THE FAST TRACK TO FLEXIBILITY IN PUBLIC PROCUREMENT

AN EXPLORATORY STUDY ON INSTITUTIONAL DESIGN CONCEPTS FOR THE DUTCH RAILWAYS USING A MORPHOLOGICAL CHART

MSC THESIS COMPLEX SYSTEMS ENGINEERING AND MANAGEMENT

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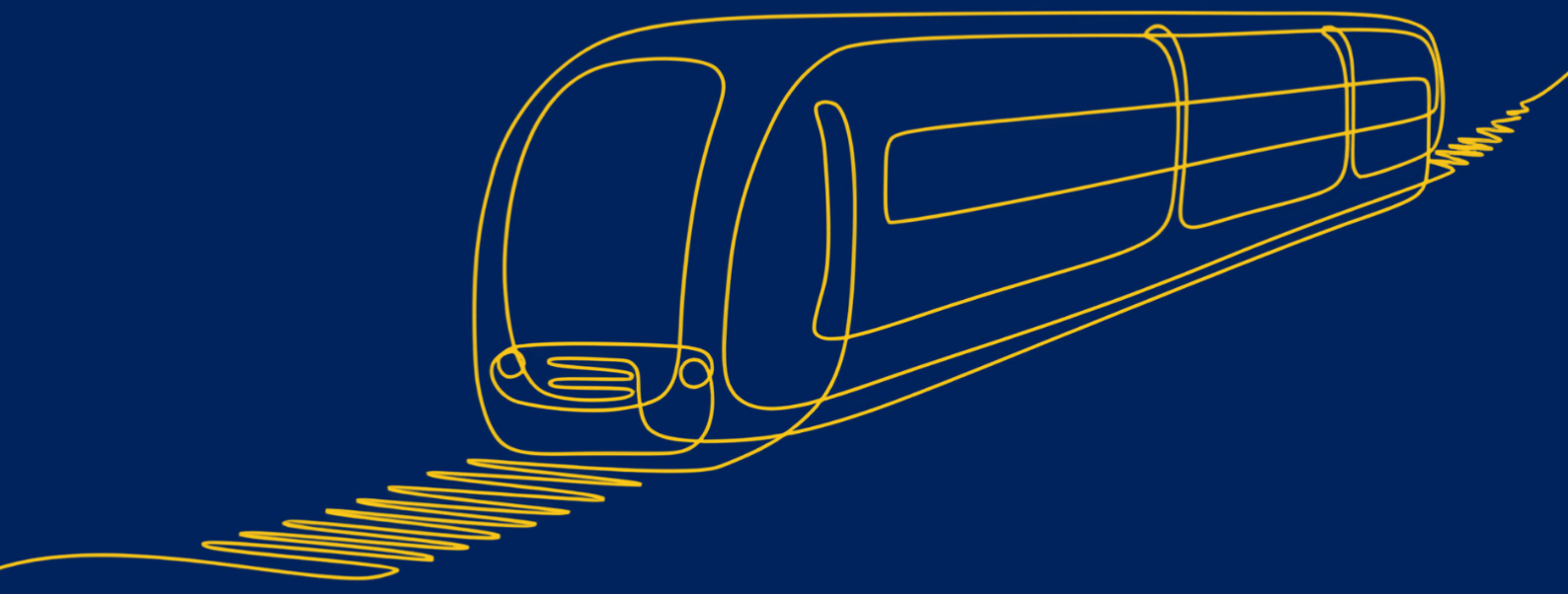

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The fast track to flexibility in public procurement

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Preface

In May 2023, after a few months at NS, I was allowed to 'wander around' the company and find myself a topic that excited me. I was lucky enough to find exactly that, an issue about flexibility in procurement, one of my main interests within my studies. How that came about I can't quite explain, what I do know is that I found two supervisors with a wealth of knowledge, and, as it turned out, great commitment and enthusiasm. It was the start of this research, to complete the MSc Complex Systems Engineering and Management, in which a little later Sander Renes and Wijnand Veeneman also became involved as supervisors from TU Delft.

In this way I would like to thank all four of you for your support over the past six months. Sander, thank you for your enthusiasm to find a new, concrete form for institutional design and also enabling the combination with procurement. Sparring about the use of the morph chart and your valuable knowledge about procurement, but especially the analytical way of looking at it, helped me a lot. Wijnand, thank you for your support, understanding and open communication. Being able to randomly walk in with a question and walk out with a lots of new ideas has been very pleasant. This way I want to express my gratitude to the both of you for sharing your expertise and understanding.

Louis, thank you for your great enthusiasm for my research and for always helping me move forward. You are so eager to improve and do not shy away from the more difficult route. I learned a lot from your critical vision and passion for what you do. Finally, Tony, thank you for your energy and critical mind, you always kept on asking questions and brainstorming, which supported me improving my work. It is special to me I was included in your team immediately, received so much support, whilst always having a laugh.

I want to thank the both of you for the early Monday meetings and the professional yet personal click. I have felt very much at home with you and all the colleagues "op de derde". I also want to briefly thank Bart, without whom I would not have had this great opportunity doing research in collaboration with the NS. Bart, thank you for your positivity and personal guidance. Further, my gratitude goes to all that have contributed to this research professionally, being the experts interviewed and the participants of the focus group. Without your willingness to share your experiences, it would have been impossible to provide such an overview of opportunities for the sector.

Continuing this 'thank you' a little longer, I would like to thank my personal support system as well. My thesis process has had some small ups and downs, but in general it went quite smoothly, something I cannot say of my personal life. It has been a bumpy road, but with the never-ending support of the people surrounding me, it all ended up well. Thank you Mau, Ro, Suus, Bar, Jan, Ing, Marien, *28*, Tim (on a distance but always there) and certainly *Het Laatste Loodje*. With special thanks to Leen, Hel, Mar, Puck and Phine for being my additional family and lastly, of course, pap en mam, "tot de maan en terug".

Writing this preface marks the end of my time as a student in Delft, of which I have spent seven years at the faculty of Technology, Policy and Management. Seven years filled with learning from great minds, having fun, becoming a better student, but mostly a better Nena. It has been the experience of a life time.

Concluding this preface, I am happy to introduce my research to you. *The fast track to flexibility in public procurement* sets a first step in the exploration of identifying flexibility in the public procurement process, with a focus on the railway sector and even more specific for the procurement of trains for the NS. Parallel to this, another 'first' has been researched by deploying the morphological chart for institutional design. This research has sparked my already existing enthusiasm for public procurement and established it for institutional design.

I encourages you to use, share and further develop the insights of this study. It was created based on a personal drive to support improvement of public procurement processes, for which I hope this serves as guidance in the discussion on process design and gives a little nudge in the direction of exploring collaborative procurement. Though, I hope the insights found on using the morph chart for institutional design provides 'grip' to others to explore and possibly embed this methodology as a standard practice, aspiring to make institutional design more tangible.

May this research show you, there is flexibility for flexibility.

Nena Schenk
Delft
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Executive Summary

Situation

Fast developing technology offers many opportunities for innovation and optimization in the public domain. However this sector is bound to European directives on public procurement transposed into national law of EU member states and therefore bound to the mandatory procurement of, among others, their assets. This legislation provides a limiting framework in which, after awarding the contract, little room for design adjustments is perceived to be left. Renegotiation or even starting a new procedure results in high additional costs and significant delays. As a result assets, especially with long-term procurement processes, are not in accordance with current technological development. The limited amount of literature on this subject provides mitigation of this in very specific cases, but no overview of flexibilities in the procurement process exists. To close this knowledge gap, the question answered in this research is: *How can flexibility to intermediate design changes within a long-term procurement process be improved within European procurement legislation?*

Approach

The railway sector was used as context of this research and since most process design choices are made by the procurer, the Nederlandse Spoorwegen (NS) [Dutch Railways] as the procurer of trains was used as focus of the research and its application.

This research aims to find the relation between institutional design and engineering design. Thus, it was chosen to also adhere to the Engineering Design Approach of Ulrich and Eppinger (2016), with a systematic overview of the flexibility in the process and conceptual process designs as its "end product".

First, the current process was mapped out using the functional modelling technique *IDEF0*, based on literature and professional (internal) documentation. Flexibilities were identified based on the found conditions of being (1) within the available scope of action of the procurer and (2) is expected to affect the possibilities for intermediate changes to the procured product.

Subsequently, a first version of a morphological chart (MC) was made. This is a product design tool, in this research used, tested and validated for institutional design, as a parallel research focus supporting the exploration of flexibilities. An MC systematically shows the design space, in which flexibilities were translated to be *categories* and available options to shape these flexibilities in the process became *means*. The initial version was created based on the MC-principles of *mutually exclusiveness* and *collectively exhaustiveness*. These respectively require that each mean is completely separate and has no overlap with other means and that for each category the sum of all means covers all possible options.

Expert interviews were conducted to develop this initial MC. The validated summaries showed three interrelated but separate data types. The first two were statements based on enhancing flexibility, split up in two topics: feedback on the MC-content (1) and relations between means (2). The last stream consisted of statements and observations on the use of the MC (3). Each iteration all findings were translated to the MC, accordingly developing its content (1) as well as its use (3). The resulting MC was finalized by a substantiated evaluation by the researcher. Based on the collected data also *trends* providing flexibility could be identified in the sector. These trends were translated into six conceptual *design lines* by connecting interrelated means (2). Finally, a focus group with NS-employees was organized to validate the use of the morph chart and the created design lines and to start a first exploration of an improved design for the NS.

Results

The functional analysis of the current process showed that the EU Directive 2014/24 and 2014/15, respectively on public procurement (2014a) and specifically for entities in water, energy, transport and postal service sectors (2014b) limit the design space. Flexibilities initially found were either product- or contract-related.

Morphological Chart

To further investigate the design space for flexibility, a morphological chart was created. During this research four additional *construction rules* were found, being (1) within scope of action, (2) readability, (3) abstraction level and (4) informational value. These were adhered to in the developed MC. Enhancing readability was done by adding chapters; changing the order of categories aligning real decision-making; implementing multiple choice categories for binary choices; designing visualization for qualitative means being interval or ratio variables; providing options to add definition and interpretation to all topics, and avoiding outliers to approach a rectangular shape of the MC. The informational value was increased by including external impacts of vital importance to the process and changing the order of means from most informative to least. Furthermore, the introduction of the tool must be complemented by emphasis of the principles, construction rules and the scope and aim of the MC. Also, support of the board to use this method enhances its effectiveness and preparation of an exemplary case in the MC is recommended, as well as using the MC by drawing on it physically. The MC is validated a useful tool to guide a systematic, substantiated and concrete discussion of process design.

Flexibilities

Using these developed conditions for the MC enabled identification and representation of aspects enhancing flexibility in the MC. These aspects were split into three chapters being *Product*, *Contract* and *Market approach*.

