did not have their infrastructure working… We are very dependent on the CSOs.." "…The result of the fact that the CSO is closing contracts with all kind of providers is a declining service level for the current providers, since their charge spot availability will decrease due to higher demand. How can we call the CSO to account for this?"* Indeed if the availability of the CSO's charge spots is not properly, the customer of the provider will experience insufficient quality of charging services. The participants expect that the customer is willing to pay for high availability of charge spots.
    - The participants discovered how income and cost flows through the value chain
- The discovery of process bottlenecks in the charge spot realization process; *"Some bottlenecks you experience early in the process, but other limitation came to the surface in a later stage, which resulted in no active charge spots while expensive contracts were closed.."*
- The participants raised the question which role should be responsible for charge spot registration?

We believe that the fact that the participants were able to share and discuss these experiences concretely in the debriefing is an indication for understanding of the roles, responsibilities and the constraints. We think that a practical hurdle such as the importance to belong to the first movers and do not wait too long with realizing infrastructure is a practical implication which is difficult to be aware of by listening to a presentation. Or the fact that players realised that they were noticeably in need for clear frameworks for the different roles such as the grid operator, local government and energy supplier. They raised questions like: where should I go for permits, connections, information on customers? These are again practical questions that typically arise by experiencing problems. These practical aspects are understood by experiencing it. Confucius and Sophocles have already quoted the relation between learning from experience. Confucius: "*I hear and I forget, I see and I Remember, I Do and I Understand"* or as Sophocles quoted in 400 B.C.: *One must learn by doing the thing, for though you think you know it-you have no certainty, until you try'.*
If we compare the gaming option with a presentation or a workshop where a process map is presented or discussed, our experience is that a process chart might seem logical on first hand, but practical issues are then difficult to foresee.

Different perspectives

The simulation game has triggered the participants to think from perspectives of other roles such as the customer. This is important for two reasons. First, it is important that the market model is convenient from a customer's perspective. In the case of electric transport, the electric vehicle driver needs a good charging experience (Interview 3). A service or a product will not be accepted if it does not fit with a customer's others systems and existing way of workings (Beyer and Holtzblatt 1998; pp.1). However it is indicated that it is difficult for involved actors to think from other perspectives such as from a customer's perspective. Members of different communities cannot simply adopt the meanings of another (Boland and Tenkasi 1995; pp.362). Worlds with different funds of knowledge and systems of meaning cannot easily share ideas, and may view one another's central issues as esoteric (Boland and Tenkasi 1995; pp.351). Playing another or construct a god's eye view would help to anticipate how another perceives a phenomenon (Ackermann 1996; pp.25). Second, thinking from the other perspectives and see other stakes can help to increase trust between stakeholders.

Gaming simulations allow for pushing players into different roles. In E-CITY 2020 this is actively designed into the game, such as in part I of E-CITY where participants are pushed in a customer's role in which they

experienced bottlenecks for the user. During game feedback some participants mentioned that the brief experience of this warming up game had helped to understand the customers need.

Furthermore, thinking from a customer's perspective is supported by the fact that in the debriefing participants have indicated that they would like to have more information and interaction with the customer, the fact that they have put the customer in the centre of the discussion and that they even mentioned that a market model without a client is not a market model. This is mainly due to the fact that consequences of their decisions are reflected by the behaviour of the customer. Meeting customer requirements is awarded with new customers for example.
However, the feedback loop in which feedback on the decisions of the roles from the customer is reflected should be improved in the next version of E-CITY 2020 which is described in section 6.3.

Also, the questionnaire answers in relation to the debriefing are enhancing the viewpoint that gaming simulations stimulates thinking from a customer's perspective. In the questionnaire the people were asked to mention the most important requirements for a customer. They mentioned the more basic criteria, such as convenience, charging speed and after the intervention occupancy rate and coverage. However, during the game, the participant's raised a more fundamental requirement. "*As provider I am not that interested in the availability of the charge spot, but how often a customer is confronted with an occupied charge spot*"
Based on the experience from a customer in round one, they mentioned that the customer is not interested in an occupancy rate, but interested in the exact availability of a charge spot. If the occupancy rate is only one percent, but the neighbour is charging at the same time this will be problematic. This is a typically feedback that seems to be based on experiences in the game. It is not claimed that this is impossible to establish this in traditional brainstorms, but a game creates an environment in which one can try and experience. The active experience give life and texture to abstract concepts (Kolb 1984; pp.21), which helps to understand these concepts more easily and triggers to think a level deeper.

Consultants are trained to think from a customer's view

However, it is emphasised that E-CITY 2020 was played with Accenture consultants only. Since consultants are trained in thinking from a client's point of view, this thinking from a client perspective might have emerged to a larger extent than what would have happened in a setting with market parties.

Second, negotiation and interaction between CSOs and providers have resulted into the fact that the participants were experiencing information requirements and interests of the different parties, such as indicated by fact that:

- The participants discussed the difficulties with differentiating as provider in the game.
- The participants evaluated the division of risks.
- The participants evaluated the dependencies between providers and CSOs. They have indicated the wishes for both roles to have information on customer segmentation, occupancy rate and the wish for the provider to account the CSO for the availability of its charge spots.

Individual experience shared in group debriefing

These experienced issues and requirements are shared and discussed in the group evaluation. The game enables a setting in which both roles have actively experienced it differently which creates a perfect setting for discussion resulting in collective understanding. And when people share experiences, they can share it fully, concretely and abstractly (Kolb 1984), which helps the whole group to understand the different perspectives.
In a workshop or presentation one can think up interests or information requirements for a certain role for example. This is what actually also is needed to construct the conceptual game model for the roles, but by actively pushing people in a role and let them make decisions gives room to find out their limited decision space and the lacking of information that they for example need to make a proper decision.

Too simplified customer segmentation

A reflection has to be made though. It can be argued that the customer segmentation might be too simplified in E-CITY 2020 and also feedback is given on the fact that better feedback from the client has to be provided in a next version. This may probably has resulted in an exaggerated need for more customer information for the CSO for example. On the other hand in a starting market it is also the case that not all customer segmentation information is clear and available to all parties, especially not in the case in which a CSO has an indirect commercial relation with the electric vehicle users.

Successful knowledge creation

The third and most obvious observation that shows the relevance of experiencing a modelled reality in games are the discussions that have revealed learning points for the market model. Besides knowledge transfer, the second purpose of E-CITY 2020 is to create knowledge on the market model. The intervention has provided two main learning points which are regarded as requirements for success in the further design of the charging infrastructure market model.

Unexpected learning points as result of experiencing dynamics

First, the identification of bottlenecks in the process for charge spot realization resulted in a learning point. The participants were experiencing problems with limited grid capacity too late in the process, which has resulted in negative lock in expensive grid connections late in the process. It should be noted that in reality the grid limitations might not be reached that fast. There is still no consensus between scientists on the impact of electric transport on the grid, but much research on the grid impact is currently performed (Kempton and Tomic 2005; Kempton and Tomic 2005; Schneider, Gerkensmeyer et al. 2008; Turton and Moura 2008; Verzijlbergh, Grond et al. 2011). However at certain penetration levels and at certain locations it will become a problem and therefore the learning point is a point to consider when refining the market model.

Price setting and risk division are experienced dynamics

The second learning point on the market model came from the discussion on price setting. *"The price setting is very complex, due to mutual dependencies between CSO & Provider. There is risk on two locations and this is compensated in the price by these two parties, resulting in high consumer prices. Maybe one party could reduce the price?"* Complexities in price setting and risk division were experienced as result of an unexpected system consequence caused by the tight interaction between expensive infrastructure, provider and CSO. The mutual dependencies between providers and CSOs make the price setting a very complex process. Both parties incorporated large margins in the prices to cover risk, which resulted into high consumer prices. The question is how to divide the risk? Can this market model support a market in this way?

Further research is definitely needed. Could this have been identified by other methods? Yes, it might be discovered if economic or institutional experts would have focussed on risk distribution or price setting. However the fact that the developers of the game including the developers of the market model had not foreseen this shows the difficulty to foresee such issues which are a result of complex interaction. By experiencing this in a modelled reality gaming simulation helps to discover and better understand these dynamics. This is due the fact that immediate personal experience is the focal point for learning life, texture and subjective personal meaning to abstract concepts (Kolb 1984; pp.21) while the game provides at the same time providing a concrete environment for testing the implications.

5.1.3 Conclusion

We conclude that gaming simulation increases the understanding of the participants from different perspectives and can create new insights into the preferred market model. A game is able to facilitate thinking from different perspectives; obvious by for example actively putting the participants in a customer's role which is the case in part I of E-CITY 2020. But also less obvious by the fact that they have to think of the customer and of the roles when negotiating or making decisions in the game.

The active experience has given life and texture to abstract concepts (Kolb 1984; pp.21) such as availability of the charge spot, which helps to understand these concepts more easily and triggers to think a level

deeper. By letting people experience their decision-making processes it is shown in E-CITY 2020 that consequences for the system such as the accumulated risk can be revealed. As Sophocles quoted around 400 B.C.: "*One must learn by doing the thing, for though you think you know it, you have no certainty until you try".* This is true for E-CITY as well. Not only knowledge is transferred from the market model developers to participants, but by experiencing unexpected dynamics new knowledge is also created on the market model which can be used in further refinement of the market model.

Based on the increased understanding of the market model we recommend paying attention to at least the following requirements for success when further refining the market model for the charging infrastructure:

- First, scrutinize the mutual dependent relation between CSO and provider. Pay attention to risk distribution, cooperation and the results on consumer prices.
- Second, optimize the process to request for a charge spot. Important issues that should be addressed:
    - Who should the customer address to realize a charge spot?
    - The sequence of process steps to be performed by the CSO to realize a charge spot. The CSO is engaging risk by closing contracts or buying permits while the CSO may experience problems with for example connecting its charge spot due to grid limitations.

Furthermore, we have some recommendations to increase the value of E-CITY 2020 to further market model design:

- Extend the game on the short term for this phase of market model design (Step II.A of the framework as depicted in figure 2.4) with the other processes and roles of the preferred market model. Only a small part of the processes of the preferred market model were included in the game so far, but the results are satisfying; an increased understanding of both the participants and designers and newly created knowledge for further market model refinement. Since, an important part of the market model on payment and settlement is not included. Yet this could be interesting to get a better understanding of the rest of the market model by extending the game.
- Extend and use the game on the longer term towards an implemented market model. We believe that E-CITY 2020 is a perfect starting point for extending and mutating the game along with the improvements made to the market model during the refinement iterations in step II.B. Furthermore, it could be a start for a multi-day multi-player game in which a next version in step II.C of the market model is fully tested with enhanced customer segmentation, roles, processes and insights. It is then a tool that can help along the whole decision making process towards consensus on a to be implemented market model.

5.2 Gaming simulation increases the understanding of designers of the preferred market model

5.2.1 Context

Besides the above mentioned learning points for both participants and designers we also observed that the designers increased their understanding during the design of the game. Druckman and Ebner (2008) have evaluated the effect of the design of a gaming or simulation exercise even more positive than participating in a game. By experiments they showed that participants in designing the game were even more motivated and had a better understanding of the concept than the participants of the game only (Druckman and Ebner 2008). Probably the synthesis part, which is learning about the relationships between different concepts, is the best learning element accomplished by the game design process. For design one "*needs to have*

systemic understanding – seeing the connections among roles, goals, resources, constraints and contingencies" (Greenblatt 1998).

5.2.2 Evaluation and discussion

Developers have learned a lot about the market model

E-CITY 2020 is developed together with two co-designers who are specialist in gaming simulation - Rutger Deenen and Ivo Wenzler - and two co-designers who have designed the preferred market model but who do not yet know about gaming simulation as methodology; Paul Ubbink and Maarten Noom. The co-developers were regularly asked after each gaming design workshop to indicate whether they have got new insights on the market model and its roles, responsibilities and processes.

We have found indications that support the great learning performance over the design process. First, the gaming specialists have indicated that they experienced a steep learning curve with regard to understanding the preferred market model (appendix B). While, as expected, it is observed and also indicated by the market specialists that they have learned about the market model as well, but less than the game developers did.
These learning points mostly came in workshops when we were defining the goals and possible actions of the different roles for the game. For example when we thought up of the customer's motivations and actions we recovered that first he not only wants a charge spot if he does not have the ability for home charging, but that he also wants his own parking spot to make sure that he is always able to charge when coming home. Secondly, we were puzzled in the request process how this would work out. As one of the designers of the market model said after a scenario talk through workshop: "*Many of the processes are triggered by the customer but it is not quit clear at which market party the customer will ask his/her question*", Another example was when we had to think about the incentives and differentiation options for the providers and CSOs. Since we had to create a scenario and roles we had to think about what they would do. Would they want to make contracts exclusive in order to have a better availability of charge spots for their customers or the other way around?

Furthermore, the market model designers indicated that they have "*explored the boundaries of the market model by thinking about drivers for a game. By not only touching upon the processes and roles but also on the need for customer demand and business models it has helped them to put the market model in a broader context of challenges and problems"*. These relations become clear since the designers, were forced to think about motivations and goals and link them to other roles and games in order to be able to make them concrete for the game. We needed to understand the 'real' incentives of the roles in the market model, in order to 'model' these in the game to 'simulate' realistic behaviour of the played roles by the participants. They have also mentioned that by doing a walkthrough of the conceptual model they have increased their trust in the fact that this market model will work.

Value of game design process E-City 2020 is negligible

But did this all have a value for market model design? Yes, this could have a value for further refinement of the market model. We have seen many issues, especially around the request processes for a new charge spot that has yet been identified when we as designers had to come up with the action possibilities and decision criteria for the game roles. However, E-CITY 2020 is developed with consultants. Consultants might not have the same stakes than primary industry stakeholders how have to conclude the actual agreements. Therefore the created knowledge and especially the implicit knowledge in the minds of the developers, which is hard to convey to others, is less of value to the market parties. It would be interesting to co-develop the game with primary industry stakeholders in order to have the deeper knowledge of the industry parties themselves. It is therefore recommended to design such a market model game next time with a designer team of gaming experts and industry representatives. A sounding board formed by for example the industry bodies could be useful to this end.

5.2.3 Conclusion

The results from the questionnaire and the evaluation lead us to attribute the value of game design to increasing the understanding of the market model system. We subscribe the value of synthetic learning when we had to design the goals, possible actions and scenarios for the game. We agree upon Greenblatt that to do this, a designer "*needs to have systemic understanding – seeing the connections among roles, goals, resources, constraints and contingencies*" (Greenblatt 1998). We needed to understand the 'real' incentives of the roles in the market model, in order to 'model' these in the game to 'simulate' realistic behaviour of the played roles by the participants.

However, in our case there were no primary industry stakeholders, who have to conclude market model agreements, included in the design team. Since in the described intervention consultants from the industry were used, the knowledge increase of the system does not occur within the primary stakeholders of the industry. The value of game design to market model development can be increased when industry representatives are included in the game design process. A sounding board that consists of industry bodies could be an implementation of this recommendation. The game designers can facilitate the design process by enabling the sounding board to use their industry knowledge to meet the challenges future market model and related processes, roles and responsibilities will bring.

5.3 GAMING SIMULATION HELPS TO CREATE A SHARED UNDERSTANDING OF A POSSIBLE FUTURE OF A MARKET MODEL AMONG THE PARTICIPANTS

5.3.1 Context

It was stated that gaming simulation provide us with a bird's eye view that helps to convey the big picture, but also enables participants to experience a simplified future (Mayer 2009) This is very important in the environment of a new market model in which there is a lack of information and where the future is very uncertain. During the gaming simulation all role players are actively involved. Mastering the simulated challenges creates confidence and trust resulting in interaction and action (Duke and Geurts 2004).

The E-CITY 2020 game brings people together in a room to explore a alternative future in a condensed time frame, so following literature it should help to create a shared understanding and shared formulations of problems and solutions (Wenzler and Chartier 1999). The shared experience that the participants will get in the simulation game can help create trust.

5.3.2 Evaluation and discussion

We have three types of indications that support this argument. First, the knowledge questions show that differences in understanding of the roles before was converged to the same ideas about the roles after (figure 5.1).

Second, questions on trust in electric transport and the preferred market model were included in the questionnaire. Figure 5.2 presents the results of the answers of the participants. From the answers on question 12 and 13 it appeared that almost all participants are convinced of a breakthrough of electric transport and the proposed provider market model. It seems that the gaming intervention has aligned the views on expected different interests. Before the intervention there were four participants who were expecting large contrary interests between roles in this market model, while after the intervention most people have changed to a neutral stance or even did not expect large opposite stakes anymore. This supports the fact that the intervention has funnelled their view on the market model. If parties feel that they have shared interests and can funnel these interests, this will increase trust which will be beneficial to the process.

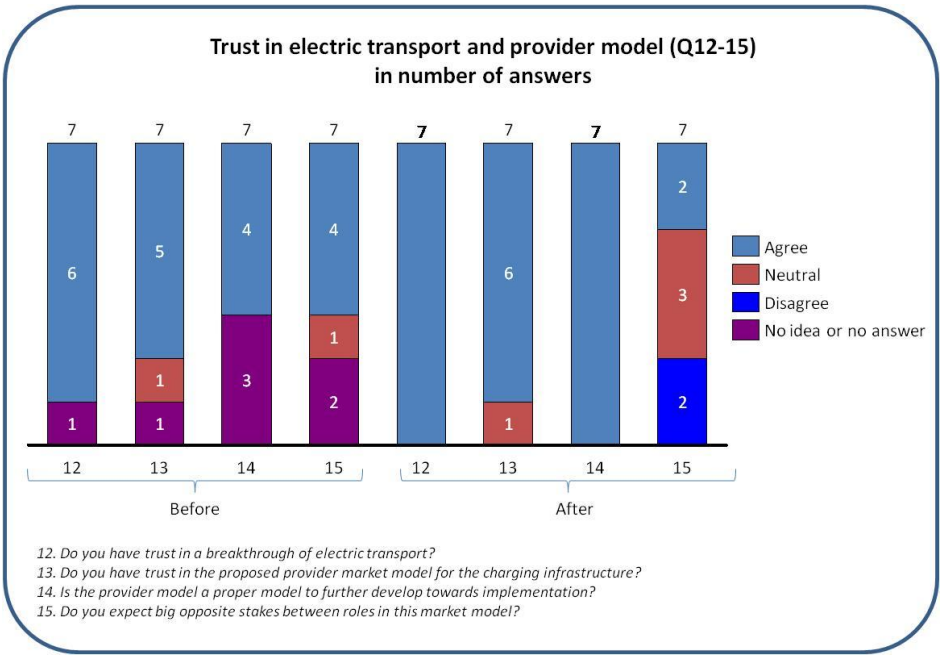

Figure 5.2 Questionnaire results on trust questions

Two observations have to be ventilated. First, the game could have left out opposite stakes which are present in the real world. This is disputable and depends on the validity of the game; to which extend the game corresponds with the real world. The structural and process validity of E-CITY 2020, which are the criteria to which degree the structure (actors, information data etcetera) and the processes are in correspondence with the real world, will be discussed in the next chapter (Peters, Vissers et al. 1998). Another type of validity is psychological validity which is about the degree to which the game provides an environment that is realistic to the players (Peters, Vissers et al. 1998). This one might have an influence on the answers. The game elements and processes are simulated rather realistic. However, since the respondents were not primary industry stakeholders. Consultants are not representatives of direct primary market firms, who have to conclude market model agreements. They may have different interests and stakes within that market, which could have biased the results. It is therefore recommended to ask these questions again in a next session with primary industry stakeholders to further research the influence of shared understanding on the perception of interest conflicts.

The third indication for increased shared understanding is the fact that we observed that people were actively sharing their experiences of the game in the debriefing. The discussions of which a few have been described under the conclusion of increased understanding point out the ability to share and discuss experiences and problems. Kolb acknowledges this as *"when human beings share an experience, they can share it fully, concretely and abstractly" (Kolb 1984; pp.21).* One of the observations that demonstrates the shared experience of solutions and problems is the fact that a participant mentioned in the discussion on accumulated risk coverage in consumer prices due to mutual dependencies between provider and CSO: "*You can also say, we are going to cooperate as provider and CSO in order to make a strategy together and recognize the risks together as well"*

5.3.3 Conclusions

In line with the expectations on gaming simulation as stated by different gaming simulation experts gaming simulation can help to create a shared understanding of a market model through its ability to let participants experience a certain future. The experiences are made explicit in the group debriefing in which participants share and discuss their experiences of the simulation. This is also what Kolb acknowledges

*"when human beings share an experience, they can share it fully, concretely and abstractly" (Kolb 1984; pp.21).*The results of the questionnaire further show a significant knowledge increase and decreased fear for contrary interests.
However, since the respondents were not primary industry stakeholders. Consultants are not representatives of direct primary market firms, who have to conclude market model agreements. They may have different interests and stakes within that market, which could have biased the results. It is therefore recommended to ask these questions again in a next session with primary industry stakeholders to further research the influence of shared understanding on the perception of interest conflicts.

5.4 People seem to be better motivated to attend a simulation game than a traditional presentation or workshop

5.4.1 Context

It is important in this phase of market model design to involve stakeholders. We expected that a 'traditional' workshop or presentation would not sound interesting enough to attract people in some occasions. A presentation or workshop might be again just one of those millions that people are engaged with, while a gaming simulation creates an experimental learning environment in which people interact in a possible future themselves and which is fun to play (Wenzler and Chartier 1999; Wenzler and Higgins 2009). A gaming simulation therefore is expected to better differentiate from other workshops or events. This should make it easier to get people involved for the first time.

5.4.2 Evaluation and discussion

We found several indications that people are more motivated to attend a simulation game than a presentation. Questions on the attractiveness were included in the questionnaire and the results are depicted in figure 5.3.

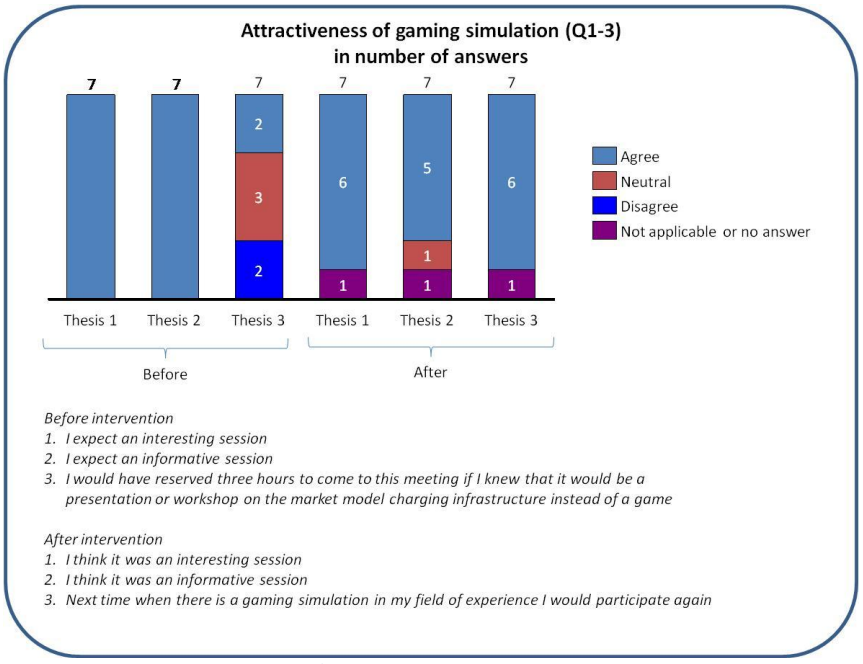

Figure 5.3 Results of the questionnaire theses on attractiveness

Besides the positive reactions that were heard during and after the simulation game the results from the questionnaire show that participants were expecting a fun and informative session. All seven respondents were before the intervention expecting both an interesting and informative session. More important, two of the seven indicated that they would not have reserved three hours time to come to this meeting if they knew that it would be a presentation or workshop on the market model instead of a game. Three would doubt to come to a presentation and took a neutral stance. It therefore seems that simulation games have a positive image, which is likely to motivate participants to come to such an intervention.

Despite attractiveness, urgency is still needed

To be willing to participate the most important is that parties need to have a sense of urgency and know that there is something in it for them (Bruijn, Heuvelhof ten et al. 1998). The participants will only make time if there is something in it for them. If they do not feel any urgency the game can be as attractive as it can be, but people will still not participate. Nevertheless, in the case when people are not fully convinced of the value of the intervention the attractiveness of the game can help to push the actors to be involved.

Risk for social desired answers

The following notion has to be considered, when drawing the final conclusion. The intervention was held with Accenture people. This makes the questions on the attractiveness of the intervention sensitive to social desired answers. The questions bear the risk that people might answer more positively, because they do not want to disappoint their colleague who has put much effort in the development of the gaming simulation. The control question whether they would have made time in case of a presentation though, seems less sensitive to positive desired answers, because they would not hurt their colleague that much. However, since their name is on the questionnaire, they might still feel pressure to answer this towards a more positive experience for gaming simulation.

On hindsight all participants thought that is was a fun and informative session and five of the six participants would participate in a following gaming simulation in their field of experience. This is important, because this demonstrates that a simulation game does not only seem to be attractive on beforehand, but the participants also experienced the intervention as interesting, which increases the chance on a social contract for further participation. This is important in the refinement cycle of the market model design. Furthermore, we observed a very energetic and enthusiastic group of participants. And one of the testers said: "*Involve me in the test groups for games, I really like this"*.