Flexibilities found related to the *product* are: the *scope of the product*, the system of *delivery* and *commissioning*, the timing of *innovative development*, how *innovation is tested*, the *sub-awarding criteria* and the type of *specifications* used.

Flexibilities found related to the *contract* are: the *contract scope*; *procurement tools* deployed; the *financial structure* and its *distribution over time*; the *eligibility requirements*, *selection criteria*; the *future modifications* defined in the contract; the content of the *innovation clause*; how the *initiative to innovate/optimize* is registered; the *awarding criteria*; the *procedure type* and the system of *limiting applicants* towards granting the contract.

Flexibilities found related to the *market approach* are: the *volume* and *duration* set in the market; the *nature*, *hierarchy* and *management* of the *relationship*; how *risk* is *determined* and *mitigated* and how the *risk profile* is defined; the *additional organizational structure(s)* deployed; who has *ownership of the innovation*; its *intellectual property*; the responsibility for *system integration* and the *continuity of the teams involved both in procurement and in asset management*.

Design lines

Validated design lines were created capturing the relations between means. Six lines were drawn based on trends identified, five based on enhanced flexibility and one as representation of the current "base" design, which is Design line 1 - *Traditional*. Design line 2 - *Innovation Only* focuses on separate procurement of innovation and the main asset, to develop and learn from procuring innovation what must be specified in the main procurement. Design line 3 - *Collaboration Light* shows a partnership for the long term between procurer and supplier, enabling innovation and optimization in collaboration whilst still specifying what is required. Design line 4 - *Collaboration Plus* builds hereon but strives to a partnership with multiple parties and leaves exact specifications behind, only the shared procurement goals of the collaborative team are contracted. Design line 5 - *International* focuses on jointly procuring innovation, or its research and development, by similar parties on international level. Lastly, Design line 6 - *Product in Network* shows a process design based on the nature of a product. Products being part of a network can make use of iterative development in which a latest-and-greatest technology requirement ensures it stays up to date.

Exploratory design NS

Applying this to the case of the NS shows that Design line 2 - *Innovation Only* and Design line 4 - *Collaboration Plus* are perceived to be most suitable as starting point of their process design. *Innovation Only* is found to offer research potential to broader application of innovations, but acknowledges the risk of having two different parties in the separate processes and the need for modularity of the main asset. *Collaboration Plus* is perceived to be radical, requiring an internal cultural shift towards mutual trust between collaboration partners. The sector challenges this by being risk adverse. This conservative disposition leads to adherence of known practices, e.g. procurers retaining to being as specific as possible. Additionally, the required internal expertise as well as the alleged requirement for financial and scale related parity between collaboration parties must be evaluated.

All together, commencing a shift from a vertical to a horizontal approach within the buyer-supplier interaction, placing greater importance on formalizing the partnership rather than specifying precise outcomes, is essential. The required redesign for enhanced flexibility to intermediate design changes in public procurement processes can be obtained by using the developed MC as guidance for discussion on the process design. The design lines can be used as starting point for creation and clearly show the shift from traditional procurement towards collaborative contracts, shifting from boarded up contracts towards extensive attention to the relationship between collaboration parties.

Contribution

The scientific contribution of this research lies in two areas. First, the MC presents a first systematic overview of the opportunities for flexibility in public procurement, which was fully absent in the existing body of literature. Second, it presents insights in the deployment of the morph chart, as product design tool, for institutional design, which has not been done before. Its practical takeaways show how the MC-principles can be upheld and expanded by the four construction rules to enable its deployment for institutional design. On both aspects, this research serves as a first step towards the exploration of two new fields of research, possibly to be uncovered jointly.

Next steps

Establishing this discovery must be done by first increasing the validity of the morph chart, its use and content. Retrieval of expert feedback on the content of the MC but be continued until theoretical saturation is reached, meaning no more modifications are suggested.

Parallel to this, options must be explored to visually represent relations between means, for which a sufficient manner is currently lacking. Also, the MC must be applied to different cases to test its usefulness and further improve both its content as well as its use for institutional design. First this must be focused on cases within the railway sector and increasing the sample of people using it. Later on, the MC can be adapted to other sectors under the same EU Directive 2014/23 (European Parliament and the Council, 2014a), or even to sectors under the general EU Directive 2014/24 (European Parliament and the Council, 2014b).

Lastly, it is recommended to policy makers to study the potential of modifying legislation for the aim of innovation to decrease chances of "trespassing" the limits of the significant change, requiring a new procurement process. This risk currently leads to avoidance of change by involved parties, surpassing the goal of innovation and optimization of societal goals, such as state-of-the-art mobility.

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Nomenclature

In table 1 the abbreviations used in this report are listed. Since some Dutch abbreviations have been used as well, these will also be included and supplemented with an English translation or interpretation.

Table 1: The Abbreviations Used in this Report.

Abbreviation	Definition
General	
PP(P)	Public Procurement (Process)
MC	Morph Chart
CoSEM	Complex Systems Engineering and Management
EDA	Engineering Design Approach
DTA	Design Thinking Approach
PPfI	Public Procurement for Innovation
PPoI	Public Procurement of Innovation
IPP	Innovative Public Procurement
IT	Information Technology
OT	Operational Technology
OBS	Observation
RQ	Research Question
SQ	Sub Question
IDEF0	Integration DEFinition 0 (for Function Modelling) (previously: Icam DEFinition)
UML	Unified Modelling Language
Public Procurement	
DAS	Dynamisch aankoopsysteem [Dynamic Purchasing System]
BAFO	Best And Final Offer
BVP	Best Value Procurement
TRL	Technology Readiness Level
PDI	Post Delivery Item
MKI	Milieukostenindicator [Environmental Cost Indicator]
MVI	Maatschappelijk Verantwoord Inkopen [Socially responsible procurement]
BPKV	Beste Prijs-Kwaliteit Verhouding [Best price-quality ratio]
RAW	Rationalisatie en Automatisering Grond-, Water- en Wegenbouw [Rationalization and Automation Earth, Water and Road Construction]
STABU	Standaardbestek Burger- en Utiliteitsbouw [Standard specifications for civil and utility construction]
UAV	Uniforme Administratieve Voorwaarden [Uniform Administrative Conditions]
UAV-GC	UAV voor Geïntegreerde Contractvormen [Concerning Integrated Contract Forms]
Rail sector	
OBIS	Onboard Information System
ICNG	Intercity New Generation
LTSA	Long-Term Service Agreement
ERTMS	European Rail Traffic Management System
MIRT	Meerjarenprogramma Infrastructuur, Ruimte en Transport [Multiyear Infrastructure, Spatial Planning and Transport Programme]
TSI	Technical Specifications for Interoperability
ROSCO	Rolling Stock Company
ATO	Automatic Train Operation
RRX	Rhein-Ruhr-Express

1 Introduction

In this chapter the existing problem (section 1.1) and its current situation (section 1.2) will be introduced. After, an elaboration on the existent perspectives in literature on the described situation will be given in section 1.3, which logically results in the identification of the knowledge gap in section 1.4. This is followed by section 1.5 in which a delineation of the research focus is given by clearly outlining its practical application and scope. Subsequently, an explanation is given on the parallel study on the morphological chart included in this research in section 1.6. This chapter is concluded by section 1.7 in which the research relevance is described and section 1.8 provides a reading guide explaining the structure of this thesis.

1.1. Problem introduction

Research has been focusing for years on making life easier, more efficient, faster and so on. As a result technological advancement is developing rapidly. One of the sectors this progressive research has focused on is the public transportation sector, creating, among others, safer and faster connections, more sustainable transport and improved travelers experience (Chung, 2021; Shah et al., 2021; Shaheen & Cohen, 2018; Welch & Widita, 2019). Keeping up with the continuous developments offers many opportunities for improvement and is of vital importance to the competitiveness of, among others, sustainability, in travelling (De Martino & Morvillo, 2008; Song & Panayides, 2008). To keep up-to-date with this progression, products and their design must be open to the adaptation to innovation and optimisation. Though, as the public sector is bound to procurement legislation (semi-)public organizations struggle with a discrepancy between the will to improve and the reality of legislative barriers to do so (Uyarra et al., 2014).

1.2. Current situation

EU Directive 2014/23 (European Parliament and the Council, 2014a) on the award of concession contracts obliges public procurement of new goods, works and services. Since EU Directives have to be transposed to national law, an obligation to procure exists for all (semi-)public organisations in EU member states. The procurement procedures resulting are not known for their flexibility to intermediate design changes to the product (Grimsey & Lewis, 2007). This causes the PP (Public Procurement) process to become increasingly rigid to changes to the initial design the further the process progresses. It leaves the perception of limited room for flexibility as after contract awarding most is fixed, which also creates a form of 'path dependency' to the buyer (Edler & Uyarra, 2013; Pircher, 2020; Tsipouri et al., 2015).

This scarcity of available options to include flexibility in the PPP (Public Procurement Process) is becoming an even bigger problem when considered in the context of long-term procedures. Looking at cases of infrastructural building projects and the construction of rolling stock, these processes can take dozens of months, if not years. It causes design choices forced to be made years in advance of the actual construction and completion of the product. As a consequence, the design is not conforming to recent developments and lags behind in benefiting of rapidly developing technical advancements (Tsipouri et al., 2015). This strongly contradicts the goals as formulated by the Dutch central government in their vision of "Procurement with Impact": "Using procurement for sustainable transition, social goals and innovation is our objective" (Ollongren & van Veldhoven-van der Meer, 2021). Additionally, the obvious option for (semi-)public organisations as procurer to enable intermediate design changes is to start a new procurement procedure. Though, the additional costs and time period take away (a significant part of) the incentive to do so for the procurer (Tsipouri et al., 2015; Uyarra et al., 2014).

1.3. Existent perspectives

Literature shows limited insights in the existent perspective(s) on how to enable or improve flexibility for innovation or optimization by intermediate design changes in public procurement procedures. In this section an overview is given of the scattered body of literature existing on this subject. First, it will be discussed how innovation in public procurement processes is addressed in literature based on the taxonomy framework of Obwegeser and Müller (2018) and what definition applies to this study. Second, an overview is given of what literature exists on this definition of innovation in PP in relation

to (improved) flexibility. Third, an overview is given of what dispersed research exists on the identification of flexibilities in the PP process.

1.3.1. Innovation in Public Procurement

An increasing amount of literature is researching the subject of innovation in the context of public procurement (Kundu et al., 2020). Rolfstam (2013) describes public procurement of innovation as being the act of purchasing by public organizations that results in innovation. However, in literature the combination of 'public procurement' and 'innovation' is made often, but the same terms are used in different contexts. Obwegeser and Müller (2018) therefore propose a framework with a clear taxonomy for the different terms used throughout scientific research. This framework divides the literature into three streams, being (1) Public Procurement for Innovation (PPfI), (2) Public Procurement of Innovations (PPoI) and (3) Innovative Public Procurement (IPP).

Obwegeser and Müller (2018) describes the first stream to be Public Procurement for Innovation (PPfI). PPfI is the procurement of new to be designed goods and services, with a focus on the procurement of technology (Edquist & Hommen, 1999). PPfI aims to find an answer to the question of how PP can be deployed to drive innovation. Rolfstam (2012) and Edquist et al.(2015) described this form of innovation and public procurement, as 'innovation-friendly public procurement'. PPfI has its specific focus on how to deploy public procurement as a tool to drive innovation (Edler & Georghiou, 2007).

The second stream is based on Public Procurement of Innovations (PPoI), which has a broader perspective than PPfI and considers all public procurement that leads to innovations. Even the innovation of the procurement process itself or combining existing technologies is seen as innovation within this stream (Kundu et al., 2020). The main focus within this literature stream is on how public services and procurement can be adjusted, such that investments in innovation are increased (Edler & Georghiou, 2007; Obwegeser & Müller, 2018). A common topic herein is a purposed change in behavior of the procurer, supporting a shift from buying the cheapest towards buying the most innovative (Yeow & Edler, 2012). Boes and Dorée (2008) describes this as a shift from a short-term focus to a long-term vision on strategic development. Such a change requires solid management and challenges the institutional set-up (Gee & Uyarra, 2013).

And lastly, the third thematic stream is the Innovative Public Procurement (IPP). IPP is the 'outsider' in this outline, as it includes all literature on how the PP process can be innovated. As presented by (Kundu et al., 2020), the articles of this stream are mostly highly specialized and cover the (possible) reformation of PP processes. It leads to scientific knowledge on the future of PP and does not involve innovation in its definition as used in PPfI and PPoI, but aims to improve the process itself (Obwegeser & Müller, 2018).

In the situation described, a lack of flexibility to intermediate design changes in the PP process is perceived. Since this relates to the procurement process requiring adjustments for innovation and a shift towards a long-term strategic vision in the procurement and the challenges that accompany this change, this study focuses on the second stream, being the Public Procurement of Innovations.

1.3.2. Definition of Innovation

Apart from these different streams, another distinction can be made between different types of innovation in PP. Edquist and Zabala-Iturriagagoitia (2012) draws a clear distinction between direct and adaptive innovation in procurement. In this approach direct innovation is perceived to be a development that is new to the world, where adaptive innovation is new to the end-user. In this research, innovation will be defined to be adaptive innovation, as most research adheres to this definition (Edler & Yeow, 2016). Also, this study focuses on flexibility in public procurement, which is not only to be found for the aim of direct innovation, but e.g. also for optimization which could be only new to the end-user.

1.3.3. Flexibility in Public Procurement Process

Apart from the innovation in public procurement, literature on other "drivers" of flexibility for intermediate changes are not mentioned often. The amount of literature on this topic is limited and mostly scattered amongst more general research on PPoI (Obwegeser & Müller, 2018).

Existing knowledge on intermediate adjustments to procured designs mostly covers what barriers hinder those changes. Research of Kundu et al. (2020) states that the role of the government and the (semi-)public organizations, as a buyer of goods and services, becomes increasingly important in discussions about innovation and public procurement, but the public procuring organizations have, among others, legislative, risk and financial limitations. Also, Bajari and Tadelis (2001) show that the procurer is faced with a trade-off between providing incentives for the design upfront and reducing ex post transaction costs, caused by costly renegotiation. Also, they suggest that the choice for contractual arrangement accommodates adaptation. Furthermore, it suggests: "if the likelihood of changes to a design is large, then the buyer should choose weak incentives, whereas strong incentives should govern purchases that are less likely to involve changes" (Bajari & Tadelis, 2001). Other 'solutions' are offered in research by Rigby et al. (2005), as being the unbundling of the product to be designed to mitigate risk for both sides, buyer and seller. And Edler and Yeow (2016) studied the role of intermediation in the PP process when adaptation was necessary. The research shows that high learning costs were involved for the buying organization in case of adaptation and that intermediation could be of help in this process. Another solution is offered by Knutsson and Thomasson (2014), who propose the procurer to use functional descriptions in their Request for Proposal (RfP) instead of a detailed description of products in the call for tender. This way innovative solutions will be stimulated.

1.4. Knowledge gap

All together, this overview of the available theoretical background of flexibility in public procurement prepares the identification of lacking knowledge, which can be translated into an outline of the knowledge gap.

Based on this overview of the existing body of literature, it can easily be seen that, although some research has been performed on or touches upon this matter, an overview of what aspects, process decisions, (can) contribute to enabling or improving flexibility for intermediate design changes is absent. Growing the body of literature on PPoI, such an overview closes this knowledge gap, providing insights on what flexibilities can be identified and how these must be deployed to obtain the availability of intermediate design changes, especially for long-term procurement. This necessity is supported by multiple studies suggesting more research should be done on the role of public procurement in innovation and its practical application (Kundu et al., 2020; Obwegeser & Müller, 2018). Also, the relevance of studying the application of flexibility in the PP process, is stressed often (Granheimer et al., 2022) as well as the need for closing the gap between existing research and procurement practices (Boykin, 2022; Kundu et al., 2020; Obwegeser & Müller, 2018; Rigby et al., 2005; Uyarra et al., 2020). All in all, the research question logically derived is:

Research Question

How can flexibility to intermediate design changes within a long-term procurement process be improved within European procurement legislation?

1.5. Research focus

Answering this research question (RQ) aims to provide guidance needed by (semi-)public organisations to establish more flexibility in their procurement procedure. Since the current body of literature provides such a limited amount of overview on this matter, this research cannot fully rely on the availability of scientific resources, which requires analysis of (common) practices throughout the procurement sector. This necessity is supported by multiple studies suggesting more research should be done on the role of public procurement in innovation and its practical application (Kundu et al., 2020; Obwegeser & Müller, 2018). Also, the relevance of studying the application of flexibility in the PP process, is stressed often (Granheimer et al., 2022) as well as the need for closing the gap between existing research and procurement practices (Boykin, 2022; Kundu et al., 2020; Obwegeser & Müller, 2018; Rigby et al., 2005; Uyarra et al., 2020).

1.5.1. Practical application: Nederlandse Spoorwegen

This emphasize on studying the (possible) procurement practices requires this research to focus on a specific sector in which procurement takes place. In the public transportation sector many long-term procurement process are required, for example for purchasing rolling stock. As explained, especially these long-term processes suffer from the lack of available options to build in flexibility, which adds high additional costs and significant delays to the design process for the procurer (Tsipouri et al., 2015). This discourages procurers to modify the design for the aim of innovation, while this is important for, among others, the competitiveness of sustainable traveling.

When looking specifically at the current situation of the Nederlandse Spoorwegen (NS) [Dutch Railways], it takes approximately 7 years from the start of the procurement process to the introduction of a new train on the Dutch Main Railway Network. As the PP process shows rigidities to intermediate design changes, roughly no intermediate changes to the procured design can be made during the process. It causes the train not to be up-to-date at completion. Consideration of this case is suitable for this research as it contains a long-term procurement process of a physical, technically complex asset that has to be designed, which currently encounters much rigidity to change through out the full procurement process. All together, the procurement of trains by the NS is the right context of this research and functions as its practical application. this justifies the execution of this research being based on the NS-case and applying the results eventually to this case as well.

1.5.2. Scope

The analysis of and application to the NS-procurement process provides clear outlining of this research. Since the NS is a semi-public organisation in the Netherlands, a member state of the European Union, EU legislation for public procurement applies via national law to public organizations. The Nederlandse Spoorwegen (NS) [Dutch Railways] is covered by this legislation and therefore has to set out tenders for new equipment. However, the NS belongs to the so-called "special sector" companies, being all contracting authorities operating in the water, energy, transport and postal service sectors. This means that EU Directive 2014/23 for public procurement (European Parliament and the Council, 2014a) is transposed into Dutch Public Procurement Law (2012), but for these companies some variations apply, transposed from EU Directive 2014/25 (European Parliament and the Council, 2014b). Therewith Dutch public procurement legislation for special sectors is considered as legislative outline of the design space available for the exploration of flexibilities.

Further, it is assumed in this study that contract values of the procurement procedures considered in this research equal or exceed the threshold value, which is mentioned in Article 8.1 of EU Directive 2014/23 (European Parliament and the Council, 2014a). This means a European public procurement process is compulsory. When contracts do not reach this value, a national procurement procedure would have been sufficient. Such a national procedure requires following certain procurement principles, but does not require compliance with the more strict EU procurement procedure (Ministry of Economic Affairs, 2012; PIANOo - Centre of Expertise on Procurement, 2014). However, this study concentrates on

long-term procurement with an application focusing on procuring trains specifically, which both affect the procurement contracts to be of high value, far exceeding the threshold value. Because of this, the option of national procurement is excluded from this study.

Moreover, this study is performed from a procurer's perspective, being the NS-perspective for the research application. This is done since the issue of current inflexibility in PP processes is experienced foremostly by the procurer. Not being able to make intermediate design changes brings certainty of the contract which is not a direct issue of the contracted supplier (Lonsdale, 2005). However on procurer's side, the inability to make these changes or eventually high additional costs of renegotiation or a new procurement procedure and the extra required time, do necessitate answering the posed RQ. Also, the procurer is the scope setting party in the procurement system. This party initiates the procurement and decides on the process design and therefore has the power to also make changes to create flexibility, if it is found and if so, how to do this.

1.6. Research parallel: Morphological Chart

1.6.1. Institutional design

Answering how flexibility can be enhanced in PP processes requires institutional design, being the substantiated creation of "systems of established and embedded social rules that structure social interactions" (Hodgson, 2006). The existence of both procurement legislation, as formal institutions, and social and organizational arrangements, as informal institutions, to coordinate the procurement as "transaction", evidently requires institutional design. This design process consists firstly of creating in-depth knowledge and understanding of the institutions within this complex socio-technical system of procurement. Secondly, the institutional design of the procurement process is created in support of desirable performance of this complex system, meaning the enhancement of flexibility (Hodgson, 2006).

Interestingly, many studies have provided, tested and evaluated existent institutional design tools, but a direct link to the broader literature on design, such as engineering design is lacking. This should be added up to the necessity of a conceptual design tool providing overview of the design space, as well as concrete insights in a new process design and leads to the conclusion that a conceptual institutional design based on engineering design is needed for this research.