5.4.3 Conclusions

We have found indications that a gaming simulation has a positive image, which can motivate participants to come to such an intervention. As expected games are fun (Wenzler and Higgins 2009). However, it is important to understand that still the main driver for participation is the feeling of a sense of urgency and the fact that the stakeholders feel there is something in it for them (Bruijn, Heuvelhof ten et al. 1998).
Furthermore, we have observed a very energetic and enthusiastic group of participants who have indicated that they experienced the intervention as interesting, which increases the chance on a social contract for further participation. This is important in the refinement cycle of the market model design. The intervention should therefore be played with real industry stakeholders to let them sign a social contract for further participation.

5.5 Conclusion and recommendations

The gaming session has delivered two main types of findings; an extensive group debriefing and group discussion and the results of the questionnaire. The debriefing of a gaming intervention is used to enhance the learning process. The following conclusions have been made based on hypothesises of gaming simulation.

- *Gaming simulation increases the understanding of the participant on the market model from different perspectives;*
- *Gaming simulation designing increases the level of understanding on the market model of the designers;*
- *Gaming simulation helps to create a shared understanding of a possible future of a market model among the participants;*
- *Gaming simulation helps creating a shared understanding among the participants of a possible future for the market model*
- *People seem to be better motivated to attend a simulation game than a traditional presentation or workshop;*

Based on the increased understanding of the market model we recommend paying attention to at least the following requirements for success when further refining the market model for the charging infrastructure:

- First, scrutinize the mutual dependent relation between CSO and provider. Pay attention to risk division, cooperation and the results on consumer prices.
- Second, optimize the request process for a charge spot. Important issues that should be addressed:
    - To whom should the customer address himself to realize a charge spot?
    - The sequence of process steps to be performed by the CSO to realize a charge spot. The CSO is running risk by entering into contracts or buying permits while the CSO may experience problems with for example connecting its charge spot due to grid limitations.

Since a gaming simulation intervention appears to be a successful tool to create understanding and knowledge on the preferred market model, we have some recommendations to increase the value of E-CITY 2020 to further market model design:

- Integrate the game on the short term for this phase of market model design (Step II.A of the framework as depicted in figure 2.4) with the other processes and roles of the preferred market model. Only a small part of the processes of the preferred market model were included in the game so far, but the results are satisfying; an increased understanding of both the participants and designers and newly obtained knowledge for further market model refinement. Since an important part of the market model on payment and settlement is not included yet this could be interesting to get a better understanding on the rest of the market model by extending the game.
- Extend and use the game on the longer term towards an implemented market model. We believe that E-CITY 2020 is a perfect starting point for extending and mutating the game along the improvements made to the market model during the refinement iterations in step II.B. Furthermore, it could be a start for a multi-day multi-player game in which a next version in step II.C of the market model is fully tested with enhanced customer segmentation, roles, processes and insights. It is then a tool that can help along the whole decision making process towards consensus on a market model to be implemented.

Finally, we have three main recommendations for further researching the value of gaming simulation to market model development in order to increase the arguments behind the conclusions:

- More cycles of interventions are required with primary industry stakeholders instead of consultants. Consultants are not representatives of direct primary market firms, who have to conclude market model agreements. They may have different interests and stakes within that market, which could have biased the results. The element whether stakeholders are willing to close a social contract and commit themselves to further market model refinement can then be tested.
- It is recommended to further co-develop the game with primary industry stakeholders to increase the level of knowledge on the system model of these stakeholders themselves. Since, it is time-consuming to involve all market parties to the design team, a sounding board that consists of industry bodies could be an implementation of this recommendation. The game designers can facilitate the design process by enabling the sounding board to use their industry knowledge to

meet the challenges future market model and related processes, roles and responsibilities will bring.

- When having an intervention in the charging infrastructure market, set up a research that measures the long term effects of the gaming intervention. This research has focused on the direct observable short term effects of gaming simulation. Measure whether a gaming simulation leads to quicker market model refinement and ultimo leading to quicker implementation of the market model. These effects can only be measured by plugging the E-CITY 2020 intervention into the real market and perform a long term research of observations till the market model is implemented.

CHAPTER 6 - DISCUSSION AND REFLECTION

This thesis has described a framework for market model development, identified gaps in the current methods that are used for the market model design phase II, identified contributions of gaming simulation and finally evaluated the contribution of gaming simulation based on experiential learning of E-CITY 2020.

Before moving on to the final conclusions and recommendations of this research, the value of the framework and findings are discussed. Reflections and discussions have been made throughout the former chapter, but this chapter describes an overall conclusive reflection. Section 6.1 describes a discussion on all findings and methods used in this thesis. In section 6.2 reflections on the development of E-CITY 2020 are presented.

6.1 DISCUSSION

6.1.1. Expert interviews on market model development

The market model framework was constructed for three purposes:

1. To define a market model design framework.
2. To identify the phase in which the market model for the charging infrastructure in the Netherlands at the moment is.
3. To identify challenges and requirements to methods used in this phase.

Restricted group of interviewees

Since not much literature on market model development is available the framework heavily relies on expert interviews. Eight people from Accenture and the TU Delft have been interviewed. These experts are carefully selected on their back ground and experience. Still, the number of interviewees is confined to a small group, because the purpose of this research is not to perform extensive research to a market model design framework. Though, it has to be noted that the experts who are interviewed are having extensive experience with market model development in the Dutch energy market. Fens (Interviewee number 7, Appendix A) for example has ten years of both pragmatic and scientific experience in the energy market and has researched the entire implementation process of market models in the Dutch energy sector after the liberalization.

Chapter aim

For the research purpose, the results based on the experience of the experts in former market development trajectories are regarded sufficient to find challenges to which gaming simulation can contribute.

If one would debate the development framework we would recommend involving bodies of industry like Netbeheer NL, EnergieNed and EDSN for more interviews. Though since the interviewed experienced have worked together with these parties no large adjustments to framework are expected.

6.1.2. Generalisation of findings

Scoped to new market models in Dutch energy related markets

The research focused on the contribution of gaming simulation to market model development. In the study to market model development different forms of market models from more organically emerged to more regulated market models have been identified. Based on the fact that the market models for the Dutch energy sector and other industries have a different form, the research is already scoped to Dutch Energy related markets in chapter two. The Dutch energy market is characterised by a highly regulated market in which parts of the value chain are still regulated by the government.

Partially regulated market model

Furthermore this market is considered to be a critical infrastructure serving public interests. The results of this study can at least be applied to such infrastructure markets in which there are different roles such as asset owners and service providers on these assets. It was described that for example fast moving consumer goods markets have less agreements between market parties in the form of a more organically emerged market model. These market models are less actively designed. Elements like for example bringing key stakeholders actively together for further market model design is therefore less relevant or even forbidden. It is therefore difficult to generalise the results of this case study to these markets with an organically emerged market model.

The case study of this research is an experiential game on the charging infrastructure. Are the results generalizable to other energy related markets? Could gaming simulation for example contribute to a new market model for decentralised production?

In our opinion the results of this study can be generalised to market models which:

- need to be actively designed to start up, i.e. for which the market model development framework applies. This is the case for e.g. regulated infrastructural markets which have to facilitate many information flows between regulated an de-regulated parties and which have to enable access for service providers on the infrastructure of another role.
- To other countries which have energy markets with the same characteristics, so with high regulated models in which parts of the value chain of an infrastructure are regulated. Although the framework heavily relies on experts with experience in the Dutch market the framework can be applied. If other countries have completely free energy markets with less market roles, market model design may work different and then the framework may not apply.
- To phase II of the market model development framework of which the purpose was formulated as follows: '*bring stakeholders together and ensure further refinement of a high level preferred market model to finally arrive at consensus for a to be implemented market model'.*

Regulated market model for new future markets

Finally, Duke notes that the typical problem for gaming simulation is a very complex real world situation characterized by: many variables interacting, no realistic basis for quantification of variables, no proven conceptual model and a socio-political context of decision-making where actions may be irrational (Duke 1980 : pp.364). The case of the charging infrastructure is a problem without such a proven conceptual model and where many variables are interacting. It shows that a *market model for a yet practically non-existing market* can be characterized as typical gaming problem as described by Duke. In the case of a high regulated market in which it is possible to actively design a market model, the gaming simulation can help bringing people together and help them understand and learn about the market model.

6.1.3 Discussion on the findings of E-CITY 2020

The findings of the E-CITY 2020 simulation game are discussed in relation to the validity of games. Validity is first introduced. Then important design choices which have been made are presented and discussed. Finally, the questionnaire is discussed.

Validity

Correspondence between reality and model

Gaming simulation is a simulation approach which means that a simplified model of the reality is constructed, learning from this model and finally the findings are translated back to reality. (Peters, Vissers et al. 1998). To make inferences about reality based on experiences in the game, the game model should be a good representation of the real situation. The degree of correspondences between the real world and the simulated game model is called validity (Peters, Vissers et al. 1998).

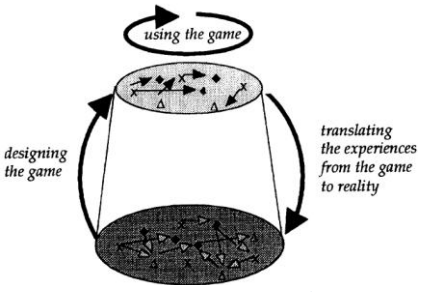

Figure 6.1 Simulation approach from (Peters, Vissers et al. 1998)

Different types of validity

This section presents the implication of the validity for the E-CITY 2020 type of game. Peters et al. (1998) distinct four types of validity: psychological validity, structural validity, process validity and predictive validity. However, there are different applications of games, such as gaming as research, teaching or policy tool, and not all these validities are applicable to all applications of games (Peters, Vissers et al. 1998). E-CITY 2020 is an application of a both a teaching and policy tool. It is a teaching tool in the sense that understanding on roles and processes of the preferred market model has to be conveyed to the participants, but a policy tool in the sense that the preferred market model is still open for different policy options which have to be evaluated. Therefore the gaming environment is rather open. The environment should challenge participants to explore several solutions and the reference system does not need to be presented in a very restrictive way (Peters, Vissers et al. 1998). Since, it is not a full teaching tool in which it is very important that the structural validity is high, such as a flight simulator for example, the structural validity for such a policy tool is less relevant. However, the outcomes therefore should have some predictive power.

Structural validity difficult to determine

There is no consensus on the future of the charging infrastructure market and the preferred market model. Although structural validity is therefore difficult to determine, the impact of major design choices on the representation of the preferred market model will be discussed briefly. But before the impact of design choices is discussed, the efforts that have been made to minimize errors in the game are described first.

Risk minimizing efforts

Attention is paid to minimize risks in the gaming model

The design process of a game is based on three principles, namely reduction, abstraction and symbolization. Concerning these principles humans can make errors when designing a game. It is possible that it is wrongly decided to leave out essential elements or relations for example or wrong symbolisations are made, which make it difficult for participants to see the relation with the reality. Another important threat is the knowledge on the reference system on the part of the game designer. Although errors are intrinsic to humankind it is possible to follow some guidelines to try to minimize errors and therefore increase validity. Peters et al. mention some guidelines. In the next list it is discussed how attention is paid to these guidelines during the design process:

- *Work systematically*: E-CITY 2020 is therefore designed using the systematic of five design steps of Wenzler in which specifications have been set and a conceptual model is constructed which finally has been translated into game elements.
- *Participative workin*g: The client was highly involved in the design team. Every two weeks workshops with the client were held. Though since the proposed market model is just a proposal on which there is no consensus yet, the value of the involvement of just the designers of the market model is restricted. To further guarantee more harmonious knowledge on the conceptual model primary stakeholders from the sector should be involved as well.
- *Check validity*: The validity of E-CITY is checked with another game developer. Wenzler participated in the design workshops once in a while to check whether a valid game was developed. It might provide the impression that this check is weak, since Wenzler seems to be internally involved in game design, because he is one of the supervisors of this thesis. However, he was not actively involved in the market model and game design and therefore was able to challenge the designs. Moreover, the content of the conceptual model was validated in validation workshop with the authors of the preferred market model.
- *Test:* E-CITY has been tested on the 14th of January 2011. The participants were asked to check the logistics of the game, but they were also asked to indicate elements of the game that they thought were not in line with reality. Only one full test has been performed. It is recommended to further test the game. On the other hand, the gaming session of the 21st January can be seen as a dress rehearsal before playing the game with market parties.

Recommended to involve external experts

Summarizing, as much as possible effort has been put in following the guidelines to minimize the risk for errors in the gaming model. However, there is no consensus on the reality of the provider model yet, more industry-wide involvement in the design would contribute through an even wider supported picture of the uncertain future.

Impact of major design choices

In chapter 4 major design choices are described that have been made in order to construct a game that is meaningful, playable and has a certain degree of similarity with reality. The major design choices for E-CITY 2020 and its impact on validity are briefly discussed.

The following design choices concerning the technology and roles and processes of the preferred market model have been made:

- Focus on new roles in the market model: provider and charge spot operator (CSO);
- Measuring responsible and program responsible are not included;
- Charge spot installer installs charge spot on lease contract, investment issue is driven to background;
- No vertically integrated parties;
- Customer is simulated by computer and very simplified customer segmentation;
- Focus on pre-charge processes;
- Post-charge processes are not physically present in E-City but is taken account of by the computer model;
- Charge steering is not included;
- Symbolic values such as cost;

High correspondence with reality on included elements

By making these design choices the resemblance with the proposed reality of the study to the preferred market model has been tried to be achieved as much as possible. To get a playable game and to help the participants accomplish their learning objectives, especially trade-offs have been made on not including all roles and processes of the market model in order to pay extra attention on representing the roles and processes that are included realistically. This has been decided to ensure that the participant can feel the resemblance with reality and to have some predictive validity on the issues that are included.

But also many market model processes not included

The result is that some important elements of the market model are not included in the game. The most important elements which are left out are measurement processes and post charge processes such as payment and settlement. These are critical for the new market model and therefore also should be refined further. It is therefore recommended to include measurement, post-charge processes and, charge steering in a next version.

Not complete market model game, but objectives accomplished

On the other hand, the version of this game enables enough substantive discussion on the topics that are included by putting the participants in a gaming world that has enough resemblance with the real world. This was of importance for the game since the players had to be transferred into future reality. To ensure this the following validation steps are performed. As described above it is difficult to validate the outcome with reality, since little is known about this future market. Therefore the conceptual model for the game is validated with the designers of the preferred market model and the translation to the game is verified with both the designer of the preferred market model and Wenzler as gaming expert. Moreover, during testing players were asked which elements they thought were unrealistic and which were realistic.

Questionnaires

Value of questionnaire is arguable

The questionnaires which are used to complete the findings from the debriefing in order to evaluate the hypothesises are causing a discussion as became clear during the evaluation in chapter five. Main reasons are: anonymity, number of respondents, and background of the respondents. Because the value of some

answers in the questionnaires can be argued, the evaluation relies mostly on the observations during the game and the discussions raised by the participants during the debriefing. However, since some topics such as attractiveness are hard to make explicit, the questionnaire is in that sense a valuable contribution in order to for example measure the attractiveness of the game.
For the next time, it would be recommended to give the following aspects a little more thought, to create a more reliable result of the questionnaires:

- *Make the questionnaire anonymous*; the possibility to answer anonymously reduces the risk on social desirable answers. A good question has to evoke the truth and therefore questions must be non-threatening. Anonymous questionnaires that contain no respondent information are more likely to produce honest responses (Dornyei 2003).
- *Involve more people*; only seven participants were involved
- *Ensure that the respondents are real market parties*; the only conclusion that can be drawn is that the gaming simulation seems more attractive to the participant than a presentation or workshop. To measure the real effect of the attractiveness of the gaming intervention on the attendance rate of relevant stakeholders in the market model, it would be better to have the intervention with primary industry stakeholders instead of consultants.

6.2 Reflection on game design process

The second research question was formulated as: *What recommendations can be made for game designing in uncertain circumstances such as the creation of a market model for a practically non-existing market?*

In this section we provide recommendation for game design by reflecting on the development of the market model game E-CITY 2020. The central line of thought behind this section is the search for what can be performed better when designing a market model game in the future. Reflection on design of E-CITY 2020 is performed on four elements divided into two categories, namely reflections on:

- Lessons learned on game development
  - Game design team;
  - Design process;
- Feedback on and improvements for the E-CITY 2020 intervention
  - Game play
  - Facilitation (Introduction etc)

The first two categories concern the design process towards the game and rely on personal reflection. The last two concerns the gaming intervention itself. On these categories the reflection relies on feedback of participants of the game. In section 6.2.1 we present our observations and learning points, which enable us and hopefully other game designers to be able to construct a market model game quicker and better next time. In subsection 6.2.2 is briefly reflected on the feedback from participants of E-CITY 2020.

6.2.1 Game design team

Before we reflect on the game design team and process we first recall the characteristics of the situation under which game design was performed. We developed a game for the beginning of the refinement phase (II) of the market model. Phase II is aimed at discussing, refining, finding consensus and settling the developed market model. The first step is to present or communicate the discussion document to key stakeholders from the market in order to start-up interaction and refinement (VREG 2006: pp.26). The environment in which this all has to be performed though is characterized by:

- A practically non-existing market, very uncertain and hard to imagine;
- A market in which many different actors interact and can behave strategically;

- A situation in which there are no clear agreements between stakeholders yet.

The design team of E-CITY 2020 consisted of five people: one main designer who is the author of this thesis and four co-designers. Two co-designers are specialist in gaming simulation and did not have knowledge of the preferred market model and two co-designers (client) formed the substantive part of the team since they have designed the preferred market model. They did not yet know about gaming simulation at the start of the project.

The good part of this team was the combination of gaming simulation experience and close involvement of knowledge on the preferred market model. However, the downside concerning the contribution to market model design is the fact that only the developers of the preferred market model itself were involved. First, the purpose of phase II is to involve stakeholders for further refinement of the preferred market model. Second, not everybody agrees upon the market model and developments in this industry are shaping up rapidly, causing a dynamic landscape. It would therefore be valuable to involve knowledge and views from other stakeholder such as e.g. governmental bodies as the Formule E-Team. We would therefore recommend working with a design team with broader backgrounds, including gaming simulation and representatives from the involved industry. Since, it is time-consuming to involve all market parties to the design team it is recommended to form a sounding board of the industry of which representatives will take part in the game design team.

6.2.3 Design process

We have followed the structured design process of five steps of Wenzler (Wenzler 1997), which contains the following steps:

1. Determine the specifications for the gaming simulation
2. Develop a conceptual map of the preferential model
3. Transform the conceptual model into gaming elements
4. Build and test the game
5. Implement and evaluate

With regard to the design process we especially reflect upon problems that we have experienced with providing the right specifications and conceptual model, which took rather long. These phases took a long time for two reasons. The first is unstable objectives which resulted into making different conceptual models. First, we experienced difficulties in setting the objectives, since the aims of the client were not always clear. Clients often have difficulties to draw a complete picture of the project since game design is multidisciplinary discipline and many clients are not familiar with the gaming simulation method, resulting in poorly described first specifications (Kortmann and Harteveld 2009). The purpose for our game regularly changed between knowledge transfer, knowledge creation or both. Since the client part of the team was not experienced with games, the game designer should help to specify the purpose and objectives. However, in our case the head designer was relatively inexperienced with game design.
Furthermore, the objectives have to be validated with the client. As Duke describes in his design steps; provide the client with tangible drawn up specifications for review to align the intentions between designer and client (Duke 1980). We e.g. struggled with the questions:

- do we have enough and correct information on the processes and roles to have a pure knowledge transfer game?
- Or do have too little information to do that and should it be a complete open workshop game to create knowledge?

We think though, that one should address these questions differently. One should clarify the objectives by having clearly in mind in which phase the market model design is proceeding and what the purpose in that phase is. In our case the purpose was to start-up interaction and refinement. The problem was that the proposed market model had to be understood, but we had also to learn further about the market model.

We recommend a game design team to derive the game purpose and objectives of the market model design framework.

Start with end-in-mind

We therefore recommend to start with the end-in-mind and to derive the game purpose and objectives of the market model design framework. End-in-mind means: confirm the objectives with all involved stakeholders and determine the specifications for the game such as the number of players (e.g. 10 players), duration (3 hours), etcetera as quick as possible. Wenzler mentions the importance of getting a clear understanding of the value to be delivered (Wenzler 2009).
Since, clients often do not exactly know what they wants we recommend the designer of a market model game to take a look at the different steps of the framework as indentified in chapter 3 which can help to derive purposes.

Accept uncertainties and start prototyping

The second reason for delay in the game design process is the following. We have tried to first make a detailed conceptual model before thinking about transferring it to game elements, while it is very difficult to imagine the future market model. The design process of Wenzler prescribes to make a 'road map' and / or 'tour guide' (Wenzler 1997). A roadmap is big picture presentation of the problem. The tour guide is a more detailed booklet. We believe in the urgency to get a systemic overview on a big picture level. Though, since processes on a more detailed level are not defined yet and therefore they are hard to map them in for instance detailed process diagrams, we think that a detailed tour guide at this stage cost too much effort. With hindsight we recommend to start earlier with prototyping. Wenzler describes the prototype phase as an iterative process of talk throughs, walk throughs and run throughs and since we started talk throughs, walkthroughs and playing first prototypes of (elements of) a game, the progression in game development and learning about the incentives goals and information requirements for roles accelerated. We therefore recommend in the situation of a practically non-existing market which is difficult to imagine, to involve the construction of a detailed conceptual model phase in the iterative process of game transformation and prototyping. This is what Kortmann and Harteveld advocate as agile game development (Kortmann and Harteveld 2009). They acknowledge that high complexity calls for a development model that allows for:

- Incomplete and sometimes incorrect requirements
- Flexible, adaptive processes, fitted to the specific project
- Fast response to project changes

Generally speaking, agile models are based on a result-driven approach, as opposed to a plan-driven approach. This makes these methods better suitable to tackle more complex and uncertain projects where the project goals and possible solutions are not clear from the outset (Kortmann and Harteveld 2009).

We have found it difficult to start prototyping due to uncertainty about the conceptual model, but since such a market model in phase II is always very uncertain one should overcome and learn by prototyping. It is important to remember when designing that an explorative simulation game is valuable for creating a what-if scenario. New market model development happens in an environment with many uncertainties in the real world. It is important to accept and take these uncertainties into the game instead of trying to fix the uncertainties of a future market in the conceptual model. Reality creates learning objectives and in the case of market model development phase II the objective is exploring the market model, so generating a scenario in which people can experience a future even with uncertainties.

Create stating points for scenarios

Finally, it is important to create starting points for scenarios of the market model. For example in the case of the charging infrastructure we were struggled in the loop of the fact that we were in need for customer requirements, but the customer requirements were alternately depending on the technology (e.g. charge speed) and the type of market, which was also unknown and uncertain. In these cases it is important for the designer to dare creating starting points and assumptions for scenarios. In the case of E-CITY 2020 we e.g. finally assumed a simulated customer demand and two charging technologies.

Overview of recommendations for development of a next market model game

- Involve relevant primary industry stakeholders
- Start with end-in-mind by deriving the purpose and objectives from the phases in the market model development framework
- Take uncertainties into account and use a agile development method to start prototyping early
- Create starting points for scenarios

6.3 Feedback on and improvements for the E-CITY 2020 intervention

Every intervention is a learning moment for the game as well. After the test on January 14th improvements have been made for the final internal Accenture session of E-CITY 2020. The intervention of January 20th has resulted for its part in constructive feedback for improvements. This section briefly discusses the major feedback from the participants on E-CITY 2020 and presents recommendations to improve next intervention.

Game play

Integration between part I and II must be better

Part I and II should be better integrated: The intervention should have a head and tail in which part I and part II of the game are regarded as a whole. There was dissent between the participants on the utility and goals of game part I. This is mainly caused by the fact that there was no decent connection between part I and part II for e.g. materials such as the map, which had for example different districts in part I which were not used in part II. So the question was whether to leave out part I or not? After a discussion with the design team it was decided that part I is a valuable contribution, because it serves the following purposes:

- Part I sets boundaries and focus for E-CITY 2020
- Part I gets the participant acquainted with E-City, the materials and bottleneck of the charging infrastructure and customer requirements

Bottlenecks of part I will be connected to part II by the voice of the customer

It is recommended to keep part I of the intervention, but it should have a better connection with part II. Therefore the experienced bottlenecks such as unavailability of infrastructure or no access to charge spots have to be connected to part II. It is recommended to connect parts I and II by including better customer feedback on the way charge spots and customer propositions are introduced in the form of a *"voice of the customer"*. In the voice of the customer the scores on performance indicators such as coverage area and occupancy rate are translated in customer perception and experience. An example of a customer voice can be: *"...The private customers travelling to the city centre are unsatisfied due to the fact that the most charge spots in the city centre are occupied for the most of the time…"*

Budget and restrictions on permits assigned

Consequence of actions: Another observation was the fact that the feedback on actions of the participants was not always explicit enough. Therefore, besides the voice of the customer a budget should be assigned to all players and restrictions on the amount of permits per participant will be introduced by the local government. This has to result in stricter consequences of wasteful action and will create a fear of death since players can go bankrupt.