Engineering design tools

The field of engineering design encompasses a diverse array of tools and methodologies aimed at systematically addressing complex problems and generating innovative solutions (Pahl et al., 2007). These tools span various stages of the design process, from problem definition to concept generation and finalization. Systematically informing the design process is done by the deployment of formal engineering design methods. Dym (2013) presents these methods to be *Objective trees, Pairwise comparison charts, Metrics, Functional analysis, Performance specification method* and *Morphological charts*. Last mentioned tool does not only provide insight in *what* sub-functions, flexibilities, must be fulfilled, but also focuses on *how* this could be done. The morphological chart stands out as a comprehensive and systematic approach to exploring the design space by breaking down a complex problem into its constituent elements and systematically considering their combinations. It shows how large the available design space per sub-function is, resulting in a delineation of the full design space effectively usable for the design to be created (Chawla & Summers, 2019; Smith, 2007; Smith et al., 2012). This research aims to conduct an exploration of the possibilities for flexibilities, which makes the morphological chart the right tool for application in this context.

1.6.2. Morphological chart

The morphological chart was first proposed by the Swiss astronomer Zwicky (1957) and provides a structured framework for systematically organizing and analyzing potential, conceptual design solutions (Richardson III et al., 2011). The importance of morphological charts in engineering design is highlighted in literature, such as research of Pahl et al. (2007) emphasizing its systematic nature and ability to provide overview. Also, the use of an MC enables conceptual design resulting in the creation of a principle solution, a conceptual design. The MC does not provide a more detailed, "physical" design, as done in embodiment design, but this is not aimed for in this research (Smith et al., 2012).

This systematic approach of the MC is established by the chart listing a set of decomposed sub-functions and for each of those their own solution fragments (Richardson III et al., 2011). Different terms are used among the body of literature on MC's, but in this research each sub-function will be referred to as *category* and for each of the solution fragments *means* will be the term used. After the exploration of the available design space by studying the categories and their totality of available means, the MC also enables the actual development of a conceptual design. This is done by combining means to create a potential integrated conceptual design (Richardson III et al., 2011).

Generation and combination of these means have been shown to follow two "principles". First, the means of each category are targeted to be*collectively exhaustive*, which is the aim for a comprehensive collection without leaving alternatives (Lee & Chen, 2018). Second, *mutually exclusiveness* of the means for each category is desired. This indicates no overlap exists between means of one category (Ritchey, 2018).

1.6.3. Research parallel

Testing if and if so how the morphological as engineering design tool can be applied for institutional design creates a methodological research objective parallel to the exploration of flexibility in PPP, whilst limited by the prevailing legislative framework. This lateral research objective beholds testing if an engineering design tool can be adjusted in such a way that

it fits the needs of institutional design, whilst providing a concrete, practical and concise methodology to do so. It aims to find out if a link between institutional design and (an) engineering design tools can be found and what the (first) application brings about.

During this research the morph chart (MC) is deployed based on its common application as engineering design tool. As this is done, it is evaluated tracked how the tool is deployed and where it falls short or needs to be modified to be applicable for institutional design. While gathering knowledge about flexibility to further develop the content of the MC, how the tool functions as a design tool will also be tracked. Thus, by the end of this research, an initial insight into the suitability and applicability of this tool for institutional design is aimed for. Also, it is targeted to provide an initial starting point for further exploring the link between institutional design and the broader design literature and specifically the use of the MC for this purpose.

1.7. Relevance

1.7.1. Society

The purpose underlying PP legislation is to provide fair, transparent and effective transactions on the European internal market, whilst preserving the most optimal price-quality ratio for buying public organizations (PIANOo Dutch Public Procurement Expertise Centre, 2010). However, innovation and optimization of the procured products is required to stay up-to-date. In the public transportation sector innovation and optimisation is desired to stay up-to-date with technological development and also to stay compliant with guidelines, prepare for future scenarios and to stay as effective and efficient as possible. Doing so will enhance the attractiveness of sustainable mobility for society. To do so, implementation of rapidly developing innovations is necessary. However, currently the PP processes do not easily show where latitude is hidden to make intermediate changes in the procurement process and to the resulting product. Therefore, finding flexibility in this process is of vital importance to maintain competitiveness for public organizations and in this research context specifically for the NS for the procurement of trains.

Adding to that, if no scope of flexibility can be found to make intermediate changes to the initial procured design. This will result in late implementation of, by then dated, improvements or even the impossibility to make use of new technologies, caused by the inability to, for the transportation sector, change a network, vehicle fleet or other transportation assets all at once.

1.7.2. NS

This affects the relevance of this research to NS. Researching the availability of such flexibilities will either provide insight in what can be done to improve this flexibility, or it leads to the conclusion that the options found will not affect improvement. In both cases, the results will provide clarity to the NS about next steps. If no options to improve can be identified, the current process must be adhered to. However, when the results show there are available options to the NS improving flexibility, this enables improved flexibility when procuring trains, affecting trains to be more state-of-the-art at completion. Hence, this study is relevant for overview, guidance and substantiation of choices to be made about the procurement process design of the NS.

1.7.3. Science

The research introduced aims to systematically provide an overview of flexibility in public procurement procedures, something that has not been done before. The tendering process is analyzed, flexibilities are identified and then, for each of these, the possibilities for fulfilling those flexibilities are determined, all from an integral approach. This way providing a structured way to discuss flexibility in institutional design of the public procurement process is already of importance to science, regardless of the overview providing a solution for specific cases, such as the NS-case of train procurement.

Apart from this, the research deals with improving the tendered product, i.e. it examines how those flexibilities can be designed in such a way that the process actually becomes more flexible, with the ultimate goal of making the result of the tendered product as good as possible. This ensures that this research is of both exploratory and applied relevance to science. Hopefully, the results may affect more research to be performed on flexibility in procurement processes, which is currently uncharted territory. This will also make technical research on innovation and optimization of long-term products to be tendered more relevant: these could then be more easily and/or quickly applied and of value.

Beyond the relevance of the insights into flexibility, the lateral research objective on the use of the MC provides added scientific value. Using an MC as an engineering design tool for institutional design attempts building a bridge between institutional design and the broader design literature. The evaluation of this use can provide valuable information for comprehensible and systematic design of institutions by an engineering design tool. The knowledge gained can be used as a first step toward more research on the multi-use of widely used engineering design tools (Dym, 2013).

Looking further, any success of the MC in this context could lead to sparking interest from other researchers to dive into this topic. The concrete and practical approach hopefully also sparks the interest of more students, increasing the attention for substantiated and further improved institutional design, aiming to advance management of complex socio-technical systems as much as possible.

1.7.4. MSc programme

Finally, this research is also relevant within the framework of the MSc Complex Systems Engineering and Management. Analyzing and designing flexibility for intermediate design changes in long-term procurement processes requires in-depth examination of the procurement process as a socio-technical system. A socio-technical system refers to the interaction between technical and human components, looking at these elements in synergy instead of isolation. Within CoSEM focus is on the application of technical disciplines being accompanied by its societal context, which as complex socio-technical system requires cross-disciplinary study (Vespignani, 2012).

The technical component is the procurement process itself, as well as the product to be procured. This is even more interesting in the context of CoSEM since this study specifically examines the procurement of trains, a product that in itself can also be considered a complex system.

The social context is formed by the interaction between procurer(s) and (potential) suppliers, but also by the public desiring improved mobility, the legislator, the operator of infrastructure. Extra complexity is added to the social context by the limiting framework of procurement legislation.

All in all, the combination of these aspects leads to a multidisciplinary research on a complex situation, in which the possible design concept(s) to be created will be based on the existing scientific knowledge as much as on its practical implications. The resulting design takes into account the social context, with the legislative barriers and its technical components, whilst exploring the flexibility of the procurement process, to guarantee innovation in the transportation sector to preserve and increase mobility now and in the future.

1.8. Reading guide

In this chapter 1 the research introduction is given. Chapter 2 the research approach on what research design is used to answer the main question is explained. This results in specific sub-questions that are also presented in this chapter, as well as the methodology used to answer these questions and how these relate to the structure of the research.

After these preparatory chapters, the current public procurement process is analyzed in chapter 3, based on which also the first identification of flexibilities is performed. Chapter 4 shows the refinement of these flexibilities and how this is transformed into the creation of the initial morph chart. The MC-content is incrementally developed, resulting in the exploration of the available design space in chapter 5, which also leads to the advancement of MC in parallel. All that has been learned during the development of the MC is presented in chapter 1.6.3. Subsequently, chapter 7 shows the trends perceived to be providing flexibility by drawing conceptual design lines into the morph chart. This leads to the application of all that is learned to the procurement process of the NS elaborated on in chapter 8. These chapters presenting all found results are followed up by the chapters 9. Conclusion and 10 Discussion. In the appendices all documentation underlying this research can be found.

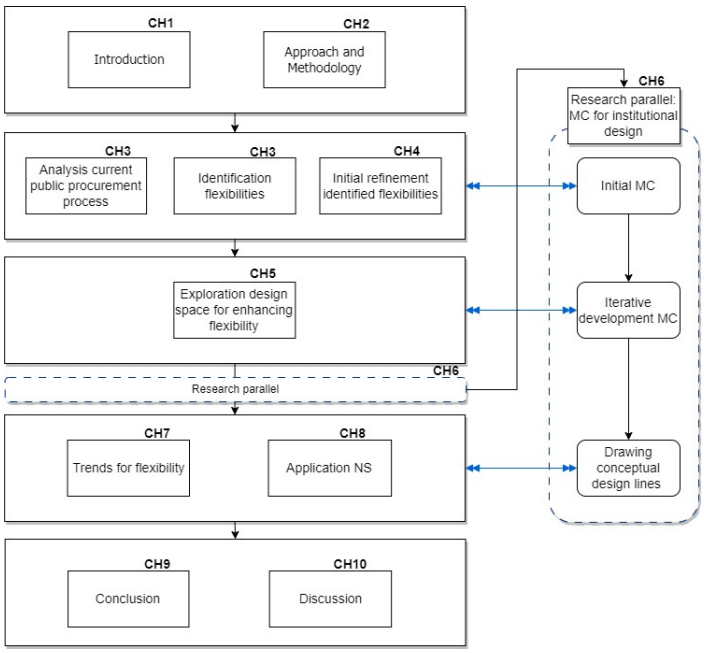


Figure 1.1: Reading Guide: Main Research Structure and the Research Parallel

2

Research approach and methodology

This chapter presents the research approach and subsequently the methodology adhered to in order to answer the posed research question and the research parallel as introduced in chapter 1. First the research approach and its phases are explained in section 2.1. Based on these phases sub questions are derived and discussed in section 2.2, which further explains the link between the engineering design phase and its application to the SQ's for institutional design. Subsequently, the methodology is set out in section 2.3, in which for each of these sub question the methods deployed for answering are set out. Though, a more detailed substantiation and elaboration of these methods can be found in the appendices. Appendix B shows the set up of the expert interviews (summaries in Appendix C) and Appendix G presents how the focus group methodology is applied (summary in Appendix H). The methodology presented is transformed into a Research Flow Diagram (RFD) in section 2.5, which provides overview of the research to be conducted. This approach and methodology chapter is finalized by section 2.6 on the applied data management for all research aspects in which input from individuals is used. This section shows how this input is safeguarded within this research.

2.1. Research approach

For the exploration of flexibilities and based hereon the creation of conceptual process designs, as aimed for in this research, making use of an institutional design approach could have been logical. However, since this research aims to see if and if so how on how institutional design and the broader spectrum of design practices relate to each other. Using this line of thought in this study, it is interesting to use an Engineering Design Approach (EDA) to explore possible design concepts for flexible procurement processes. This way, these constructs or even the absence of possible concepts serve as outcome of this research and will be seen as the 'end product' of the design.

Phase	EDA	Application Research
Phase 0	Planning	Design research structure and objective
Phase 1	Concept Development	Analysis system and identification design space
Phase 2	System-Level Design	Design interventions and locate in system
Phase 3:	Detail Design	Choice for intervention
Phase 4	Testing and Refinement	Analysis effects of intervention
Phase 5	Production Ramp-Up	Design implementation and evaluation of design

Figure 2.1: Engineering Design Approach and Equivalent Steps of this Study

Specifically, EDA has been chosen for this research, in comparison to a Design Thinking Approach (DTA), as it assumes an open system with interaction and interdependence as opposed to DTA which assumes a more closed system with a set of parameters (Greene et al., 2019). The studied procurement process is part of an open, complex system that is dependent on external factors and both technical and social interaction, making it impossible to be translated into a set of parameters to be researched. Also, EDA assumes a system-centered point of view, whereas DTA works with a human-centered approach (Greene et al., 2019). All togehter EDA is the most suitable research approach. An overview of how its process steps are

applied in this research is shown in figure 2.1. Each process step is part of a phase and on the right side of the figure it is shown what the equivalent of this step is in the proposed research.

2.2. Sub questions

Ulrich and Eppinger (2016) proposed a model of three different Engineering Design Process Flows were presented. Since this research is of an exploratory nature, iteration is inevitably necessary. Therefore, the Spiral Product Development Process Flow, shown in figure 2.2 is adhered to in this research, since it focuses on the inclusion of iteration cycles.

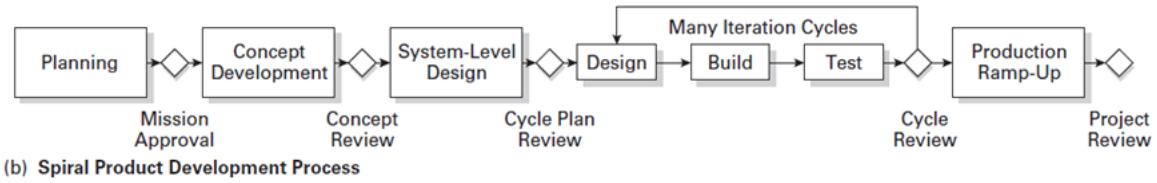


Figure 2.2: Ulrich and Eppinger Engineering Design Process Model (2016)

This process flow clearly consists of five steps, in which the iteration cycles are seen as one. Below is explained how each of these phases lead to the main RQ and the SQ's to be answered to enable finding a final answer to the RQ.

2.2.1. Phases to sub questions

'Planning' is the first of five steps and is mostly seen as 'phase zero' as it takes place prior to the actual design process. This step beholds the identification of opportunity for the design itself and its output is a mission statement including its assumptions and constraints (Ulrich & Eppinger, 2016). This phase is presented in chapter 1. Introduction and this chapter. In this part of the research, the motivation of the study is provided, the theoretical background is given, leading towards the the identification of a knowledge gap substantiating the posed research question. Lastly, the research approach and methodology deployed to answer the RQ are shown. This main question to be answered is:

RQ

How can flexibility to intermediate design changes within a long-term procurement process be improved within European procurement legislation?

The phase that follows is 'Concept Development' and aims to identify the needs of the market, the generation of product concepts and the selection of one or more of these for further development (Ulrich & Eppinger, 2016). Translation to the design of this research results in an overview of the PP process and an insight into which factors possibly offer opportunities for enhanced flexibility. It leads to the first sub question to answer, being:

SQ 1

What does the current public procurement process entail and what opportunities for flexibility in design exist herein?

'The system-level design' phase follows hereafter and takes care of the decomposition of the product into subsystems, focuses on the preliminary design and allocation of the key components that come from this decomposition. Its output can be summarized as a layout of the product and a functional specification of each of the products subsystems (Ulrich & Eppinger, 2016). As explained in section 1.6 a research parallel exists in this research, which is based on this system-level design phase. This phase focuses in this research on how the found opportunities can be evaluated and expanded for institutional design of a PP process with enhanced flexibility. It is tested if the use of a morphological chart as a product design tool can be deployed for institutional design and if it supports the design of this improved process. To test this, an initial design with the identified flexibilities is created. To do so, the morphological chart is deployed in this stage, meaning the focus of the following SQ will be on this research parallel:

SQ 2

How can the morphological chart be used for systematic institutional design of a PP process with enhanced flexibility?

In the following phase, three stages are combined, being Design, Build and Test in iteration with the objective to finalize the product created. This means that the design is worked out in detail, selections on characteristics are finished, its decomposed parts are designed and a robust design outline is ready. Conversion to this study leads to a phase in which the initial morphological chart is matured by iterations of feedback and based hereon adjustments are made to the chart. Each iteration, the adjusted version serves as input for the following feedback loop. Finally, the aimed result is a matured version of the morph chart in which the design space for enhancing flexibility is systematically presented. Parallel to this objective, the deployment of the morphological chart as an institutional design tool is evaluated simultaneously. The output of this stage therefore is a two-fold: aiming to systematically provide insight in what process options exist to enhance flexibility (1) and testing what adjustments have to be made to a morph chart used for product design to be useful for institutional design (2).

SQ 3

What process aspects have been experienced to generate flexibility in PP processes?

This phase is ended by a last iteration being performed. In this iteration the morph chart is improved both on its informational value as well as its methodological value. All found improvements are applied to the MC before validation of this result is done. This validation round is the 'cycle review' and aims to check if the morph chart functions as intended and if its content is correct and covering the design space available. To check this, the following sub-question must be answered:

SQ 4

What conceptual process designs can be created to improve flexibility in the public procurement procedure?

After finishing this last iteration, the Ulrich and Eppinger (2016) model describes the 'Production Ramp-Up' phase. It takes care of preparing the introduction of the product, fixing any remaining problems and evaluation of the design. After this, a project review is performed and intends to identify ways to improve the process for future projects. Translation of the production ramp-up phase to this research brings up the application of the morph chart for its intended use. By applying the chart to the public procurement procedure of the NS, it is tested if application provides conceptual process designs in which flexibility is enhanced. This last test aims to analyze the effects of the tool on institutional design, on the conceptual design of public procurement processes in general and on what insights can be provided for the NS by application of the tool. The last sub question is therefore:

SQ 5

Considering the created MC and conceptual design proposals for flexibility, what process design should be explored for application for the NS?

2.3. Methodology

The proposed research approach results in five sub questions that have to be answered. The methods and tools required to do so, will be discussed in this section. The overview of this methodology will be presented in the Research Flow Diagram in figure 2.3.

2.4. Methods

Phase 0: Planning

The planning phase is covered by chapter 1. and this chapter and is therefore not worked out in more detail.

Phase 1: Concept Development

What does the current public procurement process entail and what opportunities for flexibility in design exist herein?

The first sub question needs an overview of the full PP process and an overview of which flexibilities can be found. In-depth information on the process is expected to be found during *analysis of documentation* on public procurement. These documents are provided by the government, expertise centers, public organizations and scientific research. The analysis of the data will place using *IDEF0* to map the process, which is a functional modelling method. Its key advantages are that the model gives clear insights in relationships and interaction. Also, this modelling technique is often used for process redesign (Mordecai, 2019) and effectively supports communication and a common understanding of complex systems by stakeholders (IEEE Staff, 2019). After the current process is mapped out, the identification of flexibilities must be done. Since no literature exists on how this can be done, a substantiated brainstorm will be conducted in collaboration with the NS. This brainstorm aims to pinpoint conditions based on which flexibilities can be identified in the current process and additionally tries to extend the list of identified flexibilities based on present expert knowledge.

Phase 2: System-Level Design

How can the morphological chart be used for systematic institutional design of a PP process with enhanced flexibility?

Answering this SQ requires an extra focus within this research: this research parallel is introduced in section 1.6 and Phase 2 of 2.2 and explain why a morphological chart is deployed for institutional design. To answer how this is done, a morphological chart must be created with the found flexibilities, being a construction of the design space available to the procurer to undertake action improving flexibility. As described in 1.6, this type of chart is used often in engineering design processes and focuses, among others, on the conceptual design phase (Smith et al., 2012). It presents the means to 'solve' the identified problems and combines these with a potential integrated conceptual design. This does not specifically require novelty, but collects means to 'fulfill' sub functions or problems (Borekci, 2018), which is suitable for this research, that does not particularly aims to find just new solutions. It also allows the selection of a principle solution or multiple solutions to explore in the coming phases (Smith et al., 2012). To enable insight in the use of the morphological chart, the identified flexibilities are translated as 'sub function' of the process, followed by the possible options to fulfill this sub function.

After this initial design of the MC is created, two interrelated research focuses emerge. On the one hand, the content on flexibility in the morph chart is developed by iteration, which will be elaborated on in Phase 3: Iteration. Parallel to this, the use of the morph chart is evaluated based on its usage during the content development. This is continued since the focus group held to validate the design lines and exploration of a future design (Phase 4 and 5) is also used to validate the use of the morph chart. In this chapter however, the full overview is given of all results leading up to answering how the MC should be used for institutional design. This means all process steps following this phase have been completed for the use of the MC as an institutional design tool as well and these results have been collected and presented in this chapter.

Phase 3: Iteration

What process aspects have been experienced to generate flexibility in PP processes?
To gain insight on the process aspects to have been experienced generating flexibility in PP processes, expert interviews will be conducted. These interviews will be two-folded, first the experts are asked about a case which illustrates their experiences with flexibility in procurement processes. To not create bias, the morph chart will be presented after this first part. Second, the morph chart is presented to the interviewee, avoiding to create bias in the stories told, and the interviewee is asked for feedback on its content. This interview structure can be found in appendix B. The collected feedback is reported in terms of adjustments made to the initial morph chart. However, every interview the morph chart presented is the version resulting from the adjustments made based on the previous interview. Apart from feedback on the content of the diagram, the use of the MC by the expert is observed and their statements hereon will be registered too. This leads to the earlier mentioned parallel development of the MC as institutional design tool.

Phase 4: Validating iteration

What conceptual process designs can be created to improve flexibility in the public procurement procedure?
Apart from direct feedback on the morph chart, the interviews provide much input on combinations to be made of means to enhance flexibility. This extra input is analyzed and trends will be identified herein, leading to the creation of design lines, conceptual process designs with each its own 'theme'.