Customer segmentation too simplified

More realistic customer segmentation: The customer segmentation was simplified too much. There was a one-to-one connection between private and business segments and the requirements on charge speed. Private customers did not want to fast charge, however this is very unrealistic. It is also expected that

private customers are willing to pay for fast charge services. This has recently been supported by a global customer survey which presented the fact that convenience is a larger barrier for the customer to move toward electric transportation than costs. It is recommended to improve the reality of customer segmentation by including a certain percentage of the private customers that is willing to pay for fast charge services.

Struggling with processes is on purpose, because valley of despair is needed

Feedback which is not processed: Some participants found the construction processes a bit unclear in the beginning of the game. They have given feedback to introduce a certain construction card like is used in Settlers of Catan. However, the process is unclear on purpose, since the players are free to do it in their own sequence and manner. They have to find it out by learning by doing.
For the same reason recommendations to simplify the contracts is not processed. It is in line with the purpose to let the participants struggle with achieving their contracts, propositions and infrastructure in the first round. In this phase they have to go through the valley of despair; by first experiencing '*pain' in being unsuccessful to realize the desired performance, secondly they will learn* by experimenting with decision making to improve the performance and in the next years (C) they will experience success in improving their performance and enter the evaluation stage with a satisfied feeling (Wenzler 2008).

Low customer retention is realistic and needed for strict feedback on actions

The participant also provided feedback on the fact that there is not much customer retention or loyalty. Price elasticity was pretty linear. It is recommended to remain this in a next version, because feedback is provided on a yearly basis and yearly contracts are rather realistic. Furthermore, one of the starting points of the preferred market model as set by the bodies of industry of the energy market is that charging market should be a open competitive market (Accenture 2010). Finally, low customer loyalty is also better providing feedback on the consequences of actions such as price setting of the participants.

Facilitation (Introduction etc)

Administration load is heavy, so extra administrative facilitator is added

The most important enhancement concerning the facilitation is the recommendation to add an extra facilitator: the administrative facilitator. The administration of processing the yearly results is somewhat time consuming. The participants had to wait during this time, but while I was stressing to calculate the market results via Excel I was not able to observe and interact with the players.
In the next version an extra facilitator should be dedicated to the administration. The other facilitator can then already execute small evaluations between rounds resulting in better iterative learning loops as defined in the learning cycle by Kolb and Kolb (2009).

Overview of recommendations for a next E-CITY 2020 intervention

- *Increase customer feedback by implementing a "voice of the customer"*
- *Assign budget and maximum amount of permits per player*
- *Improve genuineness of customer segmentation*
- *Add administrative facilitator*

6.4 Conclusions

Before moving on to the final conclusions and recommendations of this research, the value of the framework and findings have been discussed in this chapter. The conclusions on the discussions are listed below.

Expert interviews on market model development;

Limited and confined group of experts

Due to a limited and confined group of interviewees on the market model development framework, it is hard to claim that this framework is the perfect truth. But for the research purpose, the results based on the experience of the experts in former market development trajectories are regarded sufficient to find challenges on which gaming simulation can contribute.

Generalisability;

Results for new market models for future actively designed market models

The results of this study are hard to generalise to other markets such as organically emerged market models, which are less actively designed. The results are at least applicable *to new market models for future markets that can actively be designe*d. It shows that a *market model for a yet practically non-existing market* can be characterized as typical gaming problem as described by Duke. In the case of a highly regulated market in which it is possible to actively design a market model, the gaming simulation can help bringing people together and help them understand and learn about the market model.

Validity of E-CITY 2020

Validity not restrictive for policy simulation

E-CITY 2020 is an application of both a teaching and policy tool. It is a teaching tool in the sense that understanding on roles and processes of the preferred market model has to be conveyed to the participants, but a policy tool in the sense that the preferred market model is still open for different policy options which have to be evaluated. Therefore the gaming environment is rather open. The environment should challenge participants to explore several solutions and the reference system does not need to be presented in a very restrictive way

Effort put in minimizing errors

Much effort has been put in following the guidelines to minimize the risk for errors in the gaming model. The following validation steps are performed. As described above it is difficult to validate the outcome with reality, since little is known about this future market. Therefore the conceptual model for the game is validated with the designers of the preferred market model and the translation to the game is verified with both the designer of the preferred market model and Wenzler as gaming expert. Moreover, during testing players were asked which elements they thought were unrealistic and which were realistic. However, since there is no consensus on the reality of the provider model yet, more industry wide involvement in the design would contribute through an even wider supported picture of the uncertain future.

Impact of design choices on play, reality and meaning

Major design choices and their impact on the reality, playability and meaning of the game are discussed. To get a playable game and to help the participants accomplish their learning objectives, especially trade-offs have been made on not including all roles and processes of the market model, but to represent the roles and processes that are included relatively realistic.

But also many market model processes not included

The result is that some important elements of the market model are not included in the game. The most important elements which are left out are measurement processes and post charge processes such as payment and settlement. These are namely critical for the new market mode and therefore should also be refined further. It is therefore recommended to include measurement, post-charge processes and, charge steering in a next version.

Questionnaire

Value of questionnaire is arguable

The questionnaires which are used to complete the findings from the debriefing in order to evaluate the hypothesises are leading to discussion, as became clear during the evaluation in chapter five. Next time, it would be recommended to think further about the following aspects to create a more reliable result of the questionnaires:

- *Make the questionnaire anonymous*;
- *Involve more people*; only seven participants were involved
- *Ensure that the respondents are real market parties*

Recommendations for game design in uncertain situations such as market model design

We have reflected in this chapter on the development of a game for market model development to identify recommendations for game design in highly uncertain situations. The following recommendations have been made:

Overview of recommendations for development of a next market model game

- Involve relevant primary industry stakeholders
- Start with end-in-mind by deriving the purpose and objectives from the phases in the market model development framework
- Take uncertainties into account and use a agile development method to start prototyping early
- Create starting points for scenarios

Recommendations to improve next E-CITY 2020 intervention

The recommendations for improvement on the E-CITY 2020 intervention are listed below.

Overview of recommendations for a next E-CITY 2020 intervention

- *Increase customer feedback by implementing a "voice of the customer".*
- *Assign budget and maximum amount of permits per player.*
- *Improve genuineness of customer segmentation.*
- *Add administrative facilitator.*

CHAPTER 7 - CONCLUSIONS AND RECOMMENDATIONS

At the end of a research project conclusions on the research questions are drawn and recommendations are provided. First, section 7.1 presents the results on the main research question of this thesis:

1. ***What is the contribution of using gaming simulations for designing market models in the energy related sector?***

Section 7.2 describes the conclusions on the second research question:

2. ***What recommendations can be made for game designing in uncertain circumstances such as the creation of a market model for a practically non-existing market?***

Section, 7.3 describes recommendations for future research on the contribution of gaming simulation to market model development and recommendations to improve E-CITY 2020.

7.1 CONCLUSIONS ON THE ADDED VALUE OF GAMING SIMULATION

This section provides the answer on the following research question:
What is the contribution of using gaming simulations for designing market models in the energy related sector?

The conclusions are described below.

Gaming simulation increases the understanding of the participant of the market model from different perspectives

We conclude that gaming simulation increases the understanding of the participants from different perspectives and can create more knowledge on the preferred market model. A game is able to facilitate thinking from different perspectives; obvious by for example actively putting the participants in a customer's role which is the case in part I of E-CITY 2020. But also less obvious by the fact that they have to think of the customer and of the roles when negotiating or making decisions in the game.
The active experience has given life and texture to abstract concepts (Kolb 1984; pp.21) such as availability of the charge spot, which helps to understand these concepts more easily and triggers to think a level deeper. By letting people experience their decision-making processes it is shown in E-CITY 2020 that consequences for the system such as the accumulated risk can be revealed. As Sophocles quoted around 400 B.C.: "*One must learn by doing the thing, for though you think you know it, you have no certainty until you try".* This is true for E-CITY as well. Not only knowledge is transferred from the market model developers to participants, but by experiencing unexpected dynamics new knowledge is also created on the market model which can be used in further refinement of the market model.

Based on the increased understanding of the market model we recommend paying attention to at least the following requirements for success when further refining the market model for the charging infrastructure:

- First, scrutinize the mutual dependent relation between charge spot operator (CSO) and provider. Pay attention to risk distribution, cooperation and the results on consumer prices.
- Second, optimize the request process for a charge spot. Important issues that should be addressed:

- Who should the customer address to realize a charge spot?
- The sequence of process steps to be performed by the CSO to realize a charge spot. The CSO is engaging risk by closing contracts or buying permits while the CSO may experience problems with for example connecting its charge spot due to grid limitations.

Furthermore, we have some recommendations to increase the value of E-CITY 2020 to further market model design:

- First, integrate the game on the short term for this phase of market model design (Step II.A of the framework as depicted in figure 2.4) with the other processes and roles of the preferred market model. Only some of the processes of the preferred market model were included in the game so far, but the results are satisfying; an increased understanding of both the participants and designers and new created knowledge for further market model refinement. Since, an important part of the market model on payment and settlement is not included yet this could be interesting to get a better understanding on the rest of the market model by extending the game.
- Second, extend and use the game on the longer term towards an implemented market model. We believe that E-CITY 2020 is a perfect starting point for extending and mutating the game along the improvements made to the market model during the refinement iterations in step II.B. Furthermore, it could be a start for a multi-day multi-player game in which a next version in step II.C of the market model is fully tested with enhanced customer segmentation, roles, processes and insights. It is then a tool that can help along the whole decision making process towards consensus on a market model to be implemented.

Gaming simulation design increases the level of understanding of the market model of the designers

The results from the questionnaire and the evaluation lead us to attribute the value of game design to increasing the understanding of the market model system. We subscribe the value of synthetic learning when we had to design the goals, possible actions and scenarios for the game. We agree upon Greenblatt that to do this, a designer "*needs to have systemic understanding – seeing the connections among roles, goals, resources, constraints and contingencies*" (Greenblatt 1998). We needed to understand the 'real' incentives of the roles in the market model, in order to 'model' these in the game to 'simulate' realistic behaviour of the played roles by the participants.

However, in our case there were no primary industry stakeholders, who have to conclude market model agreements, included in the design team. Since in the described intervention consultants from the industry were used, the knowledge increase of the system does not occur within the primary stakeholders of the industry. The value of game design to market model development can be increased when industry representatives are included in the game design process. A sounding board that consists of industry bodies could be an implementation of this recommendation. The game designers can facilitate the design process by enabling the sounding board to use their industry knowledge to meet the challenges future market model and related processes, roles and responsibilities will bring.

Gaming simulation helps in creating a shared understanding among the participants of a possible future for the market model

In line with the expectations on gaming simulation as stated by different gaming simulation experts gaming simulation can help to create a shared understanding of a market model through its ability to let participants experience a certain future. The experiences are made explicit in the group debriefing in which participants share and discuss their experiences of the simulation. This is also what Kolb acknowledges *"when human beings share an experience, they can share it fully, concretely and abstractly" (Kolb 1984; pp.21).*The results of the questionnaire further show a significant knowledge increase and decreased fear for contrary interests.

However, since the respondents were not primary industry stakeholders. Consultants are not representatives of direct primary market firms, who have to conclude market model agreements. They may have different interests and stakes within that market, which could have biased the results. It is therefore recommended to ask these questions again in a next session with primary industry stakeholders to further research the influence of shared understanding on the perception of interest conflicts.

People seem to be better motivated to attend a simulation game than a traditional presentation or workshop

We have found indications that a gaming simulation has a positive image which can motivate participants to come to such an intervention. As expected games are fun (Wenzler and Higgins 2009). However, it is important to understand that still the main driver for participation is the feeling of a sense of urgency and the fact that the stakeholders feel there is something in it for them (Bruijn, Heuvelhof ten et al. 1998).
Furthermore, we have observed a very energetic and enthusiastic group of participants who have indicated that they experienced the intervention as interesting, which increases the chance on a social contract for further participation. This is important in the refinement cycle of the market model design. The intervention should therefore be played with real industry stakeholders to let them sign a social contract for further participation.

7.2 CONCLUSIONS ON GAME DESIGNING IN UNCERTAIN CIRCUMSTANCES

This section provides the answer to the following research question:
What recommendations can be made for game designing in uncertain circumstances such as the creation of a market model for a practically non-existing market?

We have reflected on the development of the E-CITY 2020 game to identify recommendations for game design in highly uncertain situations. The following recommendations have been made.

Design Team

The good part of this team was the combination of gaming simulation experience and close involvement of knowledge on the preferred market model. However, the downside concerning the contribution to market model design is the fact that only the developers of the preferred market model itself were involved. First, the purpose of phase II is to involve stakeholders for further refinement of the preferred market model. Second, not everybody agrees upon the market model and developments in this industry are shaping up rapidly, causing a dynamic landscape. It would therefore be valuable to involve knowledge and views from other stakeholder such as e.g. governmental bodies as the Formule E-Team. We would therefore recommend working with a design team with broader backgrounds, including gaming simulation and representatives from the involved industry.

Design Process

With regard to the design process we have especially reflected upon problems that we have experienced with providing the right specifications and conceptual model, which took rather long. These phases took a long time for two reasons. First, we experienced difficulties in setting the objectives, since the aims of the client were not always clear. Since clients often do not exactly know what they want, we recommend the designer of a market model game to take a look at the different steps of the framework as indentified in chapter 3, which can help to state purposes. We therefore recommend to start with the end-in-mind and to derive the game purpose and objectives of the market model design framework. End-in-mind means:

confirm the objectives with all involved stakeholders and determine the specifications for the game such as the number of players (e.g. 10 players), duration (3 hours), etcetera as quick as possible.

The second reason for delay in the game design process is the fact that we tried to first make a detailed conceptual model before thinking about transferring it into game elements, while it is very difficult to imagine the future market model. Since processes on a more detailed level are not defined yet and therefore hard to map them in for instance detailed process diagrams, we think that a detailed tour guide at this stage cost too much effort. We therefore recommend in the situation of a practically non-existing market which is difficult to imagine, to involve the construction of a detailed conceptual model phase in the iterative process of game transformation and prototyping. This is what Kortmann and Harteveld advocate as agile game development.

However, we experienced it as difficult to make this step in this uncertain situation. It is therefore important for game designers to accept and take these uncertainties into the game instead of trying to fix the uncertainties of a future market in the conceptual model. Reality creates learning objectives and in the case of market model development phase II the objective is exploring the market model, so generating a scenario in which people can experience a future even with uncertainties.

Finally, in line with taking uncertainties into account, we recommend to create starting points for scenarios early. In an uncertain market situation in which many aspects are related it is difficult to create a basis for the game. For example in the case of the charging infrastructure game we were struggling in the loop of the fact that we were in need for customer requirements, but the customer requirements were in turn depending on the technology (e.g. charge speed) and the type of market, which was also unknown and uncertain. In these cases it is important for the designer to dare creating starting points and assumptions for scenarios to make progress.

Overview of recommendations for development of a next market model game

- Involve relevant primary industry stakeholders
- Start with end-in-mind by deriving the purpose and objectives from the phases in the market model development framework
- Take uncertainties into account and use a agile development method to start prototyping early
- Create starting points for scenarios

7.3 RECOMMENDATIONS

Although this research project is finished, the insights of this research have identified other future work that can be performed. These recommendations are divided into recommendations for Accenture on the E-CITY 2020 game and recommendations for future research on the contribution of gaming simulation to market model development.

7.2.1 Recommendations for improvement of the E-CITY 2020 intervention

To improve the E-CITY 2020 game following recommendations for improvement are made. These are mainly based on the feedback of the participant's. Also feedback by the participants which should not be processed into a new version of E-CITY is discussed.

Overview of recommendations for a next E-CITY 2020 intervention

- *Better integrate part I and Part II by increasing customer feedback through implementing a "voice of the customer".*
- *Assign budget and maximum amount of permits per player.*
- *Improve genuineness of customer segmentation.*
- *Extend the game: include measurement, post-charge processes and, charge steering in a next version. Then the game could not only be used in this phase to attract market parties for first involvement, but also along the way to further refine and finally test the high level market model.*
- *Add administrative facilitator.*

7.2.2 Recommendations for science

There are three main recommendations for further researching the value of gaming simulation to market model development in order to increase the arguments behind the conclusions:

- More cycles of interventions are required with primary industry stakeholders instead of consultants. Consultants are not representatives of direct primary market firms, who have to conclude market model agreements. They may have different interests and stakes within that market, which could have biased the results. The element whether stakeholders are willing to close a social contract and commit themselves to further market model refinement can then be tested.
- It is recommended to further co-develop the game with primary industry stakeholders to increase the level of knowledge on the system model of these stakeholders themselves. Since, it is time-consuming to involve all market parties to the design team, a sounding board that consists of industry bodies could be an implementation of this recommendation. The game designers can facilitate the design process by enabling the sounding board to use their industry knowledge to meet the challenges future market model and related processes, roles and responsibilities will bring.
- When having an intervention in the charging infrastructure market, set up a research that measures the long term effects of the gaming intervention. This research has focused on the direct observable short term effects of gaming simulation. Measure whether a gaming simulation leads to quicker market model refinement and ultimo leading to quicker implementation of the market model. These effects can only be measured by plugging the E-CITY 2020 intervention into the real market and perform a long term research of observations till the market model has been implemented.

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APPENDIX A - INTERVIEWS

A.1 INTERVIEWEE LIST

Table A.1 List of interview respondents

#	Date Interview	Name Interviewee
1.	22-09-2010	Mark Schütz
2.	22-09-2010	Mark Post
3.	23-09-2010	Sander van Ginkel
4.	24-09-2010	Mark Davids
5.	28-09-2010	Rolf Künneke
6.	29-09-2010	Hans Kuipers
7.	01-10-2010	Theo Fens

The validated interview summaries are listed below.

1. INTERVIEW SUMMARY MARK SCHÜTZ

Key interview data

Date and Time of Interview	**22-9-2010, 09:30 – 10:30**
Name of the interviewer	Sjoerd Helmer

Name of the Interviewee	**Mark Schutz**
Company / Organization	Accenture
Function	Sr. Manager Resources / Utilities
Experience (with market model development)	- Logic, Lead consultant Utilities - Accenture Lead smart metering and EV - Worked on "stroom opwaarts" - Responsible for EV market model study within Accenture

Summary on what is a Market Model:

Purpose

- Clearly define market roles, responsibilities and processes by self-regulation of the market parties to facilitate inter-company processes, data and information traffic.

Key elements of a market model

- Working agreements on roles, responsibilities and processes

Sectors using a market model

- At least sectors with services on infrastructures which after liberalisation should be opened for third parties.
- Telco, Banking,
- Public Transport, travel, might have one as well

Design process as perceived by interviewee

Questions:

What are the triggers or reasons to develop a market model?

- Mark agrees on the triggers as presented in the interview introduction such as:
    - Sector issues
    - New infrastructure
    - Bills
    - EU and NL law and regulation

Who initiates the development?

- Could be many parties and it depends on the trigger:
    - E.g: in the telco sector it were large players who have acknowledged the useful purpose to set up working agreements.
    - E.g.: In the case of 'stroom opwaarts' it were the ministry of economic affairs and current market parties who initiated the improvement of the market model.
    - E.g.: in the new ecosystem of electric transport it were EnergieNed and Netbeheer NL who have initiated the study to help them be in lead.

Which parties are typically involved in market model design?

- Relevant parties, which could be both consultants and governments as the relevant market which will be affected by the market model.

Which steps can be identified during the development of a market model?

- Mark agrees roughly on the design steps as presented in the interview introduction, but emphasizes the role of process management. The most challenging aspect is the process management part of model market development. Mark expect phase I and Phase II to be more parallel to each other.

Is there a relation and if so what is the relation between law & regulation development and market model development?

- Changes in the regulatory regimes can be a trigger for market model development, but at the same time issues in the sector can result in initiatives for a new market model and changes to the regulatory regime.

How long does it usually take from initiation to implementation of the market model?

- Mark estimates:
    - High level development (phase 1 – 4) length on about 1 year
    - Implementation length between 1 – 3 years

What are the most challenging aspects during the design of a new market model?

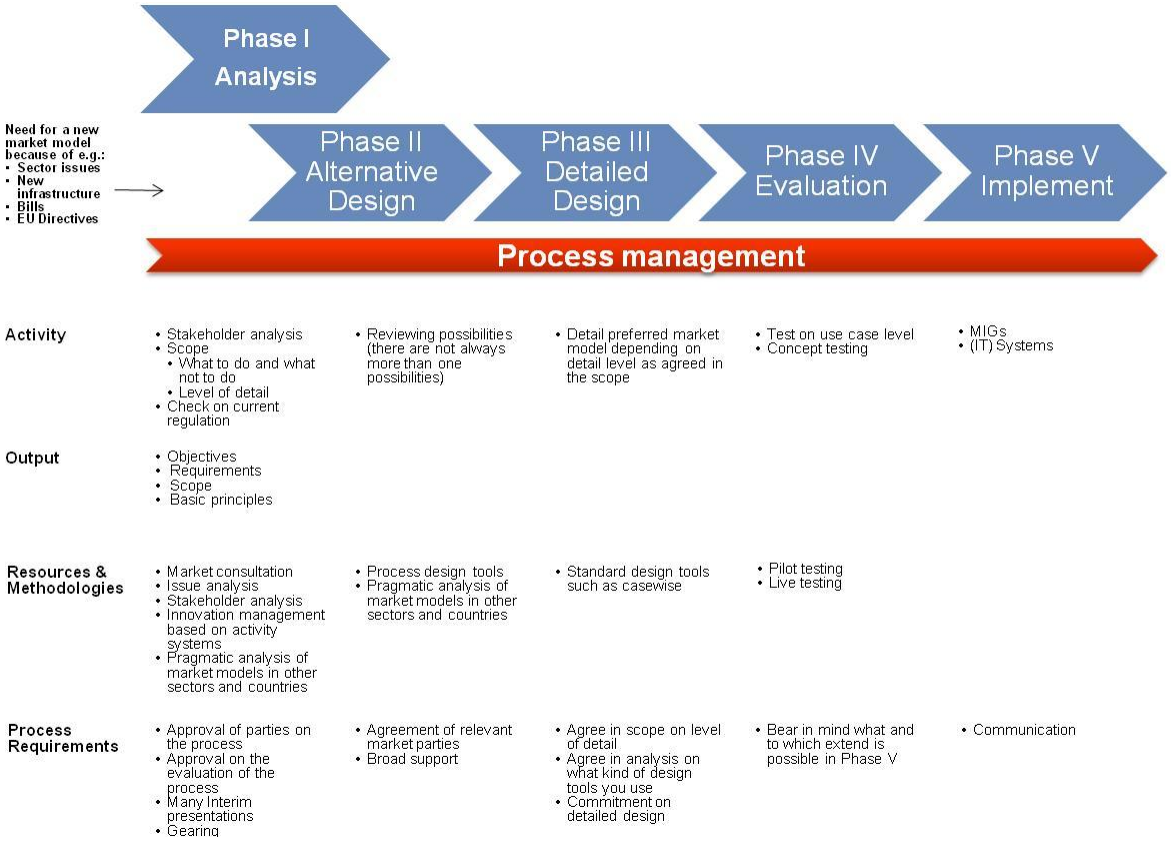
- During the development of new market model for a new ecosystem, such as is the case with electric transport where parties coming from traditional different sectors will meet, it is very challenging to bring these parties together and to let them trust each other. They have to trust each other in the

process, but they also need to understand each other on the content (which could be different in their traditional separated sectors)

What have you experienced as troublesome and what elements do you think that could be speed up or improved during the development of a market model?

- Testing of high level market models on use case level could be improved.

What methods and tools are used during the development?



2. INTERVIEW SUMMARY MARK POST

Key interview data

Date and Time of Interview	**22-9-2010, 11:00 – 12:00**
Name of the interviewer	Sjoerd Helmer

Name of the Interviewee	**Mark Post**
Company / Organization	Accenture
Function	Manager at Accenture strategy specialized in utilities
Experience with market model development	- Worked on different elements of 'stroomopwaarts' such as 'leveranciersmodel', 'capaciteitstarief' and 'smart meter market model' - Determined the impact of this new market model for different organisations

Summary on what is a Market Model:

Purpose

- The purpose of a market model is to translate codes into operational working agreements in order to implement the codes and legislation. Legislation is translated by supervisors into codes which are subsequently translated into operational working agreements by the market parties themselves.

Key elements of a market model

- Roles, responsibilities and process flows on three different levels:
    - High level market process models (MPM)
    - Detailed process models (DPM)
    - Messaging models such as Message Implementation Guide (MIG)

Sectors using a market model

- At least sectors with liberalised infrastructure
- Telco, banking,
- Public transport might have one as well

Design process as perceived by interviewee

Questions:

Which steps can be identified during the development of a market model?

- First, it is important to make a distinction between new market model development and issue refinement. EDSN has issue clubs who meet on a monthly basis to discuss sector issues. For now we are talking about new market model development.
- Mark sees the design steps a bit different than proposed in the interview introduction acknowledging the three different detail levels of a market model; MPM, DPM and MIG. (see attached ppt. with design process according to Mark)

Is there a relation and if so what is the relation between law & regulation development and market model development?

- Sector agreements in the 'stroomopwaarts' program have resulted in changes in law. Law can be a trigger for market development, but market model development can also result in changes in the regulatory regime.