To validate these design lines, but also the use of the MC and make a start with Phase 5: Production Ramp-up, a focus group will be organized. This focus group will consist of about 4 - 6 NS employees, having substantial experience in the procurement sector on a decision-making level. These participants will be asked to draw the design of the current procurement process in the MC in advance to check the use of the morph chart. During the meeting the design lines are presented to them for the aim of validation. A detailed description and substantiation of the structure of this focus group is shown in Appendix G.

Phase 5: Production Ramp-Up

Considering the created MC and conceptual design proposals for flexibility, what process design should be explored for application for the NS?

The focus group organized also enables answering this sub question. After the presentation and validation of the design lines in Phase 4: Validating iteration, the participants will be asked to vote for the two most promising design lines for the NS in their point of view. These design lines will be used to structure an exploratory discussion on how these designs for flexibility can be applied to the procurement process of the NS.

2.5. Research Flow Diagram

After the textual presentation of the research methods and tools proposedly used for answering the sub questions, a visual overview will be given by means of a Research Flow Diagram. The structure of this diagram is based on the process flows as proposed by Ulrich and Eppinger (1995), see figure 2.2. To the end of creating the most suitable process flow, the Spiral Product Development Process (b) is chosen. It results in the following structure of the Research Flow Diagram.

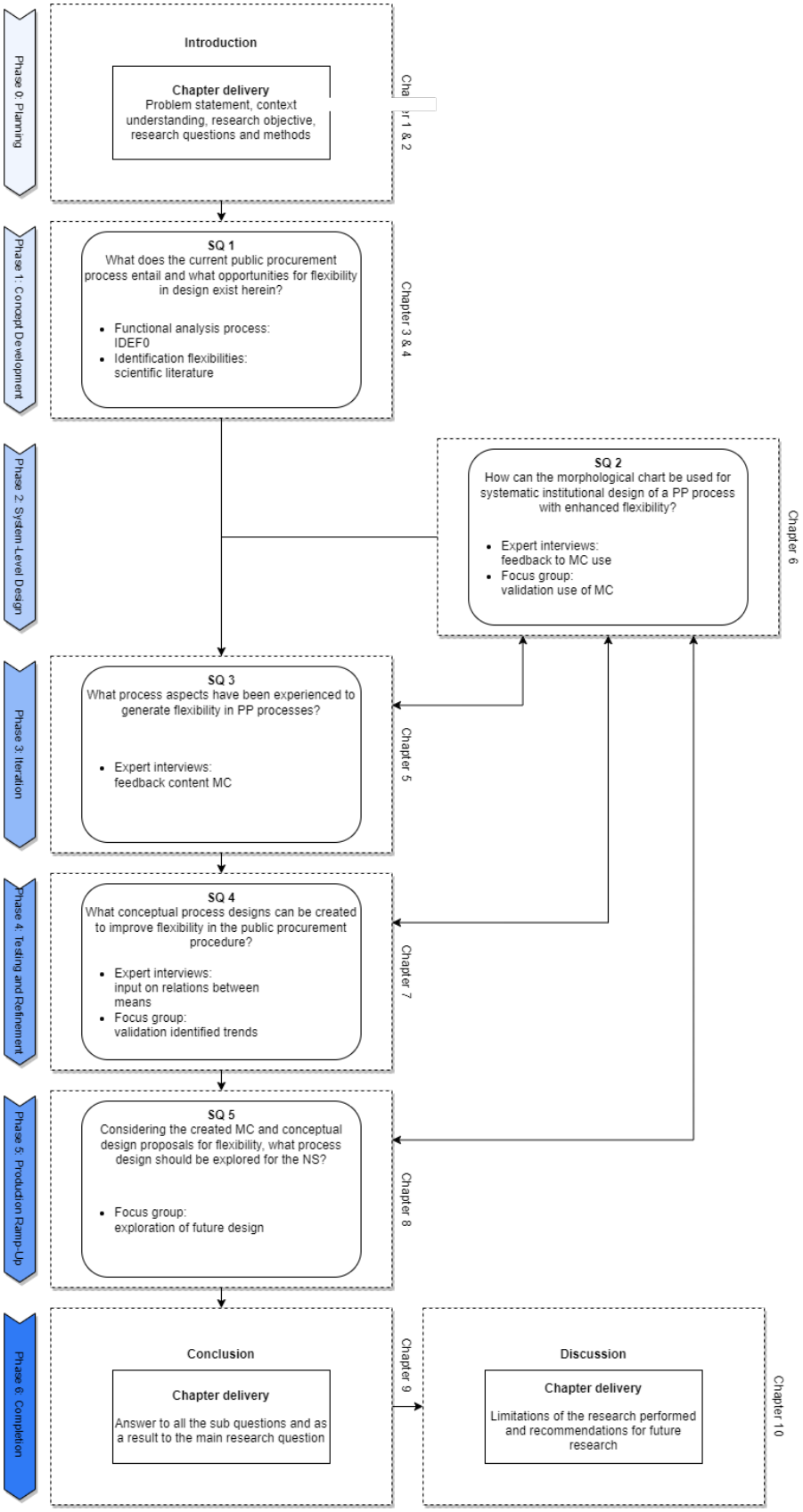


Figure 2.3: Research Flow Diagram based on Sub Questions in Phases

2.6. Data management

This research involves two data gathering methods in which humans are involved: interviews to collect data on the content and usage of the MC and a focus group to validate the use of the MC, the created design lines and to start an exploratory design for the NS. When humans are involved in research a thorough data management plan is written in which a risk analysis and mitigation plan is shown. Table 2.1 shows a summarized overview of this plan. Furthermore, the interviewees as well as the participants were asked to sign a consent form (see: Appendix I) in advance of the meeting. If and only if they signed, the research activities were conducted.

Before the meeting, the respondent(s) was/were again reminded on their participation being voluntary and the continuous option to withdraw at any time. All interviewees and participants have signed the consent form, which is saved in the TU Delft project storage.

Additionally, all experts interviewed received the summary of their interview and were asked to sign the summary. This aims to guarantee no sensitive information is unintentionally disclosed, but it also increases the validation of this data. The signed summaries of all interviews are saved in the project storage of the TU Delft.

Table 2.1: Data Management Plan for All Research Activities Involving Humans

Activity	**Identifiable Data**	**Data Used**	**Management**
Semi-structured Interviews	Name and email address	Recording transformed in summary	Name, email address and recording have been stored at the TU Delft Project Storage. Also, the summaries have been anonymized and were signed by each respondent, which ensures the content being correct in case even these measures are not sufficient to prevent identification.
NS-employees: semi-structured interviews	Name and email address	Recording transformed in summary	Name, email address and recording has been stored at NS storage drive. Also, the summaries have been anonymized and were signed by each respondent, which ensures the content being correct in case even these measures are not sufficient to prevent identification.
Focus group (all NS employees)	Name and email address	Recording transformed in summary	Name, email address and recording have been stored at NS storage drive. Also, the summary is anonymized.

3

Analysis current public procurement process

In Chapter 1 the existent literature on flexibility in public procurement is presented. This Chapter builds hereon by studying the current Dutch public procurement process. An overview of this process is the result of this study, which enables clear delineation of the research scope and shows its context. Answering the first SQ requires not only an overview of the current PP process, but also the identification of opportunities for flexibility in this process.

Since this requires zooming in on each procurement stage, the functional modelling technique IDEF0 is used. IDEF0-modelling allows for providing overview by high-level modelling as well as in-depth analysis of process steps on a (more) detailed level. These systematically mapped out levels provide the required in-depth knowledge to prepare for the identification of opportunities for flexibility in this process. In section 3.1 and 3.2 the current process model and the use of IDEF0 is explained. After, section 3.3 provides a more detailed description of the model created, being its scope, coherence and resources used, and is followed by the actual model representation in section 3.4. Rounding of the first part of this chapter, the assumptions made in the analysis of the current process are presented in section 3.5, as well as the model limitations.

Based on this model of the current public procurement procedure, an identification of the flexibilities herein must be performed. This identification is presented in section 3.6 and forms the final step of this chapter, enabling the formulation of an answer to SQ 1. In this last part, an elaboration is given on which flexibilities have been found and how. Pinpointing these factors is required as these will be used in Chapter 4 to develop the first version of a morphological chart. In its final form, this MC aims to create an institutional design (tool) of the procurement process which enhances flexibility for the aim of intermediate design changes.

3.1. Current process model

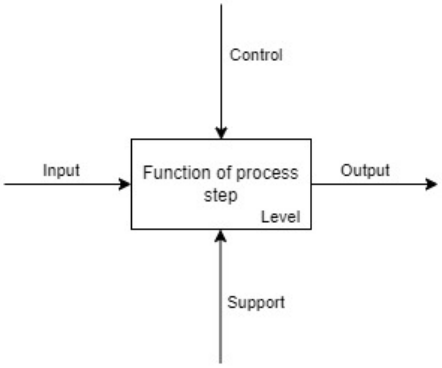
As mentioned, a functional model is created using IDEF0 as a technique to give overview and map out the detailed process steps. Below, a short explanation will be given on how the IDEF0 should be read, its scope, coherence and the resources used. After this, the model itself is presented, not in full but in logically parted sections to improve visibility. This is concluded by an overview of all these sections in one map showing their coherence. Since the PP process involves extensive documents of crucial importance, the Unified Modelling Language (UML) is used to avoid including too much information in the IDEF0. This additional UML-representation is shown in 3.4.2.

3.2. IDEF0 model

As mentioned the IDEF0 modelling technique is used to create understanding of the current process of public procurement.This way of modelling is able to reflect the multidisciplinary nature of a system, such as in public procurement, whilst bringing forth a systematic review of this complex system (Aguilar-Savén, 2004).

The functional model is created by breaking down the current process into its existing stages. These stages are then put in rectangular boxes and a descriptive verb is included to emphasize what function is fulfilled in this process step. Also, the various inputs required to do so are added. Three categories of input can be identified, being control, support and input as being the output of a previous stage. Output is the last aspect of each stage and beholds the result of the stage, most often leading to be the input for a next process step. Figure 3.1 shows an explanatory diagram of a process step and its inputs and output are presented in the IDEF0 model.

Figure 3.1: Explanation Process Step in IDEF0 Diagram



The arrow coming in on the left side of the process step is seen as the 'general' input. As mentioned before, this input most often contains the output of the previous stage and is only given when a specific input is used. The arrow coming in at the top is the control input and involves all types of information necessary to fulfill the function of a step. In this research, legislation and other regulations play a big part and are therefore, among other information types, included here. Lastly, the arrow coming in from below beholds all aspects that offer 'support' to the process step. This includes all mechanisms, tools and (physical) resources needed to perform each function (SofTech I.N.C., 1981; Zakarian & Kusiak, 2000).