- Mark his experience is that market supervisors and legislators are carefully listening to input from the sector as well.
- So market models have a continuous relation wit law & regulation. Market model development happens in the context of a regulatory regime.

How long does it usually take from initiation to implementation of the market model?

- It is difficult to give an average development length. Mark would estimate a total development length of 4 – 7 years (from trigger to working market model)
    - Analysis 1- 2 years
    - High level MPM design 1 year
    - DPM design 1-2 years
    - Implement and sector testing 1-2 years
- Development process is rather long, but time is needed to gain trust and to get the parties coming from the same starting point.

What are the most challenging aspects during the design of a new market model?

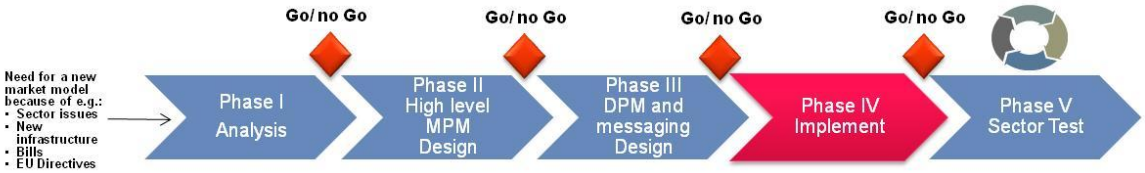
- Not every company or organization has the same structure and therefore organizations have its own preferences for and stakes in a certain market model. It costs a lot of effort and time to convince each other and to gather agreement for a market model option. It costs time and you cannot always force a quick solution without losing organizations' support.
- It is also very important to stay high level during the high level MPM design phase. The risk is that parties who are everyday involved in detailed processes such as switches are tended to go in too much detail in this phase already. So you should parties let them gain confidence in the process and let them realize that experts and operational colleges are going to design these detailed processes in follow up phases.
- A large challenge during the process is to keep all parties up to date and on the same information level. Informing and communicating parties is very important and very challenging!

Do you think that gaming simulation can be relevant during the development of a new market model? And in which phase?

- Mark expects that gaming simulation can be especially relevant serving as a test at the end of the high level MPM phase, because market model design is mainly a paper exercise while gaming simulation can help to make it tangible in order to discover issues or bottlenecks earlier than in the sector testing phase. Gaming simulation might be useful to inform, help parties to understand and accepts alternatives.
- But Mark expects that simulation can play a role at the end of every phase, although he doesn't know whether this should be gaming simulation or other simulations. In fact doe sector testing also mainly happen in a simulated environment.

The answers on the following questions are depicted in the figure on the design process as attached in the powerpoint 'interview summary on the design process'

- **What are the triggers or reasons to develop a market model?**
- **Who initiates the development?**
- **Which parties are typically involved in market model design?**
- **What methods and tools are used during the development?**
- **What process requirements are needed for each step?**
- **What are the most important elements to be tested for a market model?**



Activity	•	• MPM design in different working groups coordinated under PBM • High level design is based on many discussion	• Develop DPMs and messaging documents such as MIGs	• Implement market model in own organizations • Develop organization processes • Develop (IT) systems	• Sector testing
Output	• High level basic principles and alternatives to evaluate and design in Phase II	• MPM • Design document argumentation behind chosen MPM from different working groups	• DPMs and MIGs		• Implemented market model including the necessary infrastructure and (IT) systems
Resources & Methodologies	• Small committee involved to gather ideas and information from within the sector	• Market parties, if desired supported by consultants. • Government is not actively involved • Current market model • Industry best practices • Lessons Learned • Market models from other sectors and countries • So far Mark knows not many theoretical approaches such as game theory are used	• Market parties • In energy sector the EDSN has a prominent role in this phase		• Sector chain testing • Readiness assessment • Test environment
Process Requirements	• Commitment to process and to Go / No Go moments	• Check on the content • Not really tested, but high level calculations on e.g. the amount data traffic in a certain alternative • Commitment for high level MPM Go	• Commitment for a DMP and MIG Go	• Readiness for sector testing	•

3. SANDER VAN GINKEL

Key interview data

Date and Time of Interview	**23 -09-2010, 11:00**
Name of the interviewer	Sjoerd Helmer

Name of the Interviewee	**Sander van Ginkel**
Company / Organisation	Accenture
Function	Senior Executive Strategy
Experience with market model development	- B'Con - Stroomopwaarts

Summary on what is a Market Model:

Purpose

- A market model is the model which is the basis for a market; it is facilitative to a market.

Key elements of a market model

- Roles and relations (products, service, money, information) between roles which are anchored in law & regulation, codes, sector wide agreements, bilateral contracts between market parties and behavior of market parties.

Design process as perceived by interviewee

Questions:

What are the triggers or reasons to develop a market model?

- The definition of a developing a market model should be clear. Are you considering the development of a 'new' market model or the refinement of a market model? The first is triggered by a disruptive change such as the liberalization of a sector or the introduction of new technology as electric transport. The latter category of refinement is a continuous process. Current market models are under continuous consideration for improvement. Sector issues can lead to a refinement of the market model.

Which parties are typically involved in market model design?

- Initiatives are taken by both government and market parties. There are actually two parallel kind of development flows; one of designing and testing and one of discovering by experiences of first mover customers or pilots such as current electric vehicle owners.

Which steps can be identified during the development of a market model?

- Be aware of the fact that it is not such linear process as depicted in the 'waterfall' design process as introduced. Market model development is a very iterative process and continuous under refinement.

What are the most challenging aspects during the design of a new market model?

- It is very challenging to consensus. Strong leadership is needed to align all parties.
- It is very important and challenging to think from a customers' perspective. The model should be convenient from the customer's perspective. The eclectic vehicle driver needs a good charging experience.
- You should take a pragmatic design approach which starts with designing the market model on high level without starting to design the detailed exceptions.
- Finally, Sander recommends involving the operational designers of (IT) systems in an early stage of the design process.

What methods, theories and tools are used during the development?

- Market models are not designed using explicit scientific books or theories. Though, Sander believes that the central ideas behind theories such as the theory of transaction costs are implicitly used. Transaction costs are e.g. an important criteria when designing market models. Sander does not see the lack of theories as a gap. Sander does not believe that involving academic experts will drastically improve the design. The high level design of market models is more a functional design process than an optimization process. High level market model designing is a combination of design efforts of conceptual modeling behind a desk and learning from customer experience.

Do you think that gaming simulation can be relevant during the development of a new market model? And in which phase?

- Sander believes that gaming simulation can have a relevant role in the development process of designing and testing in which gaming simulation can help to test a high level market model on key relationships and striking points.

4. MARK DAVIDS

Key interview data

Date and Time of Interview	**24-09-2010, 11:00**
Name of the interviewer	Sjoerd Helmer

Name of the Interviewee	**Mark Davids**
Company / Organization	Accenture Strategy
Function	Senior Manager Strategy specialized in Utilities
Experience with market model development	- Supported some working groups on among other things 'leveranciersmodel' and 'capaciteitstarief' in the 'stroomopwaarts' program - Developed national business case for smart meters in the Netherlands

General information

- The relevance of this design framework can be rather high since the current energy transition is asking for more new or adapted market models for among other things: distributed generation, demand side management and electric transport.
- Put the market model for electric transport in international perspective.

Summary on what is a Market Model:

- Set of working agreements between market parties for the sake of proper provision of customer services.
- In the energy market, market models became relevant after the liberalization. The large information flows needed for the process of nomination, allocation and reconciliation asked for agreements between parties. These agreements are called a market model. In the energy sector the agreements are codified in the 'reference model'.

Design process as perceived by interviewee

Questions:

Which steps can be identified during the development of a market model?

- Mark agrees on the design steps as presented in the framework, but would change the analysis phase to "analysis and global design'. Mark explains that in the first phase high level alternatives will be developed already. The chosen alternative will be elaborated in more detail in the MPM phase.
- The study to a market model for the charging infrastructure for electric transport developed by Accenture is an example of an output of phase I.
- You should be concise in the scope of this development process. This process is considering the development of a new market model or market model that concerns large disruptive changes. It is not considering refinement of small issues in a current market model.

What are the most challenging aspects during the first two phases of the design of a new market model?

- It is very challenging to involve all stakeholders in the process that you are going through to ensure that they can give their input and that they will be happy with the outcomes.

- To ensure that there is a clear and explicit process that you will go through to ensure that the stakeholders know things like when to give input and what are the next steps. Process management is very challenging.
- Try to keep a market model as simple as possible. This will help that a large group really understands the market model. Mark experienced during the 'stroomopwaarts' program that there were only a few people left who understood the market model. A market model should be kept simple in its concept. Try to minimize agreements, leave as much as possible to organizations themselves. Try to only set agreements on the content that are really needed to solve a certain design issue.

What theories, methods and tools are used during the development?

- Design on high level is about conceptual modeling. Mark therefore sees not many specific theories used in the first phases of the market model design cycle. On the other hand you will need people who have the ability to think abstract.
- Second, Mark does not see the need for specific tools, because of the fact that market model design is not necessary about optimizing parameters. In design exercises where the purpose is to optimize certain parameters you can use for example computer aided design tools. In the case of high level market model design the purpose is to develop different high level concepts. Mark identifies one optimization objective for market model development; minimize the amount of agreements and information exchange to arrive at a certain goal.

Do you think that gaming simulation can be relevant during the development of a new market model? And in which phase?

- Mark feels that (gaming) simulation is currently being used at the end of the development process during the implementation/sector test phase where gaming simulation is used as a training tool to increase understanding.
- Mark thinks that gaming simulation can also be relevant in the early high level design phases. He feels that there are two different roles at the early high level stages:
    - Bring stakeholders together and increase understanding compared to the paper process pictures
    - Marketing role: an attractive and fun way for press and decision makers to live through a proposed paper model. The earlier you make a gaming simulation the more benefit you can gain along the way of the design cycle.

5. ROLF KÜNNEKE

Key interview data

Date and Time of Interview	**28-9-2010, 13:30 – 14:30**
Name of the interviewer	Sjoerd Helmer

Name of the Interviewee	**Rolf Künneke**
Company / Organization	Delft University of Technology
Section	Economics of infrastructures
Experience with market model development	- Specialized in regulation, liberalization and analyzing and designing preconditions for market functioning

General / Additional information

- Difficult to give a blueprint of a standard development process. The assumption behind this development framework (as presented by Sjoerd) is the manageability of such a process. It is a rather Dutch model in which you assume that you will find consensus by 'polderen'. In the US the process will be different; like mobile Telco they just start without looking for consensus. Washington will not regulate what kind of EV there will be, that is against the American feeling of freedom.
    - For example in Denmark wind energy is developed against the will of the government. In the sixties a farmer has build a windmill and connected to the network to see whether something would happen, but nothing happened. This has resulted in large cooperatives with Denmark as a large wind energy country at the moment.

Summary on what is a Market Model:

Purpose

- A market model contains the preconditions under which a market can function given the objectives for certain market.

Key elements of a market model

- Role and responsibilities
- Agreements on what domains should be regulated or should be left to market parties

Sectors using a market model

- All markets have a market model, since all markets need preconditions under which the market can function. Even product markets needs agreements on decision rights, property rights, competition policy, guarantees, liability, safety norms etc.

Design process as perceived by interviewee

Questions:

What are the triggers or reasons to develop a market model?

- Künneke agrees on the triggers as presented in the framework

Who initiates the development?

- Both government and market parties can take initiative but often market parties see chances and opportunities for a new product or service market to gain a competitive advantage and then they might encounter the urgency for agreements or a dialog with the government:

- E.g. currently, in the 3 dimensional television market have market parties taken the initiative to develop agreements on standards.
- Looking at the GSM market you see that in Europe the government decided to take the lead in developing a standard (GSM) while in the US they have left this to the market which has resulted in different standards.
- In some cases market parties or sectors also need to lobby and start the dialog with the government to stimulate certain developments (subsidies, tax benefits etc.)

Which steps can be identified during the development of a market model?

- In the first phase you should define what you want with the market, what are the objectives, performance criteria and evaluation criteria. Then you can think on issues like how to let this function in a market, whether this is even possible by market functioning and if so under which preconditions such as regulation, physical, technical and market party agreements is this possible.
- Künneke also points out the relation with the technical architecture. Infrastructural sectors and networks might result in natural monopolies. It is important to think about the influence and preconditions of the physical technical infrastructure when developing a market model. Think about whether there are critical functions that should be supported such as load management in the energy sector or the economical settle system for electricity supplies.

What theories, methods and tools are used during the development?

- Künneke sees a range of theories that are applicable to market model design such as:
  - Competition policy theories to understand issues like possible entry barriers, potential monopolistic power or too much competition.
  - Transaction costs theories to identify the transaction cost of the system and to identify who should bare these costs.
  - Institutional economics to understand whether the correct incentives are in place to invest and maintain for example the charging infrastructure?
  - Co-evolution and coherence theories to identify requirements for a market model from the technology
- Künneke does not know whether these theories are really used during the design but feels it desirable

What process requirements are needed for each step?

- Künneke agrees on the importance of commitment.

Do you think that gaming simulation can be relevant during the development of a new market model? And in which phase?

- Künneke sees a role for gaming simulation during the whole design process. In the early phases gaming might be relevant in identifying the degrees of freedom, where do we go, what are the development paths etc. Though, a game is learning as well, so a game developed in the early stages might be adapted and used during the rest of the design and implementation process as well.
- Interesting gaming element in the high level design phases is to regard whether certain market design result in a monopolistic market (resulting in high prices) or on the other hand e.g. in a market with too many competition resulting in a lack of willingness to invest (due to high risks or long payback periods).

6. HANS KUIPERS

Key interview data

Date and Time of Interview	**29-09-2010, 16:00 – 17:00**
Name of the interviewer	Sjoerd Helmer

Name of the Interviewee	**Hans Kuipers**
Company / Organization	Accenture
Function	Senior Executive
Experience with market model development	- No specific experience with the development of explicit market models in new partly regulated sectors, but much experience as consultant supporting telecom companies on how to deal with the implications of market model changes

Summary on what is a Market Model:

- All sectors might have a certain market model, but there are large differences between market models in more regulated markets and market models in free e.g. (product, FMCG) markets. There are market models which are highly regulated and market models which almost purely consist of market party agreements and probably everything between on the depicted spectrum below:
- Central regulated market <----------> free market
- On the left side of the spectrum there might be *highly regulated market models* which can be designed. This is possible in highly regulated markets with a central regulating force such as the energy market. The market model are then needed to:
    - Either support or safeguard public values in sectors with public functions (e.g. water, energy sector).
    - Or to start up new markets after liberalizations (e.g. liberalization energy, post, telecom, healthcare market) or the introduction of disruptive new technologies (EV). In this case it is important to recover and to arrange which parties will or should take up which roles.
- On the right side of the spectrum market we find the more '*organically emerged market models*' in sectors which are more dominated by free markets and where there is no central institution that has to ability to design a market model. In this case it is an organic process in which market parties have stakes to develop roles in order to support their businesses.
    - This is the case in the current telecom market in which 80 – 90 % is organized by agreement between market parties and not by the OPTA in such.
    - An example the Telco market where there is still central power is the cable market in which access to cable infrastructure is still regulated by the OPTA.

Purpose

- The first type of market model has an explicit goal: to start up new markets, e.g. the EV market
- The organic version does not have an explicit goal. Individual actors try to maximize their business driven by self interest which inevitably leads to certain agreements between market parties.

Telecom market

- Hans does not know whether Telco market models are also explicitly codified and called market model, but there are things that are (centrally) regulated in the telecom sector are:

        - Competition rights
            - E.g. KPN is not allowed to offer services on the cable
            - Some minimum prices to prevent large parties to outcompete small parties resulting in monopolistic powers (NMA based)
        - KPN has e.g. some supply obligations w.r.t. phone boots and traditional phone networks
    - In the telecom market settle & clearing is set, but this is performed by market parties. Clearing houses are market parties as well (EDS).

Design process as perceived by interviewee

Questions:

What are the triggers or reasons to develop a market model? And who initiates the development?

- Depends on the purpose:
    - In the case of Electric transport the government might start to formulate objectives to start up the market for the sake of e.g. achieving the Lissabon goals. In order to do this they might give (Semi-) public parties or industry bodies such as EnergyNed or Energy Chamber a certain authority to start designing a market model in order to establish regulation and agreements.
        - Another example from the telecom sector is the founding of BUMa Stemra which safeguard and coordinate the author rights.

Which steps can be identified during the development of a market model?

- Hans recognizes the presented design steps and sees the analogy with the development of agreements and processes on number portability (COIN database) which is part of the telecom market model.
- Hans thinks that it is possible to design a market model but under certain conditions:
    i. There need to be a high regulated market in which the market model does not emerge organically.
    ii. There must be a legal framework within it is possible to develop a market model and preferably a framework which gives authority to a certain party.
        1. E.g. sometimes you need to perform actions which might not be desirable from a competition point of view, but which are necessary to start up a market. Then agreements are necessary with the purpose to start up the market.
    iii. Finally, you should be a relevant stakeholder within the chain on which the market model has its impact.

What are the most challenging aspects during the design of a new market model?

- In the case of a new market the MPM phase is very important since it defines who should take which role, so you need to find out who and why a party would take up a role. You need to find viable roles for commercial parties within the market model and need to make agreements on many issues such as plug incompatibility and load management in which the technology is not decisive yet.
- It will be challenging to start up interaction; process management.

Do you think that gaming simulation can be relevant during the development of a new market model? And in which phase?

- When a first high level market model is developed it can function as test and used to iteratively improve the market model. The game need to be flexible in order that roles and rules can be adjusted and both the game and market model can learn.

7. THEO FENS

Key interview data

Date and Time of Interview	**1-10-2010, 09:00 – 10:00**
Name of the interviewer	Sjoerd Helmer

Name of the Interviewee	**T.W. (Theo) Fens**
Company / Organization	TU Delft,
Section	Economics of infrastructures
Experience with market model development	- 10 years of both pragmatic and scientific experience in the energy market - Experienced the whole implementation process of market models in the energy sector after the liberalization.

General information

- Be explicit and scope the design process in the right way. Fens expects that this game design is about the settle infrastructure for EV.
- Be neutral in your thesis; e.g. wording like 'working market model' is risky
- Make a value chain to help you identify market imperfections
- Don't see technology as a showstopper in the EV model, but you could incorporate time as a criterion or prerequisite.
- www.ucpartners.eu → energy transformation

Summary on what is a Market Model:

Purpose

- The design of the governance structure which enables commercial activities.

Key elements of a market model

- There are different forms of market models from on the one hand completely free markets (auctions) to regulated markets where the price is not the result of demand and supply but is regulated by an entity in the regulated domain.
  Market models contain the following elements:
  - Market mechanism
  - Actors
  - The commodity

Design process as perceived by interviewee

Questions:

Who initiates the development?

- Market parties will initiate to develop a market model if they feel that new markets or technologies have impact on their business. In the case of electric transport E-Laad.nl and EnergyNed are examples of parties who felt the urgency to start something. The role of the government should be more facilitating and performs checks by ministry of economics and the NMA.

Which steps can be identified during the development of a market model?

- Fens recognizes and agrees on the design process as presented, but would advise to replace specific IT terms such as MIG by more generic terms such as information exchange.
- Fens thinks that more or the less the process as presented is also used during market model design after the liberalization of the energy market.

Is there a relation and if so what is the relation between law & regulation development and market model development?

- The development of law & regulation and market models is highly related and a very iterative process.

What are the most challenging aspects during the design of a new market model?

- Fens does expect that it will be very challenging to align interest since actors will have their own ideas on how the roles should be. It will also be challenging to define transactions between the parties as concrete as possible.
    - What is the exact transaction?
    - Operationalize the transactions

Do you believe that it is possible to design market models?

- Fens believes that market models can be designed.

What methods and tools are used during the development?

- Developing market models is a very pragmatic process; market parties come together, set-up workgroups, make agreements on a process, develop market model agreements and then it goes to ministry of economic affairs and NMA to check it on enforceability.
- Ministry of economic affairs and NMA might use more theoretic tools or theories to check the models.
- Theories that can be used:
    - Game theory
    - Transaction Cost Theory
    - Innovation theory from van Geels

APPENDIX B - EXPERT INTERVIEW ON LIMITATIONS AND EVALUATION OF GAMING SIMULATION

Key interview data

Date and Time of Interview	**17-02-2011, 16:00 – 18:00**
Name of the interviewer	Sjoerd Helmer

Name of the Interviewee	**Dr. I. (Ivo) Wenzler**
Company / Organization	Accenture, TU Delft
Specialised in:	Gaming simulation

What are the limitations of gaming simulation?

- Limitations have to be seen in relation to another method, such as an presentation or simulation and in relation to the objectives
- General problems that Wenzler has experienced in his gaming simulation career:
  - Gaming simulation (GS) is used for complex problems that have to be modeled on a certain abstraction level, so not every problem is suited for gaming simulation. So the applicability depends on the problem. If a detailed simulation or even pilot is necessary then GS will not fit.
  - So whether it has limitations depends on the goal:
    - If there is for example only one hour time, a GS might not fit
    - If 1500 people should be involved it is possible, but might be challenging and expensive to use a game
  - The limitations of gaming simulation does not come from the intrinsic characteristics of the game itself but from:
    - the *acceptation of the users*, because of the following:
      - Not everybody is willing to play
      - Sometimes gaming simulation is not regarded as a serious intervention
      - A game is always on a higher abstraction level than reality. Some players are not able to think on this level and therefore do not accept it as reality
      - Gaming simulation is often claimed as a safe environment. This is true for the fact that it is an experiential environment in which nobody is harmed or is going bankrupt. However, it is not always a safe environment from a personal relations perspective. Some people are scared to experience losing face, especially in very hierarchal cultures.
    - Costs; a gaming simulation is more effective in learning but often also more expensive to develop than a presentation. The development time is longer. The perception of value is not always seen, if costs are a hard requirement.
    - Time; to let people experience many elements in an hour is difficult. However, presenting many topics in an hour is possible but also hard to remember for the audience.

How to measure contribution of game design to market model development?

- You have evaluation forms of the design workshops
- You have observed the steep learning curve of me and Rutger
- And you also have observed that Paul & Maarten were challenged on their market model and that they have created new insights
- Furthermore learning during design is such strong since:
    - It forces the developers to think in a structured manner such as processes and roles
    - By building a model you learn from reality
    - It is an iterative process from problem to conceptual model to game in which you can learn in every iteration
    - It is a group process of which the participants have commitment to a physical product instead of only a document or minutes
    - All the knowledge block should be integrated, because the game is a test
- So by designing a game you learn how the system (market model) works
- And by playing the game you test it, learn about scenarios, move boundaries and refine.

APPENDIX C - GAMING SIMULATION BACKGROUND

Background

Regulation on air quality and CO2 emissions enforces the transportation sector towards structural and radical changes. The technological developments in battery technology of last decade have enabled the current possibilities for electric transport. The expectations for the electric car are high, but the effects are unknown to a large extent. Charging infrastructure will have a central role in the development of electric driving. It is a pre-requisite for successful and convenient electric driving. The infrastructure should be affordable, reliable, safe and convenient. The charging infrastructure involves the process of taking care of charging the battery in the electric vehicle. The infrastructure consists of charging stations at various locations, including the communication and payment infrastructure (Accenture 2010).

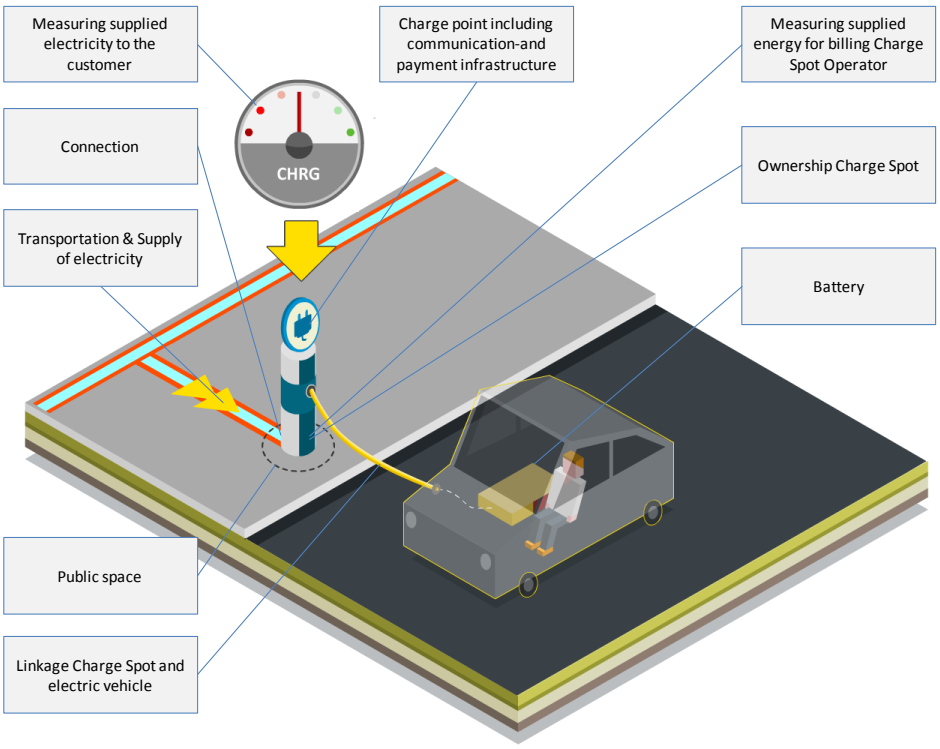


Figure C.1 The Infrastructure consists of: the power grid to transport the (renewable) produced electricity consisting of a transport and a distribution network, the connection on the electricity network with a certain capacity, the charge spot on the connection, the measurement of electricity, the link between charge spot and the electric vehicle and the battery in the electric vehicle (Accenture 2010 : pp.17).

Charging options

There are different possibilities for charging; charging at different speed and charging at different locations. There are many scenario's possible and it is still uncertain how the future charging infrastructure will look like. This subsection will briefly introduce the different charging options.

Normal charging

One of the most obvious options for charging is charging your car at the common low current grid. The car can then charge 1-phase (230V) or 3-fase (400V, power current) using alternating current. Maximum power is 40 kW (3x63 A). The charger is located in the car. Normal charging could be located at different locations as depicted in the figure below. Normal charging means that a car needs to be connected at the grid for a rather long time. This provides opportunities for service development around this charging type, such as shaving load profiles (peak shaving) and regulating misbalances on the grid.

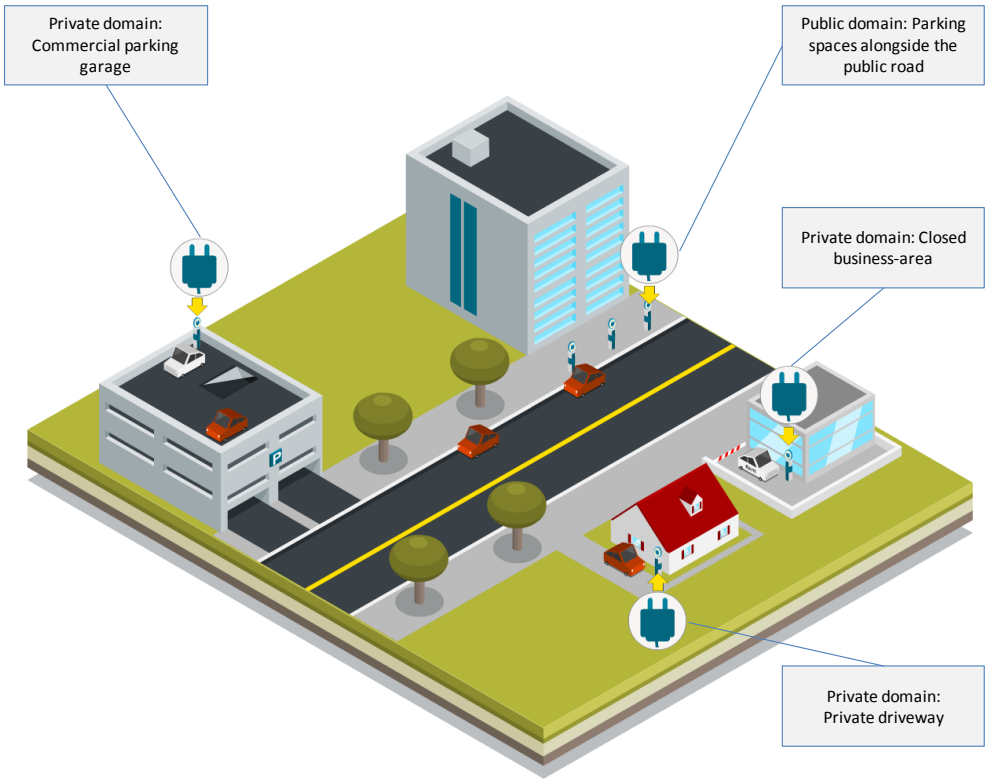


Figure C.2 Different charge locations.

Home charging makes use of the house connection. If necessary an additional grid connection might be needed. This is the same for a company connection at work. At commercial parking areas power is supplied by a business-to-business (B2B) grid connection with additional meters. Finally, there is the possibility for charging at public parking at the road side. An additional grid connection with additional meters is necessary for this option.

Home and work charging can make use of current connections without extra cost. Though charging 26 kWh will take 13 hours using normal sockets. This will lack convenience with bigger batteries. Parking lots offer the possibilities for charging. Identification and payment start to play a role here. Payment by the parking tariffs can be a solution.

This thesis focuses on public curb side charging. Most cars in the Netherlands are parked most of their time on the road near their home. Using extension power cord would result in dangerous and chaotic situations. This means that almost every parking spot should have a charge opportunity resulting in more than 7 million public road side charge spot needed (P1 2008 : pp.31).

Quick charging

Quick charging is using 500V direct current. This needs another plug and the charger is located in the charging station. The impact on the grid is unknown at the moment. Epyon is one of the companies that already is able to install quick charging spots. The connection needs to be able to transport between 50kW and 250kW.

Another possibility for quick charging is provided by Betterplace; battery swapping stations. Though it sounds promising, there are complications. To operate this in a viable way it means that all cars should have the same battery package. This seems unrealistic.

A final possibility is ultra quick charging, which also comes with some practical issues. To charge a future battery of 100kWh, which will provide a car electricity for about 600 kilometer, in 5 minutes will demand about 1,5 MW (500 V DC, 3.000A). This will need a 10 kV connection for one charge spot and will impose enormous fluctuations on the grid. At the same time the advantages of possibilities for grid services, such as power storage and peak shaving do not occur in this situation.

Challenges to the charging infrastructure

There are still many economical-technical, political and managerial challenges in the transition towards this infrastructure. The main economical-technical issue is the battery and charging technology. Battery capacity and charge speed are limiting vehicle range and are rather expensive. Also the expected impact on the grid is uncertain. There are also political issues, such as the importance of internationals standards on charging requirements such as a universal plug. Standards should allow industry to organize itself in a competitive market (Bleijs 2009). Charging infrastructure is essential for functioning of society and economy in the next generation transport infrastructure. It is therefore a so called critical infrastructure with public interests.

Problem

This thesis focuses on one of the managerial issues; the market model that has to set the working agreements between market parties on roles, responsibilities and processes. In 2009 it became clear that the electric car as customer does not fit very well in the current market model for the Dutch electricity sector. The current market model is based on customers who might switch energy supplier but who are not switching grid connection. The expectation was that an electric car driver wants to charge on more spots a day (at home, at work or at the gym for example). Furthermore it was expected that a driver would pay directly. The current market model does not facilitate these aspects. Furthermore, the new market should deal with many information processes and interactions between actors which should be effectively taken care of by making agreements on roles, responsibilities and processes.

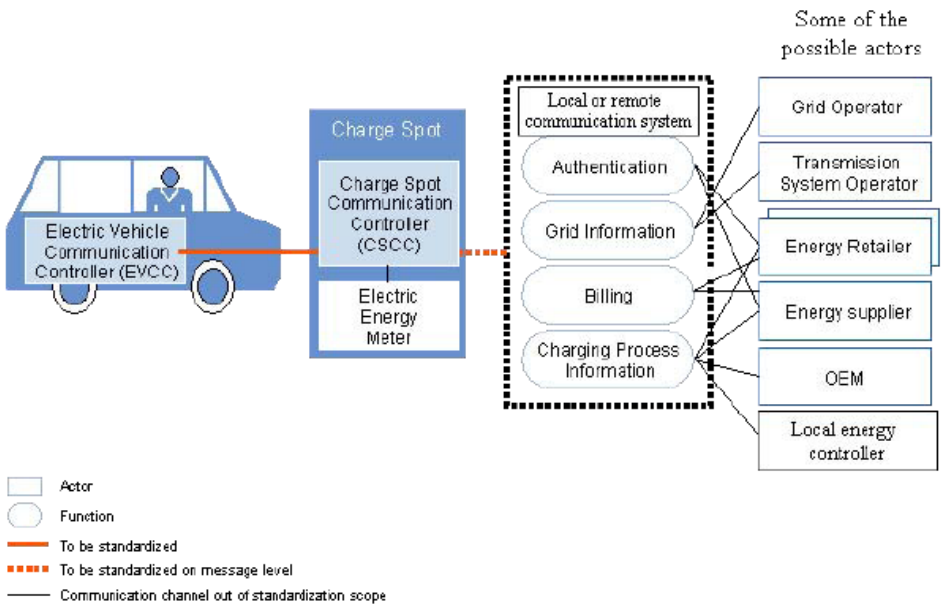


Figure C.3 Picture with overview of communication systems and possible involved actors (Bleijs 2009).

Therefore, Accenture, commissioned by EnergieNed and Netbeheer Nederland, performed a study on the market model charging infrastructure for Electric Transportation. The goal was to streamline the public discussion by providing a discussion model.
The study was started with a market consultation with energy and grid companies, car manufacturers, suppliers and operators of charge spot, local governments and clubs such as the ANWB. The results of the market consultation are used for the development of starting points of the market model, preferences for the design choices and weighing the criteria to score the different alternatives.
Widely supported starting points for the market model are:

- Easiness of use for the customer
- Minimum impact on current law, regulation and processes
- Scalable to a large market of 1 million vehicles
- Drivers of electric vehicles must be able to charge at all charging points in the public domain;
- Drivers from abroad must be able to charge at all charging points in the public domain;

The outcome of the market consultation has further provided the following widely supported design choices for a market model:

- Charging infrastructure must support multiple service providers per charging point;
- Customers must be able to pay for a charging transaction using common payment methods (PIN, Chipknip, OV-chipcard, monthly bill, etc.);
- All market parties except the Car manufacturers, think that the ownership of charging points in is private hands;
- New market roles, that emerge specifically for electric transportation must not be regulated by central governments unless there is a profound reason[2];
- Market parties foresee an important role for local governments in the approval for the realization of charging infrastructure in the public domain;

[2] When appears that the market is not taking up correctly, or when the market is threatened by the emergence of a monopoly.

- Use the existing tariff structure that is used in the energy sector for billing the transport and supply of Electricity. This is more transparent for the party that is connected and using the existing tariff structure covers the costs of regulated parties such as the grid operator.

This means that the charging of electric vehicles should develop itself in a free market environment the coming years. Furthermore, current payment and tariff structure should be used as many as possible.
The parties have different or unclear view on the type of contract that a customer has for charging services (coupled to a residential contract or a separate contract for an electric vehicle and the exact way of payment).

Provider model
The study has finally provided the preferred market model; the provider model with the ability for Direct Pay method. The provider model contains a total of nine potential roles in market relationships of which are three new main roles; the provider, the charge spot operator and the charge spot owner.
Since it is the intention to provide this as a free market it is of great importance that there are many parties. It is also possible that parties take up more than one role, such as provider and operator. The conceptual model of the nine roles of the preferred market model en its environment including responsibilities and flows is depicted in appendix D.

In the current market model for electricity, the market role of grid operator has been regulated. The reason for this is the fact that the supply of electricity is transported over an extensive network which, if owned by a commercial party, might result in disproportionate market advantages. In addition to this the energy infrastructure is a critical infrastructure with public interests such as the insurance of supply involved. Investments in and maintenance of the network are of importance for the insurance of supply, therefore the government wants to stay in control.
A comparable situation may occur in the market model for the charging infrastructure for Electric Transportation in which the charging infrastructure is owned by a (commercial) market party with other market parties offering services on the charge spot. However, the starting point is to make this market a free market.

The study also provides a high-level description of the activities taking place from the request for a charge spot to the payment for the energy consumed. The process model is depicted below. An overview of the process model is provided in figure C.4. The worked-out processes depicted in swim lane diagrams can be found in appendix E.

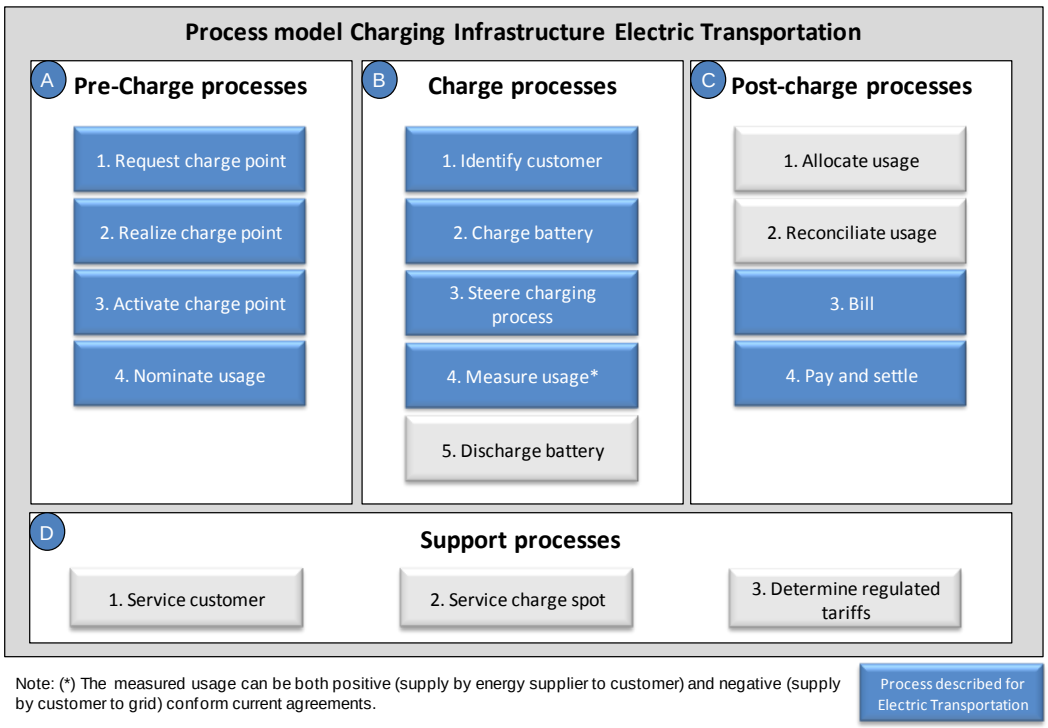


Figure C.4 Process model Charging infrastructure (Accenture 2010).

The preferred market model and its proposed processes have no impact on the roles and responsibilities of existing roles in the current market model for electricity.

Practically this market model could work as follows: An Electric Vehicle driver has a contract with provider Nuon and arrives at a charge spot of charge spot operator E-spot. Using his RFID card, the back-office systems find out that the driver is a Google client and grants access. The driver plugs in his car and car got charged. The operator has its own energy contract with Essent. The operator measures the usage of the customer and when the customer comes back a couple of hours later to plug out his car he sends a bill to the clearing house. The clearing house send a daily bill to Nuon and Nuon collects the customer's transactions and bills the customer on its turn on a monthly basis. Essent sends a monthly bill for the usage of all connected charging stations of E-spot.

Challenges ahead concerning the market model

There are still many uncertainties around the new market for charging infrastructure with regard to technology, (customer) needs and institutions.

The market is furthermore difficult to imagine, because the market for future charging infrastructure is not similar to the current market for fuel-stations. Where the current fuel market brings much flexibility due to the availability of a wide network of fuel stations where you can fill up your car within 5 minutes, this is different for electricity. Charging and battery technology does not allow for this manner of refuelling. Recharging of a cars battery is taking more time.

The proposed preferred market model contains three main new roles for this market: the provider, charge spot operator and the charge spot owner. These roles will be further introduced under roles. The market model is designed at a high-level, which leaves still much room for different processes such as different request possibilities. The roles, responsibilities and processes should be crystallized further.

By making a game we have to go one level deeper in the processes and decisions per role. Though many uncertainties are present, the challenge now is to let many parties understand the proposed market model

in order to further develop the market model and start up the market for charging infrastructure. By making use of a gaming simulation it is possible to eliminate some uncertainties by creating a future scenario. This will help to bring the future market model alive and help people understand the new roles and processes.

Scope
As described in chapter 1 was the preferred market model the starting point for the game. Therefore, the study focuses on developing a market model for the charging infrastructure in the *public domain*, freely available to customers. The study does not focus on the market model for charging infrastructure in the private domain. For charging infrastructure in the private domain, the current market model already meets the requirements. For large load- or battery exchange stations that allow comparisons with stations along the highway, the same applies. Work agreements for these concepts in the private domain are not necessary.
The study describes *new processes* around the charging infrastructure for Electric Transportation which are not set in the current market model for electricity. Some examples are: the application and realization of charge spots, closing of a contract, linking the electric vehicle(s) to a contract, the measurement of reduced energy to the charging infrastructure, payment and settlement of the costs.

The *central governments (including ministries, NMa, Office of Energy) are not part of the market model* as they do not take part in the different market processes.

The game will be geographically bounded by the Netherlands, because national characteristics of the energy sector and law and regulation might influence market models in other countries in a different way. However, game scenarios should allow for open access to external parties. A foreigner should be able to charge its car in the Netherlands as well.

The scope around time is not sure yet. Depending on the game the game might simulate scenarios between 2012 and 2025. In 2012 there is no charge infrastructure pusher anymore (E-Laad.nl). In 2025 it is expected that electric transportation is not a niche anymore. A steady state is expected of a million electric vehicles.

Out of scope
The gaming simulation is developed as part of the market model development process. In this stage as depicted in chapter two we will not simulate a market, since there is too few data and too many uncertainties. The game will not provide an answer to the investment problem of the infrastructure and will not provide business cases. The commercial viability of roles is unrealistic at this moment. Though to get a market there should be viable business cases to attract market parties. This might be a purpose of a gaming simulation version in a next stage.

APPENDIX D - CONCEPTUAL MODEL: ROLE DIAGRAM INCLUDING RESPONSIBILITIES

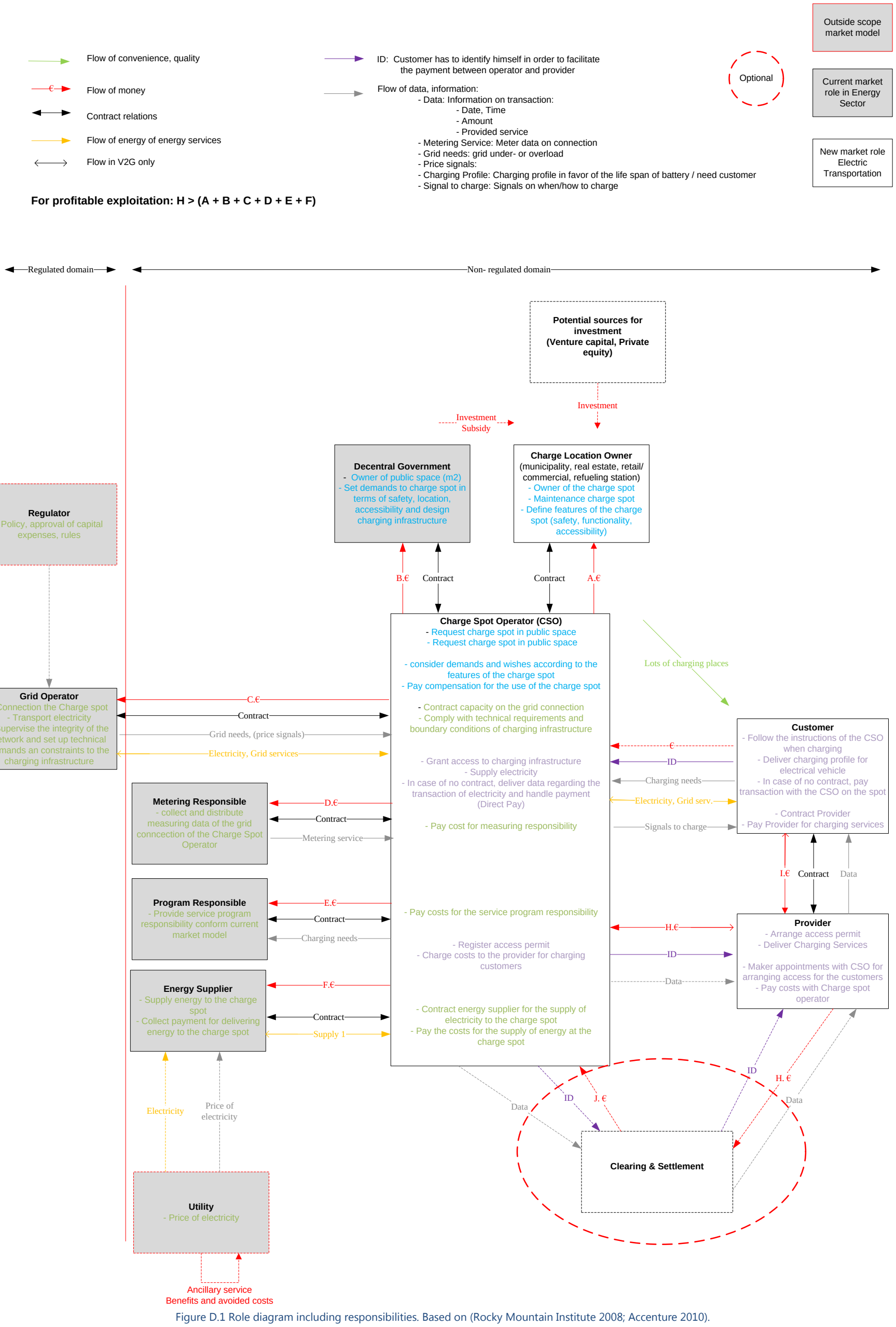
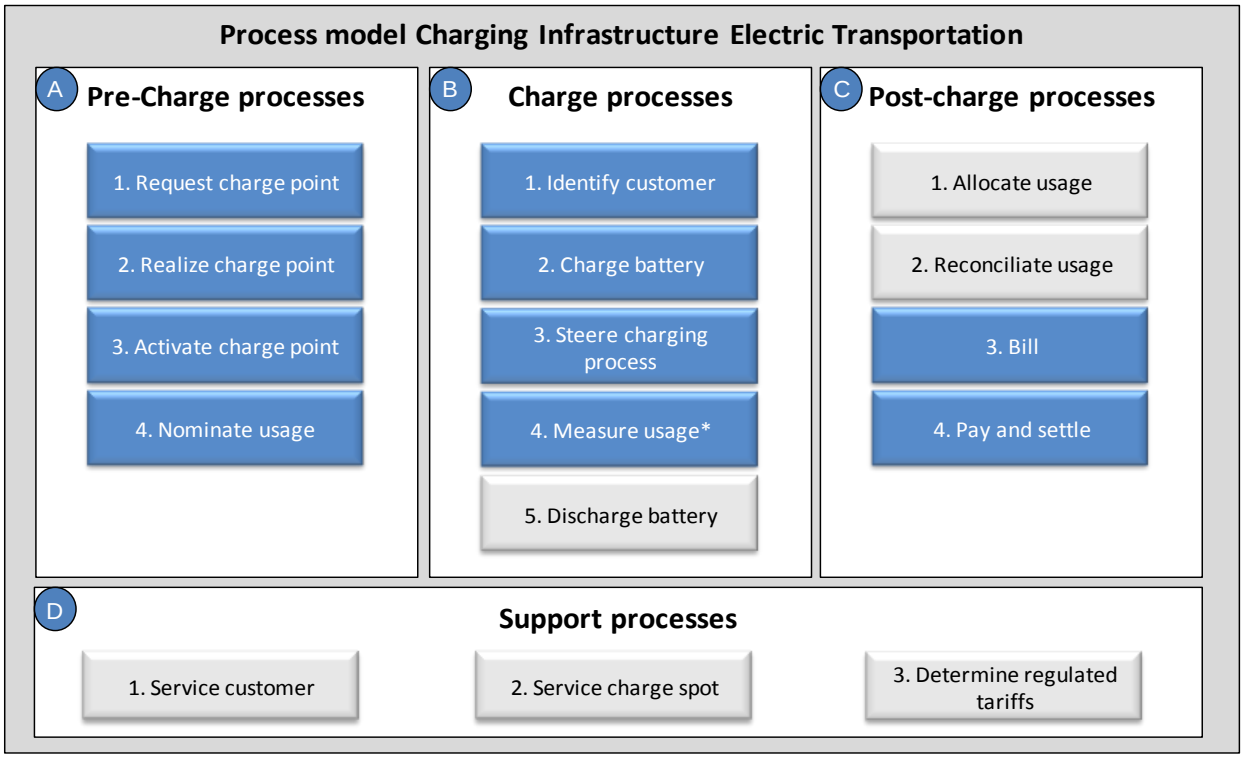


Figure D.1 Role diagram including responsibilities. Based on (Rocky Mountain Institute 2008; Accenture 2010).