3.3. Model explanation

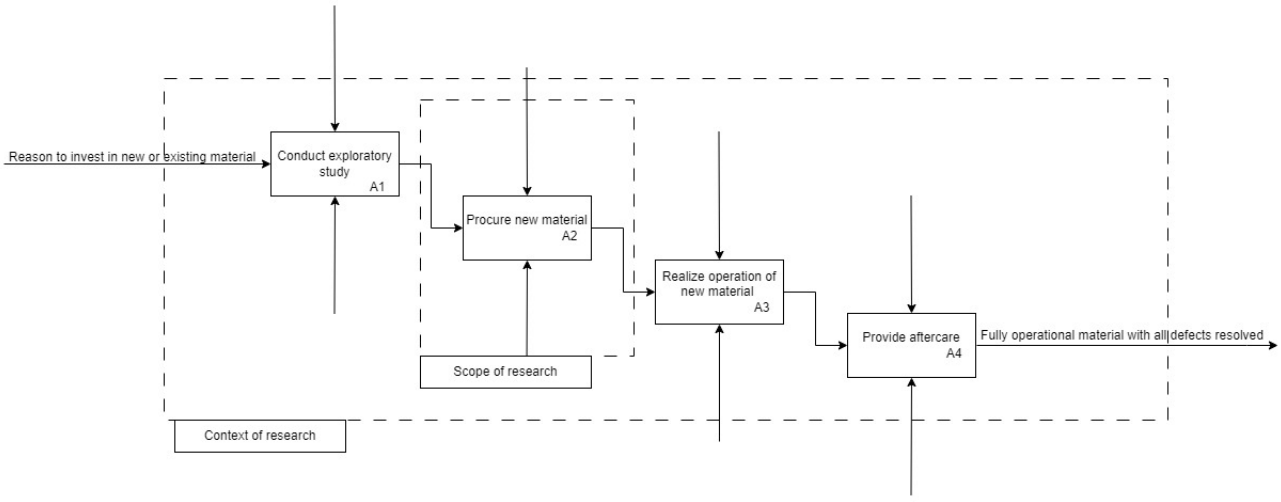
3.3.1. Scope

Since 'shaping' the procurement process is mostly done before the contract is awarded, the realization and aftercare have not been set out in the model. Decision-making on process aspects of these stages is either done or defined before the contract awarding takes place (Tadelis & Bajari, 2006). Also, in this study it is assumed that the procurement will certainly be set out and tendered, which means an exploratory study has been conducted and resulted in approval of the procurement. Together this means that the exploratory study, the realization and aftercare are out of scope for the analysis of decision-making in public procurement processes, as can be seen in figure 3.2. It must be noted that decisions made before the awarding of the contract still do heavily impact stages later on in the process, as this beholds the further course of the procurement.

For the aim of clarity, the highest process level presented contains no input and can be seen in figure 3.2. It merely is presented to provide context and show the scope of the research. After that, each stage consisting of multiple functions has been worked out on a more detailed level.

3.3.2. Context and scope

Figure 3.2: IDEF0: Context and Scope of the research* *****



3.3.3. Resources

Most of the inputs used in the model come from a limited amount of resources. However, as these resources are to be found in internal, professional NS process documents and originate from the European Directive 2014/25 on public procurement by entities operating in the water, energy, transport and postal service sectors (European Parliament and the Council, 2014b), this possesses high reliability. Apart from this, a few other resources were used to provide additional information to complete the process steps. To enable clear referencing, the following notation is used:

- (Art.) = Each input with a reference to a section of law finds its source in this legislative article of EU Directive 2014/25 on public procurement by entities operating in the water, energy, transport and postal service sectors (European Parliament and the Council, 2014b).
- * = Internal NS Documentation
- ** = PIANOo - Centre of Expertise on Procurement, 2016f
- *** = NS Procurement Support, 2022
- **** = European Union Publications Office, 2023
- ***** = PIANOo - Centre of Expertise on Procurement, 2016e

3.4. Model representation

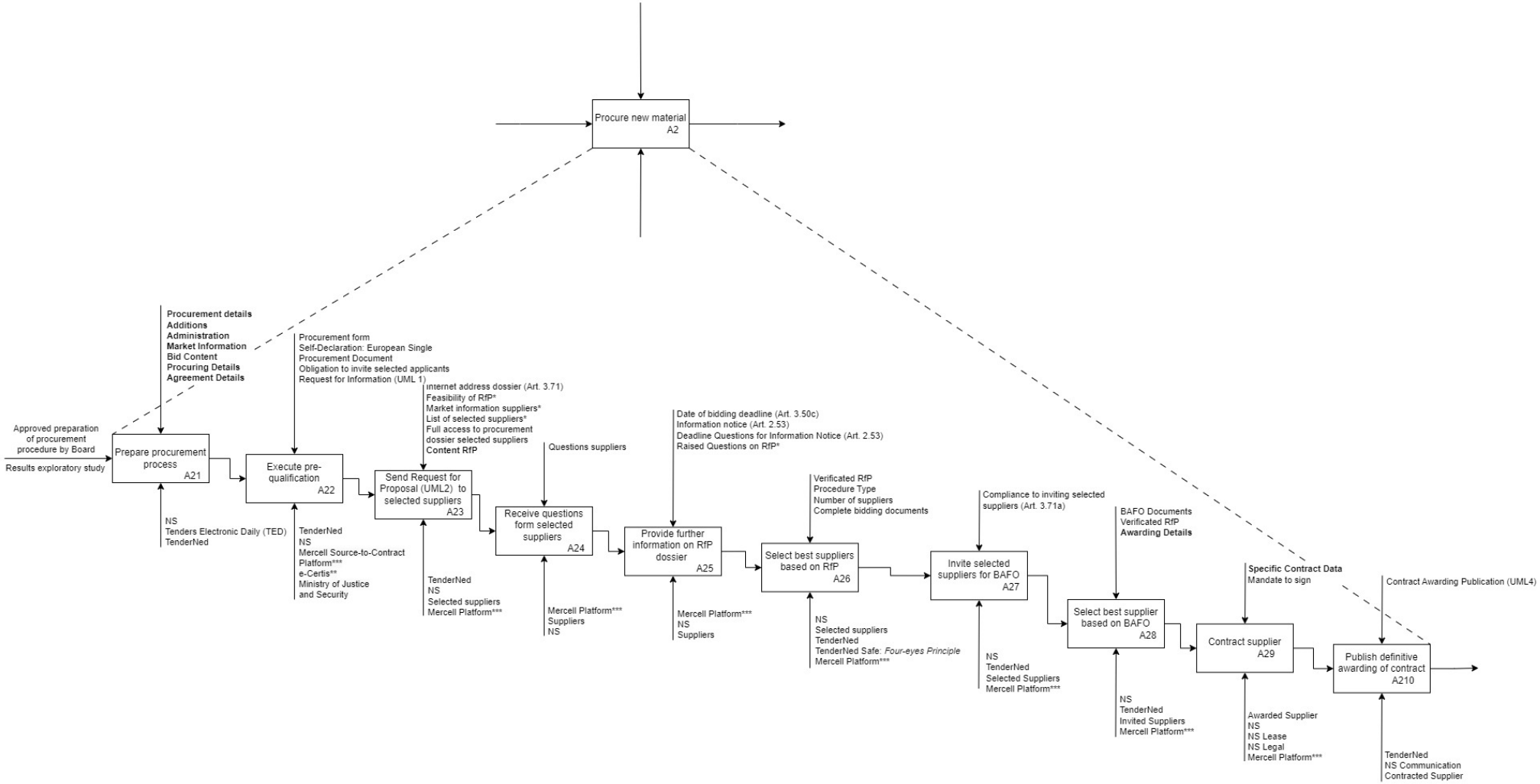
Underneath the created model is shown. Though, not all model parts are included here. The aim of mapping out the current process is to enable a first identification of flexibilities in the public procurement. In section 3.6 an elaboration will be given on how these flexibilities were identified. However, for the readability of this research only the model parts in which flexibilities were initially identified (yellow) are presented here, being the preparation of the procurement process in figure 3.4 and sending the RfP to the suppliers in figure 3.5. This is preceded by figure 3.3 showing the procurement process in full to provide context and overview to the more specific figures.

A full overview of the IDEF0 is presented in Appendix A, which also contains a map showing the coherence between all model parts (see figure A.8).

Also, it must be noted that as a support input, often the NS is mentioned. Logically, this aims to represent the departments and individuals involved in the procurement of trains, specifically being the Department New Rolling Stock.

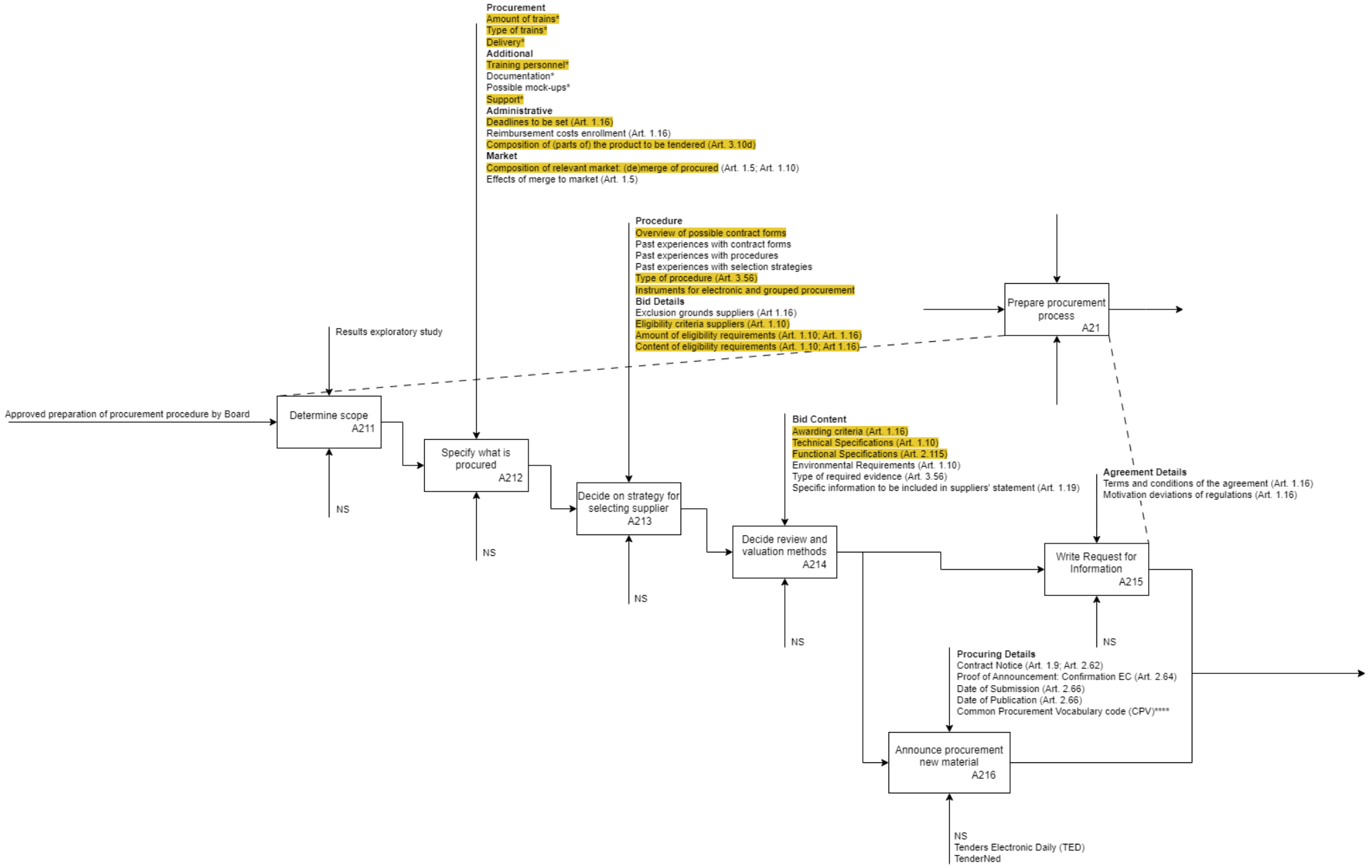
3.4.1. Procurement of New Material

Figure 3.3: IDEF0: Process Overview of the Procurement of New Material (A2)