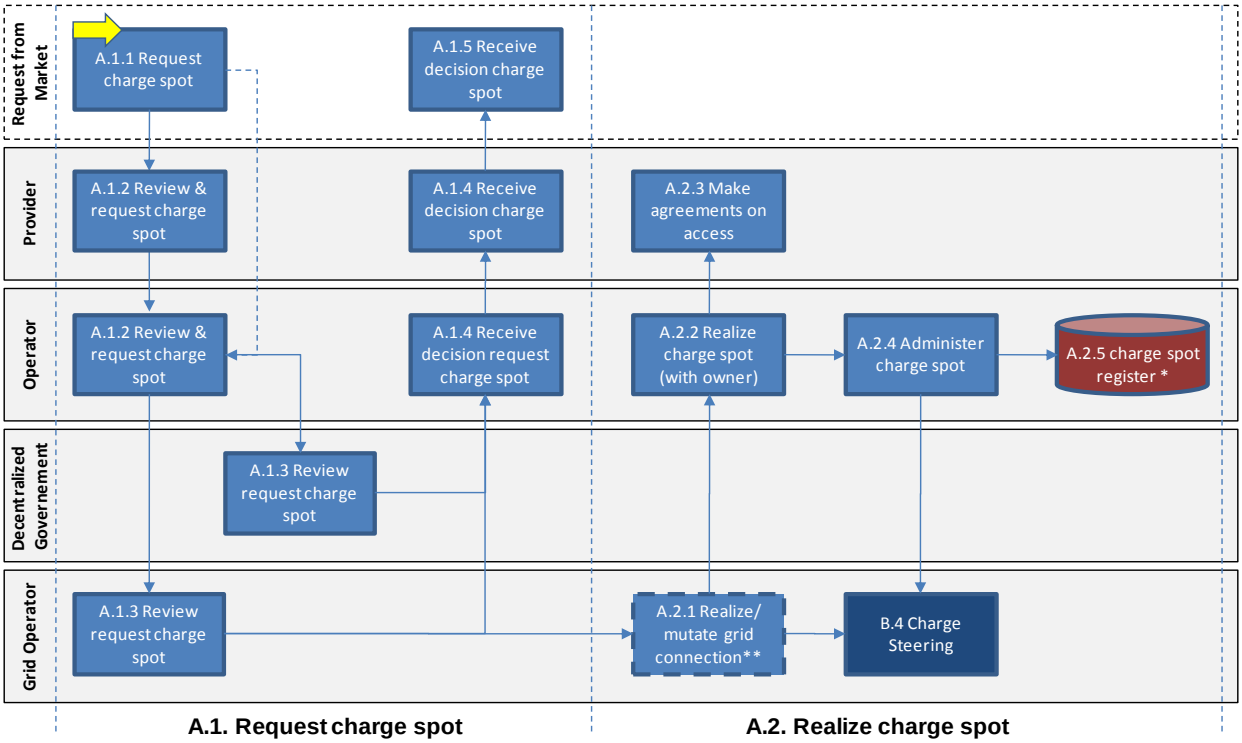
APPENDIX E - CONCEPTUAL MODEL: PROCESSES

Appendix E contains the process model of the preferred market model as provided in the kick-off document by Accenture (Accenture 2010). First an overview is given. Then on the following pages the swim-lanes are depicted.

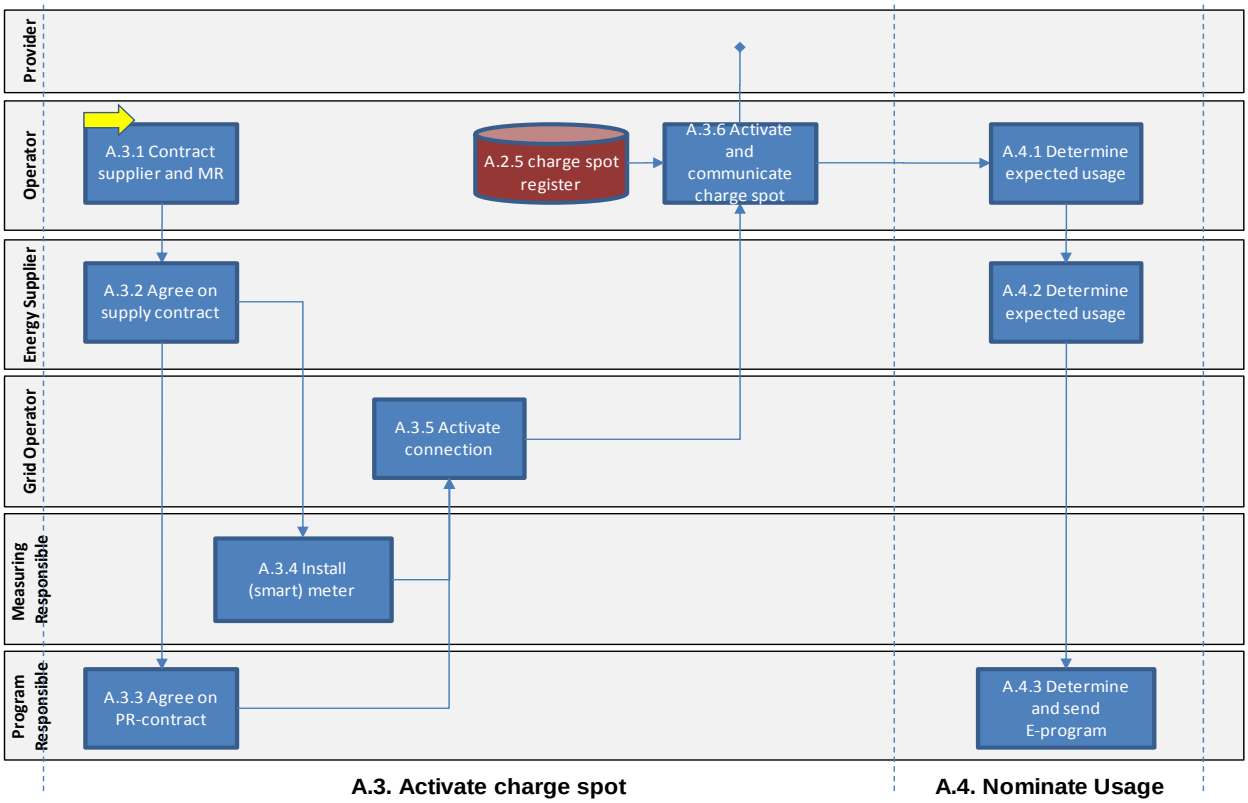


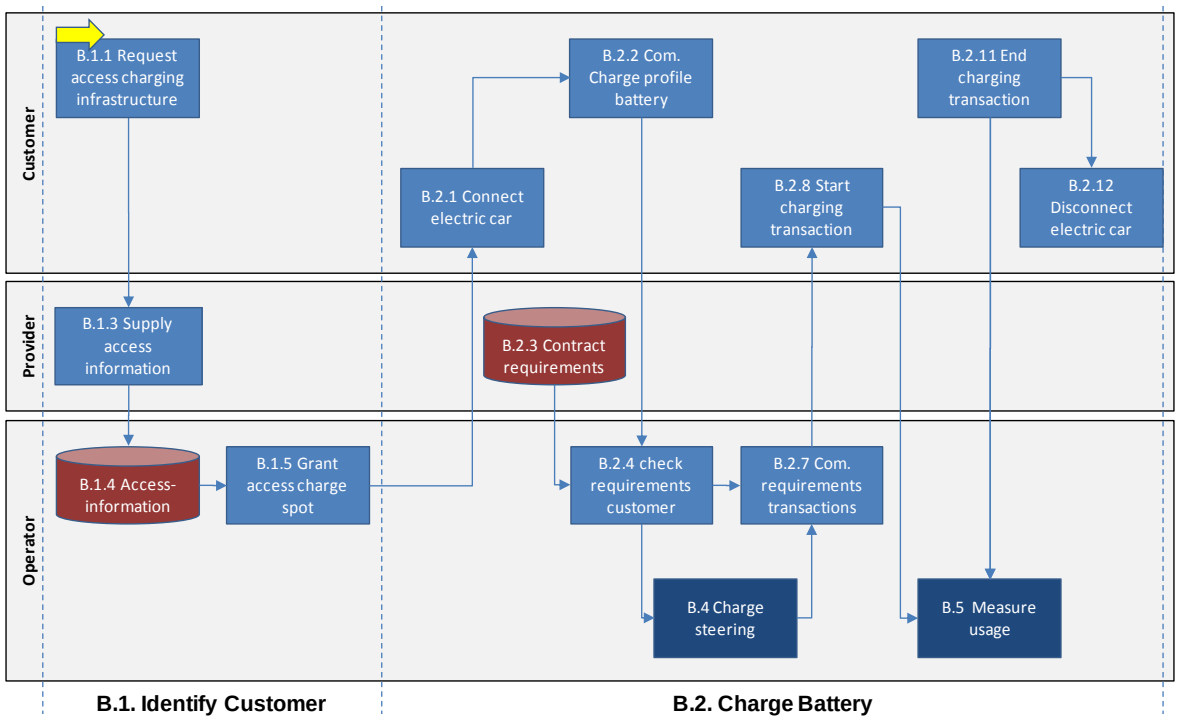
Note: (*) The measured usage can be both positive (supply by energy supplier to customer) and negative (supply by customer to grid) conform current agreements.

Process described for Electric Transportation

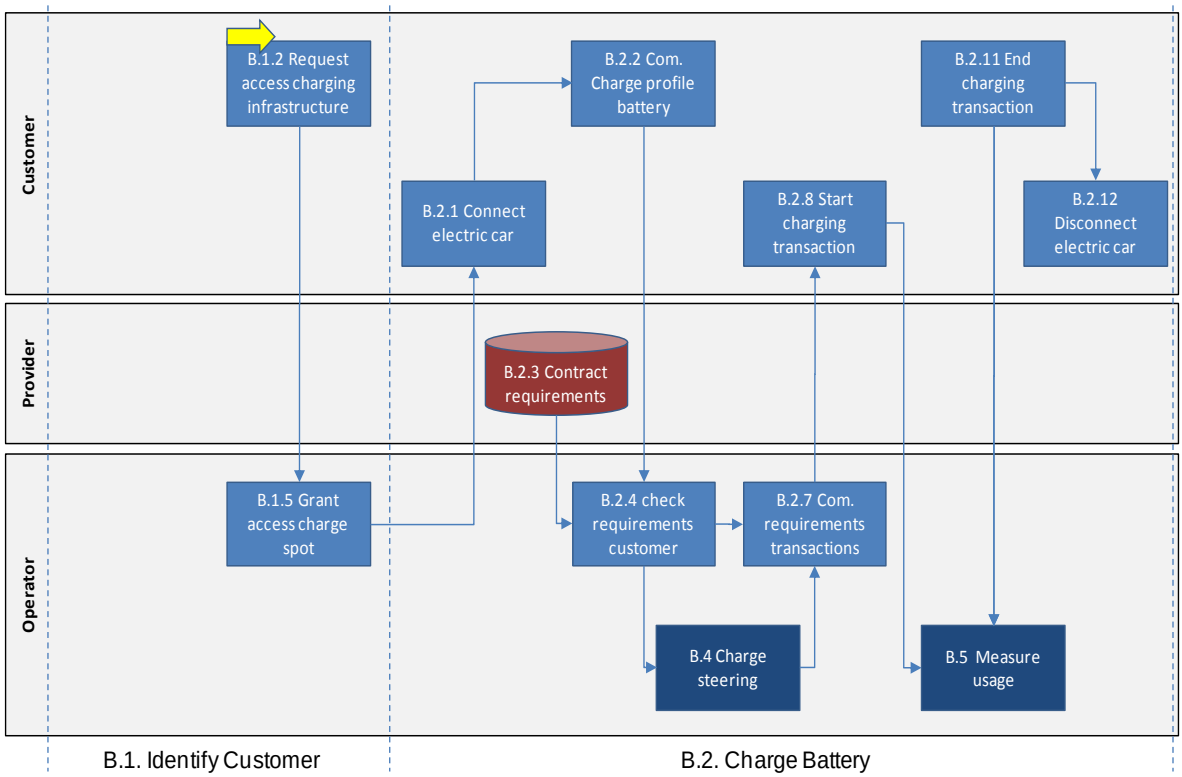


Note: (*) Possibility of collaboration between Grid Operators, Charge Spot Operators and Providers for making market facilitating information of charging infrastructure available (**) If the grid connection already has enough capacity the charge spot can be installed directly.

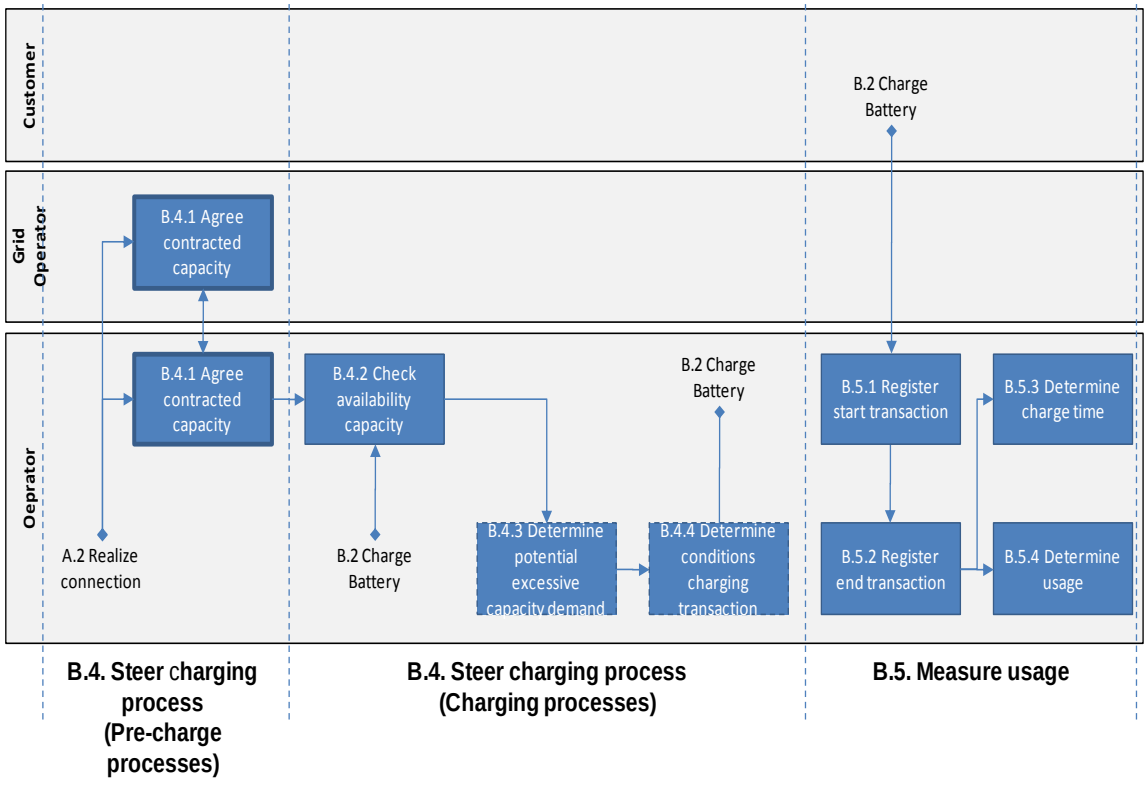


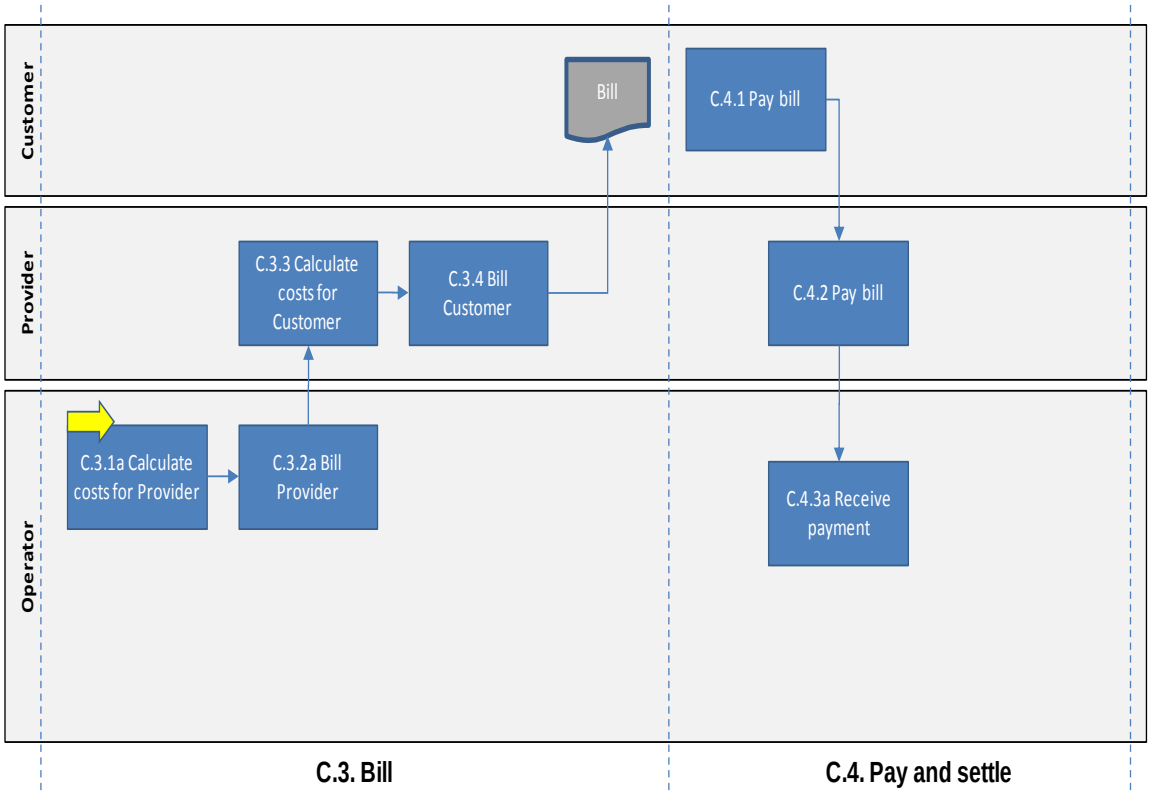


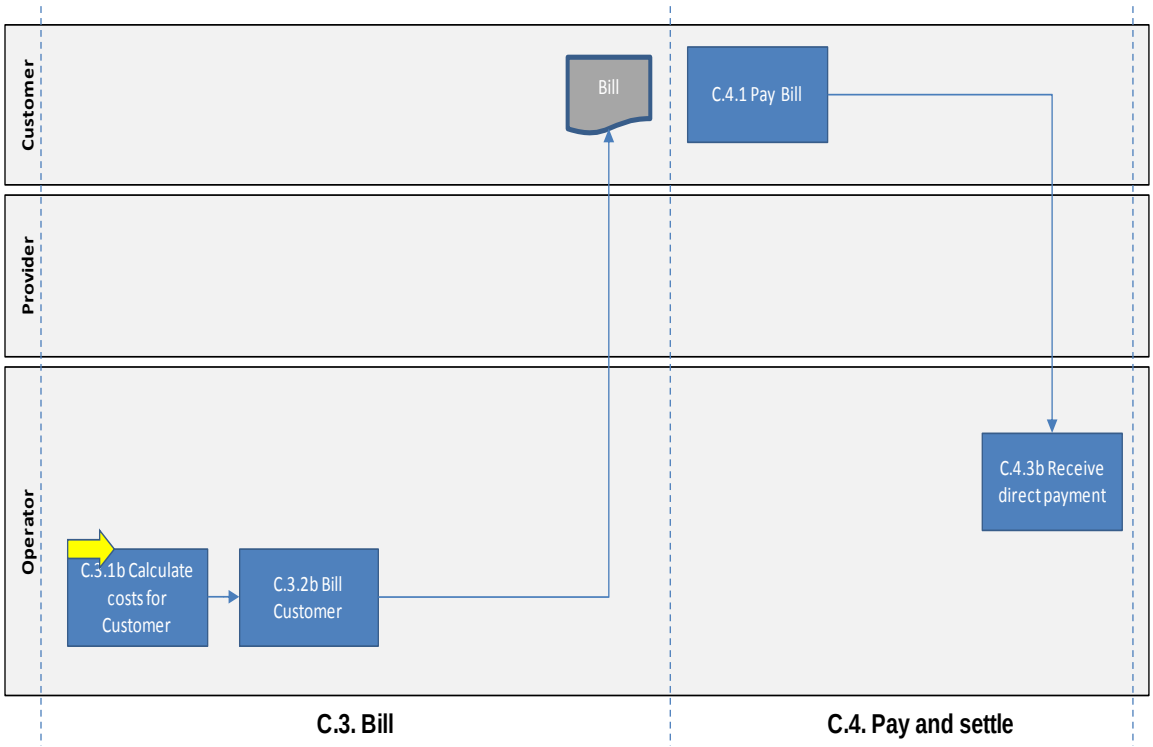
Request access for charging transaction using a contract with a Provider



Request access for charging transaction using Direct Pay


Customer
Grid Operator
Oeprator
B.2 Charge Battery
B.4.1 Agree contracted capacity
B.4.1 Agree contracted capacity
B.4.2 Check availability capacity
B.2 Charge Battery
B.5.1 Register start transaction
B.5.3 Determine charge time
A.2 Realize connection
B.2 Charge Battery
B.4.3 Determine potential excessive capacity demand
B.4.4 Determine conditions charging transaction
B.5.2 Register end transaction
B.5.4 Determine usage
B.4. Steer charging process (Pre-charge processes)
B.4. Steer charging process (Charging processes)
B.5. Measure usage


Customer
Provider
Operator
Bill
C.4.1 Pay bill
C.3.3 Calculate costs for Customer
C.3.4 Bill Customer
C.4.2 Pay bill
C.3.1a Calculate costs for Provider
C.3.2a Bill Provider
C.4.3a Receive payment
C.3. Bill
C.4. Pay and settle


Customer
Provider
Operator
Bill
C.4.1 Pay Bill
C.4.3b Receive direct payment
C.3.1b Calculate costs for Customer
C.3.2b Bill Customer
C.3. Bill
C.4. Pay and settle

APPENDIX F - THE E-CITY 2020 GAMING INTERVENTION; PROGRAMME AND MATERIALS

PROGRAMME

Table F.1 Programme of the 21st January E-CITY 2020 Intervention

Time	Section	Content
09.00 – 09.10	Reception + Enquête	
09.10 - 09.25	Introduction E-City 2020	• Introduction Electric Transport and urgency for market model • Introduction provider model • Introduction spel
09.25 – 09:50	**E-City 2020; Part 1**	• In the Shoes of a customer
09.50 – 11.10	**E-City 2020; Part 2**	• Realise infrastructure and charging services
11.10 – 12.30	Debriefing / Evaluation	• Evaluation market model • Evaluation game • Enquête

MATERIALS

On the next pages some game materials are depicted to provide an impression of E-CITY 2020.

MAP OF E-CITY 2020

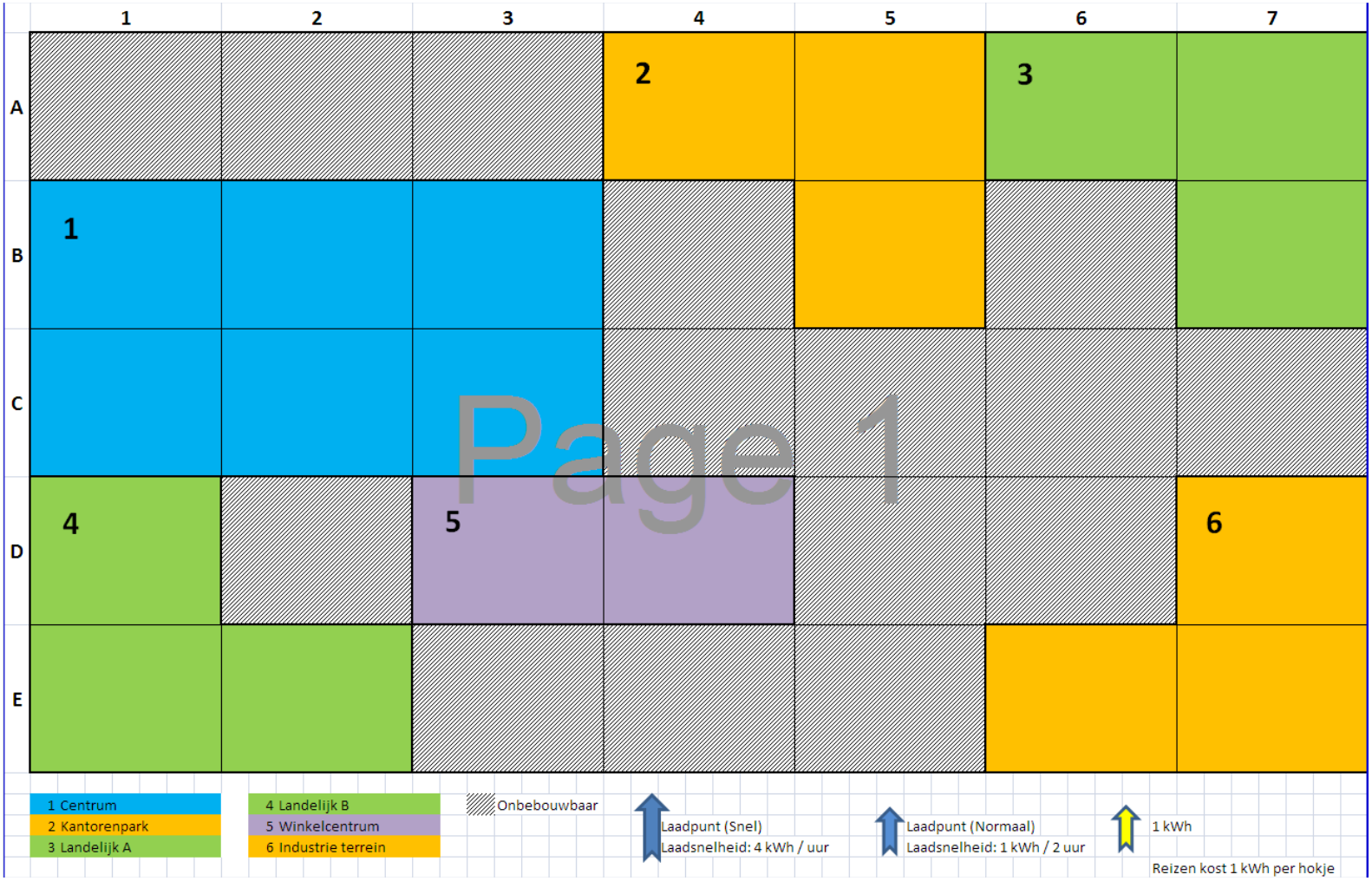


Figure F.1 E-City Map (in Dutch)

MAP OF GRID CAPACITY FOR GRID OPERATOR

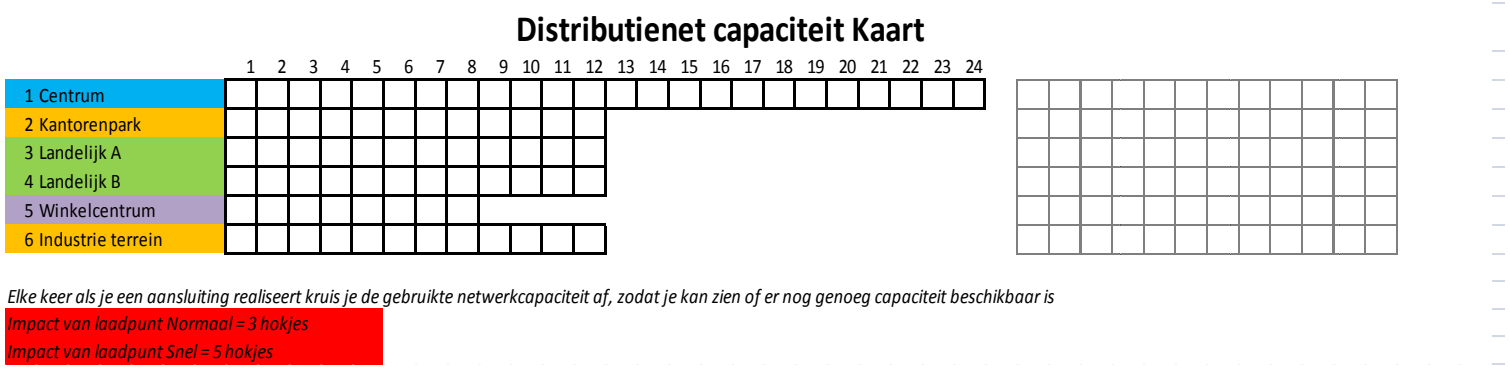


Figure F.2 Map of grid capacity (in Dutch)

EXAMPLE CONTRACT BETWEEN PROVIDER AND CSO

Provider - Laadpunt Exploitant Contract

1	Naam LPE	
	Naam provider	

2	Datum van ingang	
	Contract termijn in jaren *	

Het contract is geldig voor de hierboven overeengekomen duur en kan enkel in wederzijds overleg gewijzigd of verbroken worden.

3	De bovengenoemde laadpunt exploitant verleend op zijn laadpunten toegang aan klanten van bovengenoemde provider gedurende de duur van het contract.

4	De LPE verzekert de provider toegang tot het volgende minimaal aantal laadpunten.	
		Aantal Laadpunten
	1 Centrum	
	2 Kantorenpark	
	3 Landelijk A	
	4 Landelijk B	
	5 Winkelcentrum	
	6 Industrie Terrein	

Turf hierboven per regio het aantal laadpunten tot waar minimaal toegang wordt verleend.

5	**Toegang tot snel Laden****	Ja	Nee

Omcirkelen wat van toepassing is

6	**Tarief structuur**	**N+S**	**N**
	Vaste deel contract (€ / jaar)		
	Prijs vast per klant (€ / klant / jaar)		
	Prijs elektriciteit (€ / kWh)		

Hier kan je de tariefstructuur differentieren:
- N+S is de tariefstructuur voor klanten die zowel willen kunnen laden bij laadpunten Normaal en Snel
- Schrijf onder N de prijzen voor klanten die enkel willen laden bij laadpunten op normale snelheid

7	Extra Clausule ruimte

8	Extra Clausule ruimte

9	Handtekening Provider	Handtekening LPE

Figure F.3 Example contract between provider and Charge Spot Operator (in Dutch)

MARKET RESULTS 2020 AND MARKET PROGNOSES 2021

At the start of every year the new market prognoses are presented. Also the market results of the previous year are beamed. Based on this market information and their personal information the participants can set strategies and make decisions.

Resultaat Markt

Aantrekkelijkheid markt Zakelijk Segment	30%
Aantrekkelijkheid markt Prive	50%
Gemiddelde prijs vaste deel Exclusive Pakket (€ / jaar)	13,5
Gemiddelde prijs vaste deel Simpel pakket (€ / jaar)	6,5
Gemiddelde prijs elektriciteit (€ / kWh)	2,5
Gemiddelde kosten ZAKELIJK (€ / gebruiker / jaar)	76
Gemiddelde kosten PRIVE (€ / gebruiker / jaar)	32
Gemiddelde dekkingsgraad N	3,0
Gemiddelde dekkingsgraad S	1,0
Gemiddelde dekkingsgraad N + S	3,3
Gemiddelde bezettingsgraad N	1,66
Gemiddelde bezettingsgraad S	1,80

Figure F.4 Market Results over 2020 (in Dutch)

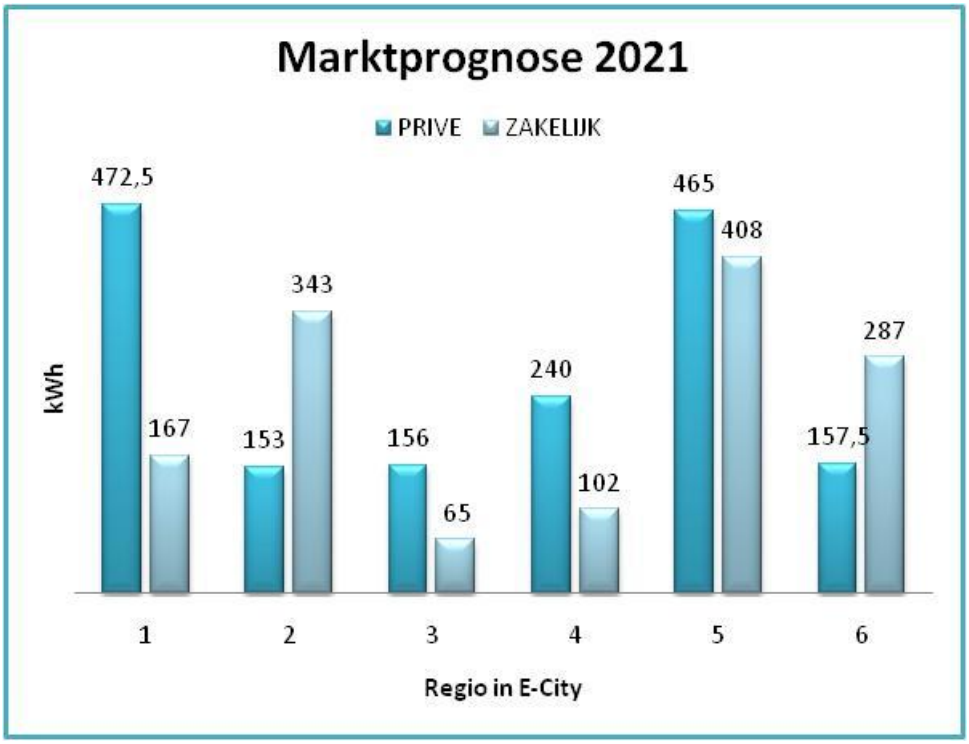


Figure F.5 Market prognosis for 2021 (in Dutch)

OUTPUT OF THE EXCEL MARKET MODEL ON THE 21ST OF JANUARY, 2011

At the end of every year (round) the contracts and propositions are put into the excel model. The following feedback is provided. The results are the results of the participants in 2021 of the intervention on the 21st January.

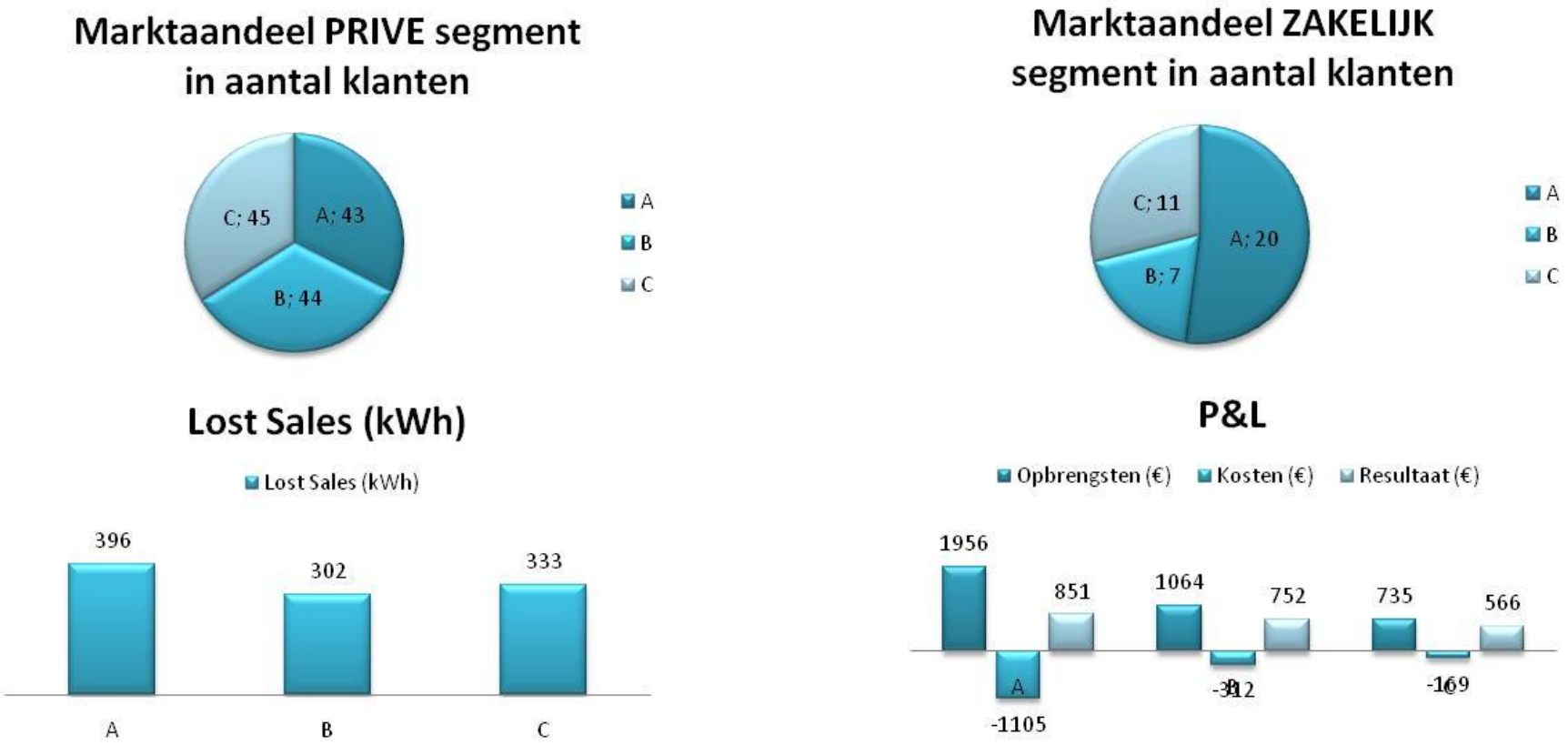


Figure F.6 Results provider in 2021 (in Dutch)

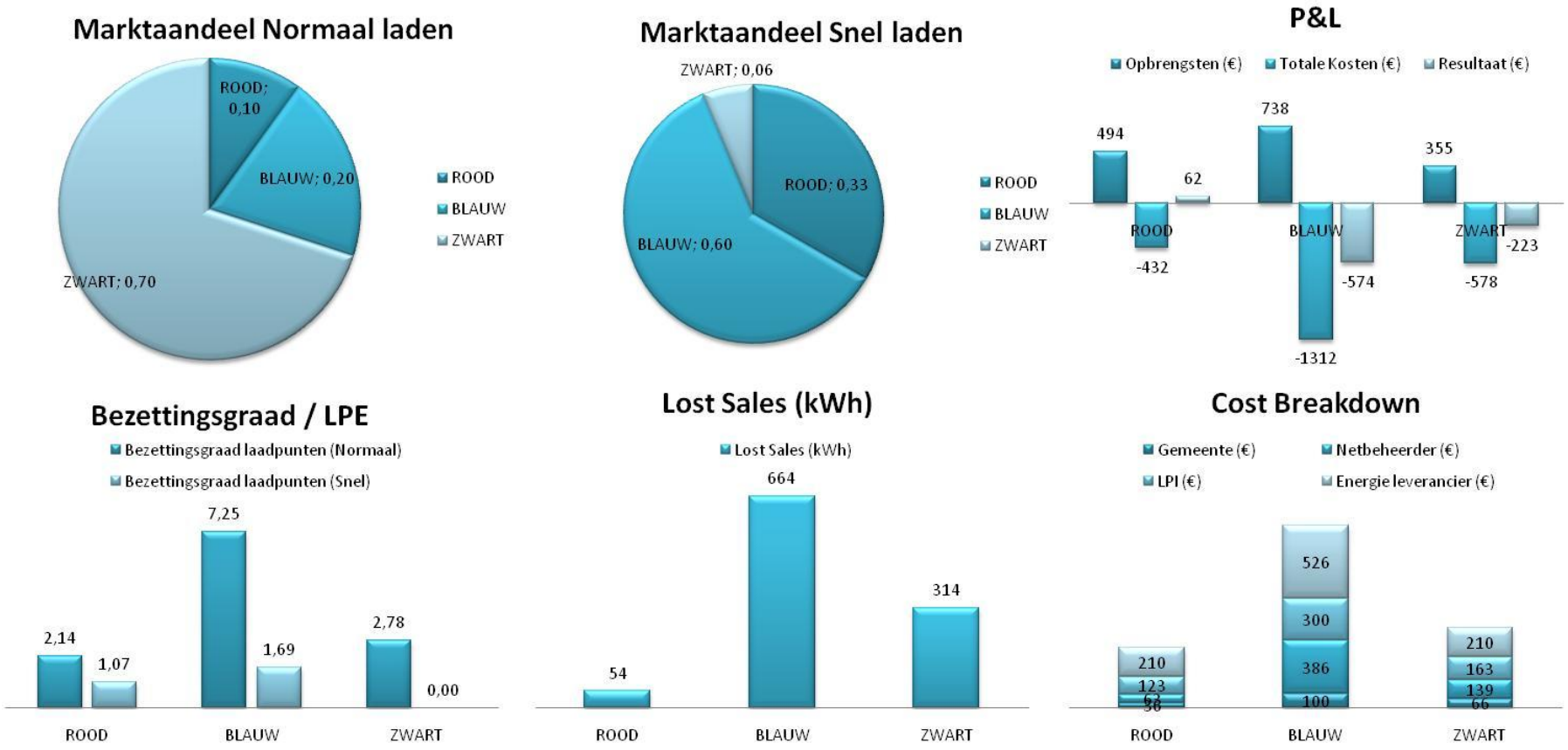


Figure F.7 Results of Charge Spot Operator (in Dutch)

PHOTOS

Some photos of the intervention on the 21st January are enclosed to provide an impression of the intervention.

APPENDIX G - QUESTIONNAIRES

G1. QUESTIONNAIRE DESIGN (BEFORE)

General

Name		Industry background		
Function		What is your foreknowledge on Electric transport and / or the energy sector?		

Attractiveness

	Question / Thesis	Disagree	Neutral	Agree	N.A.
01	I expect an interesting session				
02	I expect an informative session				
03	I would have reserved three hours to come to this meeting if I knew that it would be a presentation or workshop on the market model charging infrastructure instead of a game				

Knowledge

	Question / Thesis	Disagree	Agree	No idea
04	The provider is the central role in the provider model			
05	The Charge Spot Operator is the central role in the provider model			
06	The local government is responsible for a proper grid connection			
07	The provider can be the owner of charge spots			
08	The Charge Spot Operator has an incentive to close exclusive contracts			

09	It is in the benefit for the provider to have universal access to charge spots			
10	The grid operator is the central role in the provider model			

Customer Requirements

	Question / Thesis	
11	Write down the three most important customer requirements to the charging infrastructure?	

Trust in electric transport and provider market model

	Question / Thesis	Disagree	Neutral	Agree	No idea
12	Do you have trust in a breakthrough of electric transport?				
13	Do you have trust in the proposed provider market model for the charging infrastructure?				
14	Is the provider model a proper model to further develop towards implementation?				
15	Do you expect big opposite stakes between roles in this market model?				

G2. Questionnaire Design E-City 2020 Questionnaire (After)

General

Name		Industry background		
Function		What is your foreknowledge on Electric transport and / or the energy sector?		

Attractiveness

	Question / Thesis	Disagree	Neutral	Agree	N.A.
01	I think it was an interesting session				
02	I think it was an informative session				
03	Next time when there is a gaming simulation in my field of experience I would participate again				

Knowledge

	Question / Thesis	Disagree	Agree	No idea
04	The provider is the central role in the provider model			
05	The Charge Spot Operator is the central role in the provider model			
06	The local government is responsible for a proper grid connection			
07	The provider can be the owner of charge spots			
08	The Charge Spot Operator has an incentive to close exclusive contracts			
09	It is in the benefit for the provider to have universal access to charge spots			
10	The grid operator is the central role in the provider model			

Customer Requirements

	Question / Thesis	
11	Write down the three most important customer requirements to the charging infrastructure?	

Trust in electric transport and provider market model

	Question / Thesis	Disagree	Neutral	Agree	No idea
12	Do you have trust in a breakthrough of electric transport?				
13	Do you have trust in the proposed provider market model for the charging infrastructure?				
14	Is the provider model a proper model to further develop towards implementation?				
15	Do you expect big opposite stakes between roles in this market model?				

APPENDIX H – SCIENTIFIC ARTICLE

THE E-CITY 2020 GAME: THE USE OF SIMULATION GAMES CAN ACCELERATE MARKET MODEL DESIGN FOR CHARGING INFRASTRUCTURE ELECTRIC TRANSPORT

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Delft University of Technology and Accenture
Sjoerd.helmer@accenture.com

Keywords: market model, simulation games, charging infrastructure, electric transport

Abstract
The charging of electric vehicles is a new market that is emerging, partially from existing markets. The emergence of such new markets requires the definition of new roles and responsibilities. Such a 'market model' describes the market roles (e.g. owner, operator etc) in terms of responsibilities and interactions between roles (processes). However, the development of an abstract market model for a future market is complicated since the dynamics of future markets are difficult to imagine, let alone understand. The use of simulation games is a proven method to deal with such complexities but is never applied on market model design. Here we report the complexity of and challenges to market model design based on expert interviews. Second, the novel E-CITY 2020 simulation game was developed to examine the contribution of gaming simulation to market model design for Dutch energy related markets. The game simulates a preferred market model for the charging infrastructure in a fictive city in 2020. E-CITY 2020 resulted in an increased insight in the dynamics and interactions in a new market from different perspectives (operator, customer, etc) for both designers and participants of the intervention. Second, we found that a gaming simulation creates a shared understanding of the future market model. Finally, we identified requirements for success for implementing the market model. In conclusion we find that simulation games are an effective tool to overcome complexities in market model development.

1. Introduction

Increasing dependency on oil imports from unstable political regions, declining oil supplies, increasing awareness of the contribution of CO_2 emissions to the global warming processes is asking for solutions in the energy and private transport sector (International Energy Agency (IEA) 2008). These aspects are rapidly driving innovations to electric driven vehicles (Guille and Gross 2009). However, there are still many barriers to overcome in the fields of technology, customer acceptance and organization. At the technology side, the main barriers are related to the impact on the grid, energy supply, the necessary ICT layer, battery capacity, charging time and the charging infrastructure (Kempton and Tomic 2005; Turton and Moura 2008; Dickerman and Harrison 2010; Srivastava, Annabathina et al. 2010).

One of the most important barriers to a large scale introduction to Plug-in Electric Vehicles (PEVs) is an effective charging infrastructure to fulfill customer requirements. The 'chicken-egg' problem, which describes the reluctance of car manufacturers to introduce alternatives for the Internal Combustion Engine (ICE) in the absence of infrastructure or the other way around slowed down the progressions on electric transport (van Bree, Verbong et al. 2009) to start up the market and to ensure a reliable and open market where market parties can take their roles and execute their strategies a market model has to be introduced. A market model facilitates the market and contains agreements on market roles, responsibilities and processes. It sets preconditions under which a market can function given objectives. These agreements can be anchored on different levels, from formal law & regulation to informal agreements between market parties.

The expectation is that an electric car driver wants to charge on more spots a day (at home, at work or at the gym for example). The current market model for the Dutch electricity sector does not facilitate

this, since the system does not allow for daily or even hourly switching of energy suppliers on the same grid connection. Netbeheer Nederland and EnergyNed acknowledged the urgency to accommodate agreements for charging and payment for electric transportation in a market model. The result is the kick-off for dialogue document '*Study market model charging infrastructure for electric transportation'* provided by Accenture which contains a design of roles, responsibilities and processes of a preferred market model.

A market model is ultimately about interaction between roles in different processes and the dynamics and result on the system as a consequence. But a future market and its dynamics of processes and interaction are difficult to imagine, let alone understand, due to two faces of complexity. First, there is technical-economical complexity which stems from the emergent complexity among the physical-technical-economical entities within the market (Mayer 2009). Second, complexity which is the result of strategic interaction between different actors with different stakes who are interdependent on each other in realizing their goals (Bruijn and Heuvelhof ten 1999; pp.15; Roth 1999).

A market model is not constructed in one day, but takes long. We defined that market model development consists of five main phases (see appendix). Phase I, analysis and global design, is already performed by a consultant company. The market model for the electric vehicle charging infrastructure in The Netherlands is proceeding at the moment in phase II 'Refinement of global design'. A market model however should be accepted by all relevant stakeholders to make it work. It is therefore important to initiate a dialogue with stakeholders to refine the market model and ultimo arrive at an accepted market model that is addressing all issues (VREG 2006 : pp. 8; Accenture 2010). Phase II is therefore aimed at discussing, refining, finding consensus and settling the developed market model. The first step is to present and / or communicate the message of the discussion document to key stakeholders from the market in order to start-up interaction and refinement (VREG 2006: pp.26). The environment in which this all has to be performed though is characterized by:

- An uncertain and hard to imagine future;
- A market in which many different actors interact and can behave strategically;
- A situation in which there are no clear agreements between stakeholders yet.

Methods used in phase I are experienced not to be successful in phase II. The methods used in the design process such as conceptual modeling, market consultation and traditional presentations and workshops do not suit to convey, understand and further develop these complex processes and dynamics of a market model.
Gaming simulation is a tool that can deal with complexity (Mayer 2009). A typical gaming simulation problem is a very complex real world situation characterized by: many variables interacting, no realistic basis for quantification of variables, no proven conceptual model and a 'futures' context (Duke 1980 : pp.364). Interaction has a central role in simulation games, which makes them interesting to create insights into the interaction between parties and the results of this interaction on the market. Gaming simulation is therefore a method which makes it possible to address the technical-economical and multi-actor complexity and might be valuable during the design of market models. However it is not explicitly applied and described as tool for market model design. Therefore the main question addressed in this article is: *What is the contribution of simulations games to market model design?*

The novel E-CITY 2020 simulation game was developed to examine the contribution of gaming simulation to market model design for Dutch charging infrastructure market. The game simulates the preferred market model for the charging infrastructure in a fictive city in 2020. The game was played in January 2011 with a representative group of senior Accenture employees with a background in the utilities and resources. Evaluation data were gathered by observations during the game, a group discussion and debriefing on roles, responsibilities, processes and information and a questionnaire before and after the intervention. The remainder of this article describes the E-CITY 2020 game and the results.

2. The conceptual model of E-CITY 2020

The design of E-CITY 2020 is based on the preferred market model as presented in the report *'Study market model charging infrastructure for electric transportation'* provided by Accenture (2010).

The translation to the game roles is depicted in figure 1. The market roles are divided into:

- active game roles: comprising the most central roles of the preferred market model; the charge spot operators (CSOs) and charge service providers
- facilitated game roles: local government, grid company, energy supplier are facilitated roles, which pose constraints on the behavior of the CSOs and providers from their framework in the current energy market.
- a simulated role by a computer model: customer

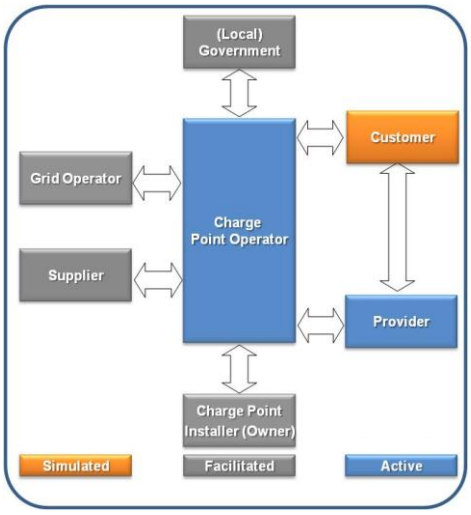


Figure 41. E-CITY 2020 game roles

Furthermore, the preferred market model distinguishes various processes classified into pre-charge processes, charge-processes (e.g. identification and measuring) and post-charge processes (e.g. billing, paying and settlement). The E-CITY 2020 intervention is focused on the pre-charge processes; all processes around charge spot realization and contracting on access terms.

3. The E-CITY 2020 intervention

Change and understanding of the market model in within stakeholders is required. A simulation game is considered as an intervention to manage change. The purpose of the E-CITY 2020 game is to bring relevant stakeholders together to help them understand the interactions of the preferred market model for the electric vehicle charging infrastructure and create insight in requirements for success for further implementation of the market model.

The game is designed to enable the following aspects:

- Create shared insight in the roles and responsibilities, decision criteria and limitations of the different stakeholders in the preferred market model
- Create shared insight in the charging infrastructure processes as defined in the preferred market model
- Create shared insight in the interactions and dynamics between the different stakeholders within the preferred market model
- Create insight in requirements for success for implementing the market model

E-CITY 2020 is a custom built market model simulation of a future preferred market model for the Dutch charging infrastructure for electric transport. The main purpose of the simulation is to involve important stakeholders and create insights into the dynamics of the preferred market model. It is a three hour simulation which combines a role-playing game with a setting that simulates a charging infrastructure market in the fictive E-City around 2020. Trough stimulating government action, increased customer awareness for green transport and the breakthrough of attractive electric cars the number of electric cars is expected to surge. E-CITY is a fictitious conglomeration made up of six regions. Characteristics are the inclusion of fast and normal charge spots in E-CITY and segmentation of customers in private and business. For every segment demand is know per region.

Course of intervention

The E-City 2020 intervention consists of three main parts: the introduction (at the start before playing), the game (B, C, D) and the evaluation (E, F). Furthermore a questionnaire is used to recover knowledge on the participants and their knowledge levels (1 and 2). The course of the intervention and its relation of its elements to the performance level of the participants are depicted in figure 2.

(1&2)Questionnaires

The participants were offered a questionnaire before and after the intervention. The questionnaire is used to identify the motivation and learning of the participants in order to answer the question of this paper: *What is the contribution of simulations games to market model design?*

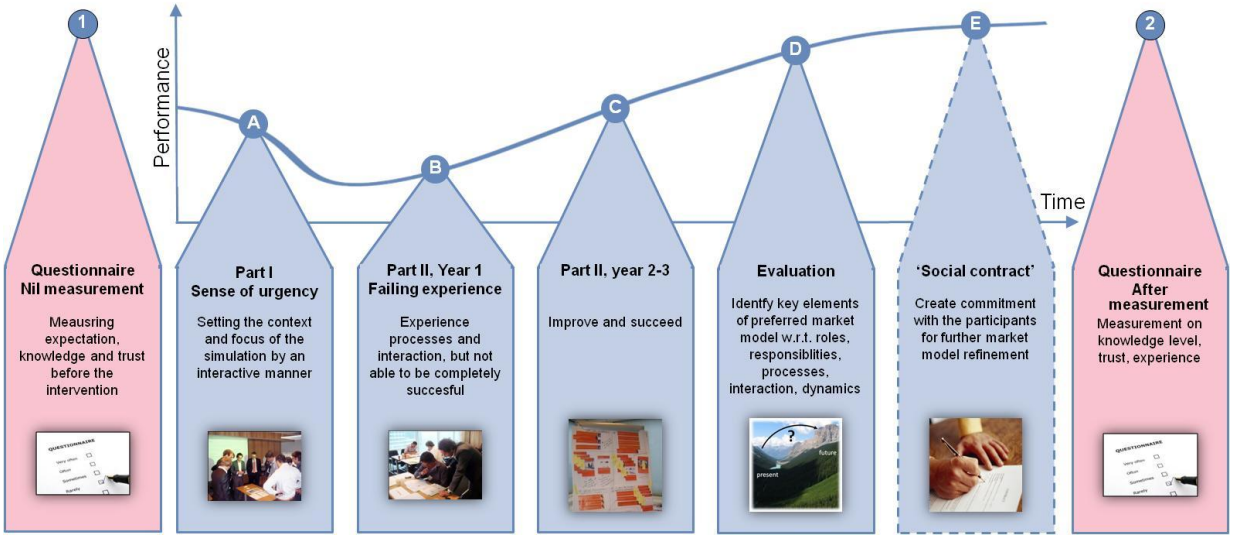


Figure 9; Design and course of E-CITY 2020 intervention

(A) Part I: In the role of the customer

After a brief presentation on electric transport the participants start with a brief warming up game to:

- Get acquainted with E-CITY and the materials;
- Let them think from a customer's perspective by engaging bottlenecks for electric car customers. This puts the participants in the right setting for the remainder of the intervention.

(B & C) Part II: Infrastructure realization

In part two the participants experience realization of infrastructure from the management view of a CSO or service provider. The purpose of part two is to experience the dynamics, roles and interactions. The game simulates the period 2020-2023. Every year (round) is divided into trimesters. Trimester one is the strategy trimester in which the participants analyze the results of last year and rethink and reformulate their strategy. The second trimester is the 'action' trimester in which all the parties can interact, negotiate, realize infrastructure and make customer propositions. In the third trimester the facilitators make up the results with aid of the computer model.

The individual goal for every actor is to maximize profit and gain market share in the market for charging infrastructure in E-CITY by attracting customers to electric vehicles by offering attractive charging services. The attractiveness criteria are price setting, coverage are and occupancy rate. These criteria are calculated by the computer model.

In the first round (B) the participants are struggling with realizing their contracts, propositions and infrastructure. In this phase they have to go through the valley of despair; by first experiencing '*pain' in being unsuccessful to realize the desired performance, secondly they will learn* by experimenting with decision making to improve the performance and in the next years (C) they will experience success in improving their performance and enter the evaluation stage with a satisfied feeling (Wenzler 2008).

(D) Evaluation

The debriefing is used to let the participants share their experiences, identify learning points and to make the transfer to the market model reality. The debriefing was triggered by questions related to the game objectives. The first questions were aimed at releasing stress of the players. The second type of questions was aimed at triggering discussion on roles and responsibilities. The third type was aimed at

triggering discussion on processes and interaction and finally questions were posed to trigger the participants to share bottlenecks in the market model.

(E) Social contract
One of the aims of the intervention is to involve industry key stakeholders in the process of further market model refinement. It is therefore desirable that they commit to further market model design and cooperation. This part of the intervention was not performed with the Accenture stakeholders but will be part of the intervention with industry key stakeholders, in order to commit these stakeholders to the requirements for success for implementing the market model.

4. Results and discussion

A combined literature review with findings from the E-CITY 2020 intervention have resulted in four statements on the contribution gaming simulation to market model design:

I. *Gaming simulation increases the understanding of the participants on the preferred market model from different perspectives*
II. *Gaming simulation helps to create a shared understanding among the participants of a possible future for the preferred market model*
III. *Gaming simulation helps to create a shared understanding among the participants of a possible future for the preferred market model*
IV. *People seems to be better motivated to attend a simulation game than a traditional presentation or workshop*

We will motivate the statements by providing supportive arguments from literature, the questionnaire results, observations during the game and indications of the debriefing.

I. *Gaming simulation increases the understanding of the participants of the preferred market model from different perspectives*

Understanding of the preferred market model is crucial in this phase to involve industry stakeholders to help further refine the proposed model and finally arrive at consensus. Gaming simulation is a method that can be useful for visualizing and identifying critical elements of a complex problem. At a higher level of abstraction they help to understand the big picture (Wenzler and Chartier 1999). E-CITY 2020 has resulted in several indications that support the ability of a simulation game to increase the understanding of both participants and designers on the preferred model. The arguments are structured along the purposes and objectives of E-CITY 2020. The first purpose was to transfer market model knowledge on roles, responsibilities and the interactions in the processes to the participants.

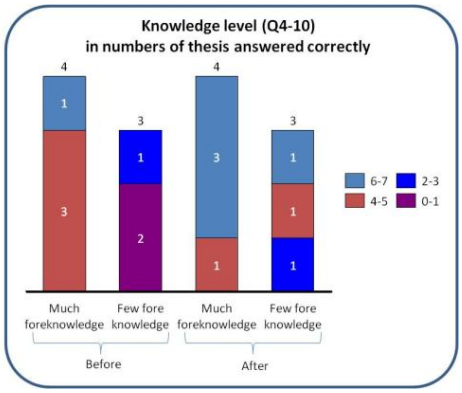


Figure 43; Results on knowledge questions.

Increased insight in the roles and responsibilities is supported by the questionnaire results and indications from the debriefing. The questionnaire shows that the participants increased their knowledge on these questions as depicted in figure 3. The questionnaire included seven questions on roles and responsibilities of the preferred market model. The value of the questionnaire results, which are used to complete the findings from the debriefing, can be argued. Arguable are the fact of: lack of anonymity of the respondent, the number of respondents, and background of the respondents. However, we believe that the participants were honest and had no incentive to bias answers. Because the value of some answers in the questionnaires can be argued, the evaluation relies mostly on the observations during the game and the discussions raised by the participants during the debriefing.

The level of substantive discussions that were raised in the debriefing of the intervention demonstrates the understanding of the roles, responsibilities and interaction between roles (processes). We will list a few discussions and questions from the debriefing to support this:

- Participants raised the urgency for clear frameworks for different roles. They were trying to understand where they had to go for permits, connections, information on customers etc.
- The participants also discussed possibilities for differentiation of the providers.
- They discovered that it is important for the CSO to quickly build relationships on the one hand and realize infrastructure on the other hand.
- They experienced many dependencies between the provider and CSO:
    - Need for influence of the provider on charge spots
    - Need for CSO to perform market analysis
    - They experienced that the provider wants to be able to account the CSO for charge spot availability. Quotes from the debriefing: *"We as providers did have contracts with the CSOs, but they did not have their infrastructure working… We are very dependent on the CSOs.." "…The result of the fact that the CSO is closing contracts with all kind of providers is a declining service level for the current providers, since their charge spot availability will decrease due to higher demand. How can we call the CSO to account for this?"*
    - The participants discovered how income and cost flows through the value chain
- The discovery of process bottlenecks in the charge spot realization process; *"Some bottlenecks you experience early in the process, but other limitations came to the surface in a later stage, which resulted in no active charge spots while expensive contracts were closed.."*
- They raised the question which role should be responsible for charge spot registration?

We believe that the fact that the participants were able to share and discuss these experiences concretely in the debriefing are an indication for understanding of the roles, responsibilities and the constraints.

Gaming simulation has supported to think from perspectives of other roles such as the customer. Gaming simulations allow for pushing players into different roles. In E-CITY 2020, this is actively designed into the game, such as in part I of E-CITY where participants are pushed in a customer's role in which they experienced bottlenecks for the user. During game feedback some participants mentioned that the brief experience of this warming up game had helped to understand the customers need. Thinking from a customer's perspective also became clear in the debriefing. First, participants indicated that they would like to have more information and interaction with the customer. Second, they have put the customer in the centre of the discussion. Finally, they mentioned that a market model without a client is not a market model. This is caused by the fact that consequences of their decisions are reflected by the behavior of the customer. Meeting customer requirements is awarded with new customers for example.
Finally, experiences from negotiating and interacting have helped to see other points of view. These experiences are shared in the group evaluation, which helps the group of participants to understand the different perspectives.

The second purpose of E-CITY 2020 is to create knowledge on the market model. The intervention has provided the following two main learning points which are regarded as requirements for success in the further design of the charging infrastructure market model:

- Price setting is a very complex process, because of mutual dependencies between providers and CSOs. The balance in risk was not fairly divided in the market model. Both parties incorporated large margins in the prices to cover risk, which resulted into accumulated prices. The question is how to divide the risk? Can this market model support a market in this way?
- Bottlenecks in the process were identified and should be carefully taken into account in further design; limited grid capacity for example became just obvious very late in the process chain for realizing a charge spot.

We conclude that gaming simulation increases the understanding of the participants and can create more knowledge on the preferred market model. By letting people experience their decision-making processes it is shown in E-CITY 2020 that consequences for the system such as the accumulated risk can be revealed. As Sophocles quoted around 400 B.C.: "*One must learn by doing the thing, for though you think you know it, you have no certainty until you try".* This is true for E-CITY as well. Not only knowledge

is transferred from the market model developers to participants, but by experiencing unexpected dynamics new knowledge is also created on the market model which can be used in further refinement of the market model.

II. *Gaming simulation increases the understanding of designers of the preferred market model*
Besides the above mentioned learning points for both participants and designers we also observed that the designers increased their understanding during the design of the game. Druckman and Ebner (2008) have evaluated the effect of the design of a gaming or simulation exercise even more positive than participating in a game. By experiments they showed that participants in designing the game were even more motivated and had a better understanding of the concept than the participants of the game only (Druckman and Ebner 2008). Probably the synthesis part, which is learning about the relationships between different concepts, is the best learning element accomplished by the game design process. For design one "*needs to have systemic understanding – seeing the connections among roles, goals, resources, constraints and contingencies*" (Greenblatt 1998).

We have found indications that support the great learning performance over the design trajectory. We observed a steep learning curve of the game designers, but also the designers of the market model have indicated learning points on their own market model. These learning points mostly came in workshops when the goals and possible actions of the different roles for the game were defined. For example when thinking-up of the customer's motivations and actions we recovered that first the customer not only wants a charge spot if he does not have the ability for home charging, but that he also wants his own parking spot to make sure that he is always able to charge when coming home. Secondly, we were puzzled in the request process how this would work out. As one of the designers of the market model said after a scenario talk trough workshop: "*Many of the processes are triggered by the customer, but it is not quite clear at which market party the customer will ask his/her question*", Another example was when thinking about the incentives and differentiation options for the providers and CSOs. Since a scenario and game roles had to be created we had to think about what the different roles would do. Would they want to make contracts exclusive in order to have a better availability of charge spots for their customers or the other way around? The market model designers indicated that they have "*explored the boundaries of the market model by thinking about drivers for a game. By not only touching upon the processes and roles but also on the need for customer demand and business models it has helped them to put the market model in a wider context of challenges and problems"*. These relations become clear since the designers were forced to think about motivations and goals and had to link them to other roles and games in order to be able to make them concrete for the game. Understanding on the 'real' incentives of the roles in the market model was needed in order to 'model' these into the game to 'simulate' realistic behavior of the played roles by the participants.

The results from the questionnaire and the evaluation lead us to attribute the value of game design to increasing the understanding of the market model system. However, in our case there were no primary industry stakeholders, who have to conclude market model agreements, included in the design team. Since in the described intervention consultants from the industry were used, the knowledge increase of the system does not occur within the primary stakeholders of the industry. The value of game design to market model development can be increased when industry representatives are included in the game design process. A sounding board that consists of industry bodies could be an implementation of this recommendation. The game designers can facilitate the design process by enabling the sounding board to use their industry knowledge to meet the challenges future market model and related processes, roles and responsibilities will bring.

III. Gaming simulation helps to create a shared understanding among the participants of a possible future for the preferred market model
Having a shared understanding of this difficult to imagine future of the market model would help in finding consensus. The E-CITY 2020 game brings people together in a room to explore an alternative future in a condensed time frame, so following literature it should help to create a shared understanding and shared formulations of problems and solutions (Wenzler and Chartier 1999).

There are three types of indications that support this argument. First, the knowledge questions show that differences in understanding of the roles on beforehand were converged to the same ideas about the roles afterwards.

Second, questions on trust in electric transport and the preferred market model were included in the questionnaire. It was found that the gaming intervention has leveled the views on expected different interests. Before the intervention there were four participants who were expecting large contrary interests between roles in this market model, while after the intervention most people have changed to a neutral stance or even did not expect large opposite stakes anymore. This supports the fact that the intervention has funneled their view on the market model. If parties feel that they have shared interests and can funnel these interests, this will increase trust which will be of benefit to the process.

The third indication is the fact that we observed that people were actively sharing their experiences of the game in the debriefing. The discussions of which a few were described under the conclusion of increased understanding point out the ability to share and discuss experiences and problems. Kolb acknowledges this as *"when human beings share an experience, they can share it fully, concretely and abstractly" (Kolb 1984; pp.21).* One of the observations that demonstrates the shared experience of solutions and problem is the fact that a participant mentioned in the discussion on accumulated risk coverage in consumer prices due to mutual dependencies between provider and CSO: "*You can also say, we are going to cooperate as provider and CSO in order to make a strategy together and recognize the risks together as well*"

In line with the expectations on gaming simulation as stated by different gaming simulation experts gaming simulation can help to create a shared understanding of a market model through its ability to let participants experience a certain future. The results of the questionnaire further show a significant knowledge increase and decreased fear for contrary interests.
However, since the respondents were not primary industry stakeholders. Consultants are not representatives of direct primary market firms, who have to conclude market model agreements. They may have different interests and stakes within that market, which could have biased the results. It is therefore recommended to ask these questions again in a next session with primary industry stakeholders to further research the influence of shared understanding on the perception of interest conflicts.

IV. People seem to be better motivated to attend a simulation game than a traditional presentation or workshop

It is important in this phase of market model design to involve stakeholders. To be willing to participate the most important is that parties need to have a sense of urgency and know that there is something in it for them (Bruijn, Heuvelhof ten et al. 1998). Besides a needed sense of urgency we believe that the attractiveness of the intervention also can help to bring people together. We expected that a 'traditional' workshop or presentation does not sounds interesting enough to attract people in some occasions. A presentation or workshop might be again just one of those millions that people are engaged with, while a gaming simulation creates an experimental learning environment in which people interact in a possible future their selves which is fun to play (Wenzler and Chartier 1999; Wenzler and Higgins 2009). A gaming simulation therefore is expected to better differentiate from other workshops or events. This should make it easier to get people involved for the first time.

We found several indications that people are more motivated to attend a simulation game than a presentation. Questions on the attractiveness were included in the questionnaire. All seven respondents were on beforehand of the intervention expecting both an interesting and informative session. Furthermore two of the seven indicated that they would not have reserved three hours time to come to this meeting if they knew that it would be a presentation or workshop on the market model instead of a game. Three would doubt to come to a presentation and took a neutral stance.

On hindsight all participants thought that is was a fun and informative session and five of the six participants would participate in a following gaming simulation in their field of experience. This is

important, because this demonstrates that a simulation game does not only seem to be attractive on beforehand, but the participants also experienced the intervention as interesting, which increases the chance on a social contract for further participation. Furthermore, we observed a very energetic and enthusiastic group of participants. And one of the testers said: "*Involve me in the test groups for games, I really like this*".

5. Conclusion & Recommendations

The charging of electric vehicles is a new market that is emerging, partially from existing markets. The emergence of such new markets requires the definition of new roles and responsibilities. However, the development of an abstract market model for a future market is complicated since the dynamics of future markets are difficult to imagine, let alone understand. The methods used in the design process such as conceptual modeling, market consultation and traditional presentations and workshops do not suit to convey, understand and further develop these complex processes and dynamics of a market model. E-CITY 2020 was developed to evaluate the contribution of simulation game to further market model design. Based on the findings the authors draw the following conclusions on the contribution of gaming simulation to market model development:

- *Gaming simulation increases the understanding of the participants and designers on the preferred market model*
- *Gaming simulation helps to create a shared understanding among the participants of a possible future for the preferred market model*
- *People seems to be better motivated to attend a simulation game than a traditional presentation or workshop*

Based on the increased understanding of the market model we recommend paying attention to at least the following requirements for success when further refining the market model for the charging infrastructure:

- First, scrutinize the mutual dependent relation between CSO and provider. Pay attention to risk distribution, cooperation and the results on consumer prices.
- Second, optimize the request process for a charge spot. Important issues that should be addressed:
    - To whom should the customer address himself to realize a charge spot?
    - The sequence of process steps to be performed by the CSO to realize a charge spot. The CSO is running risk by entering into contracts or buying permits while the CSO may experience problems with for example connecting its charge spot due to grid limitations.

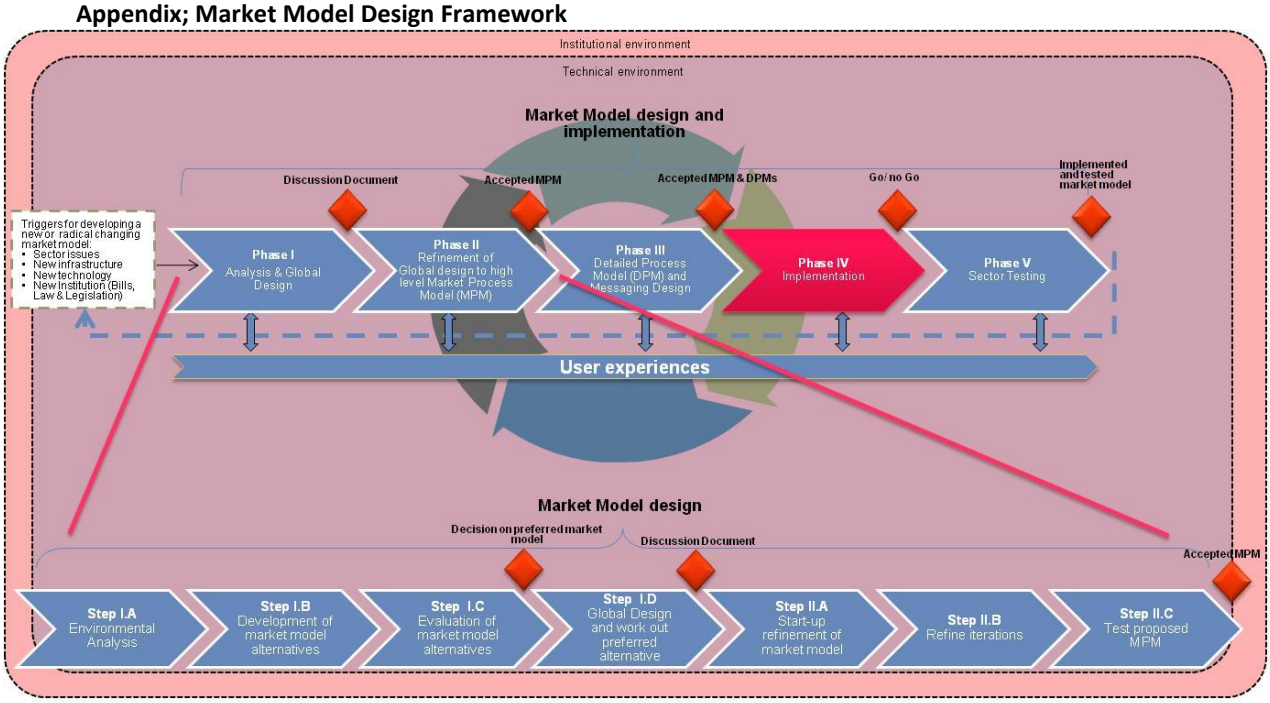
The authors also have recommendations to increase the value of E-CITY 2020 to further market model design:

- Integrate the game on the short term for this phase of the design (Step II.A of the framework in the appendix) with the other processes and roles of the preferred market model. Only some of the processes of the preferred market model were included in the game so far, but the results are satisfying; an increased understanding of both the participants and designers and new created knowledge for further market model refinement. Since, an important part of the market model on payment and settlement is not included yet this could be interesting to get a better understanding on the rest of the market model by extending the game.
- Extend and use the game on the longer term towards an implemented market model. We believe that E-CITY 2020 is a perfect starting point for extending and mutating the game along the improvements made to the market model during the refinement iterations in step II.B. Furthermore, it could be a start for a multi-day multi-player game in which a next version in step II.C of the market model is fully tested with enhanced customer segmentation, roles, processes and insights. It is then a tool that helps along the decision trajectory towards consensus on a market model to be implemented.

Finally, we have three main recommendations for further researching the value of gaming simulation to market model development in order to increase the arguments behind the conclusions:

- More cycles of interventions are required with primary industry stakeholders instead of consultants. Consultants are not representatives of direct primary market firms, who have to conclude market model agreements. They may have different interests and stakes within that market, which could have biased the results. The element whether stakeholders are willing to close a social contract and commit themselves to further market model refinement can then be tested.
- It is recommended to further co-develop the game with primary industry stakeholders to increase the level of knowledge on the system model of these stakeholders themselves. Since, it is time-consuming to involve all market parties to the design team, a sounding board that consists of industry bodies could be an implementation of this recommendation. The game designers can facilitate the design process by enabling the sounding board to use their industry knowledge to meet the challenges future market model and related processes, roles and responsibilities will bring.
- When having an intervention in the charging infrastructure market, set up a research that measures the long term effects of the gaming intervention. This research has focused on the direct observable short term effects of gaming simulation. Measure whether a gaming simulation leads to quicker market model refinement and ultimo leading to quicker implementation of the market model. These effects can only be measured by plugging the E-CITY 2020 intervention into the real market and perform a long term research of observations till the market model is implemented.

Appendix; Market Model Design Framework



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