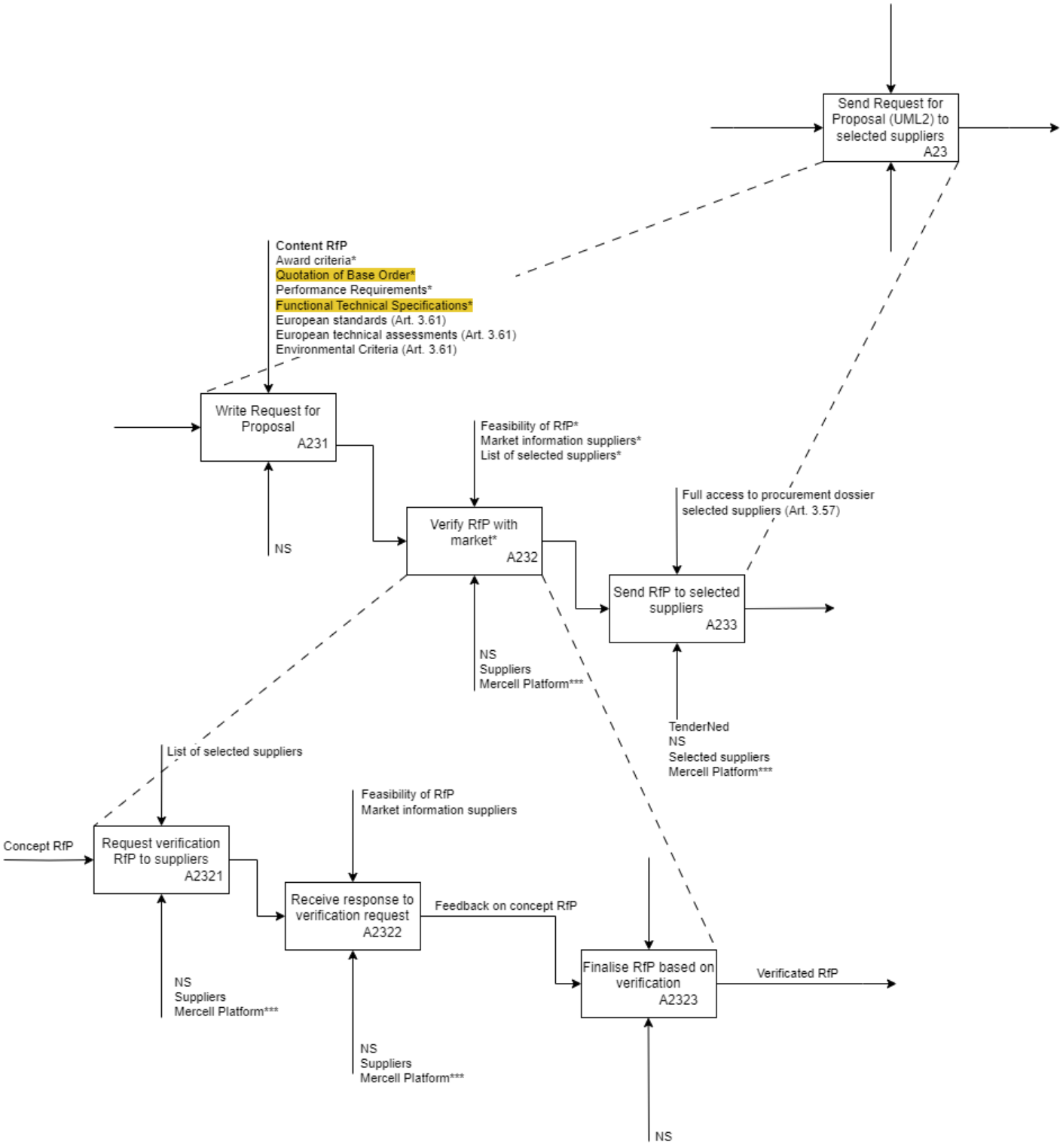
Preparation of Procurement

Figure 3.4: IDEF0: Detailed Break Down of the Preparation of the Procurement Process (A21)



Sending RfP to Suppliers

Figure 3.5: IDEF0: Break Down of Sending RfP to Selected Suppliers (A23) and Further Detailing of Verifying RfP with Market (A232)

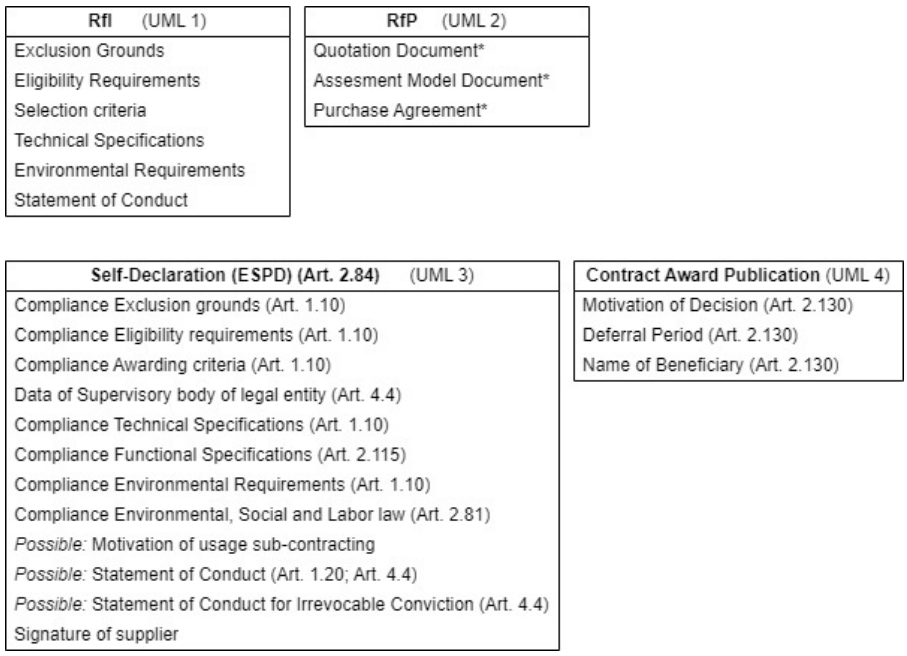


3.4.2. Extra: UML for Documentation

All together the IDEF0 diagrams contain four extensive forms of documentation, being the Request for Information (RfI), the Request for Proposal (RfP), the European Single Procurement Document (ESPD) and the contract award publication. To avoid illegibility of the diagram, the relevant information in these documents has not been included in the IDEF0. However, this content must be included for the identification of aspects affecting flexibility in the documents. The Unified Modelling

Language (UML) has been deployed to give insight in the content of each of these documents. This language is often combined with IDEF0 for the purpose of creating improved insight in information definition in IDEF0 models (Dorador & Young, 2000). The created UML can be seen in figure 3.6.

Figure 3.6: UML: Class Diagram of the Most Important Object and Their Attributes in the Process



3.5. Assumptions and limitations

The model tries to approach a representation of reality as good as possible. Still, some assumptions had to be made, as well as the decision to leave some information out of scope. Providing an elaboration on the made assumptions and other decisions is the best way to justify the model.

Firstly, a few aspects have been left out of scope, one of which is the aspect of time. As it does not necessarily have direct implications for the extent to which a process is (in)flexible, the duration of (parts of) the process and deadlines have been decided to be out of scope and hence have been left out of the model. Also, the optional occurrence of a preliminary injunction has been left out of the research. Not-selected suppliers could cause a delay to the process. However, this possible process step is not taken into account in the analysis of the PP process as it does not involve possible courses of action for the procurer enhancing flexibility in the PP process. In the light of this research, a preliminary injunction can only cause delay, but does not influence the studied objective.

Secondly, two assumptions have been made on the scope of process steps and their input. The first decision made is to present the full process in such a way that a logical process is the result. As mentioned before, the preliminary injunction e.g. has been left out, but some other process steps are included, when they are also not directly influencing the flexibility of the process. This has been done to present a consequent and continuous process of a logical sequence. Deletion of process steps that would have led to the overview not being consistent or understandable has been avoided, these steps have been included.

The second assumption made is that the control/information input for the IDEF0 contains specific information as well as information of a more general level. In each case the level of detail applied is chosen based on available information and what level of detail was required for the research. To find out where flexibility can be added to the process, the overview of the process is of greater importance than the level of detail of control/information for process steps. Only information that is of importance to the process and this research is therefore mentioned in this input flow.

Thirdly, the model is based on the theory that all that has been used for input, unless specifically mentioned in literature or legislative documentation for a certain process step, will remain available to whom it was available to from its entrance in the system. These 'inputs' will not be repeated, e.g. the CPV code.

Fourthly, the model presents a non-public procedure, as this is the most extensive procedure. However, when the public procedure is followed, the pre-qualification and selection of best supplier is merged into one process step (see: 4.3 Procedure Types). The pre-qualification is executed simultaneously with the submission of the bid. This means that when a bidder complies with the criteria and requirements, the bid is taken into account and a decision is made based on those accepted bids. It results in all suppliers submitting a bid, not just the selected suppliers. For the model, this results in

a merge of at least A22 till A26: execute pre-qualification (A22), send Request for Proposal to selected suppliers (A23), receive questions from selected suppliers (A24), provide further information on RfP dossier (A25) and select best supplier based on RfP (A26).

Lastly, a few short notes have to be made on the resources of the information in the model:

- A significant part of the resources used are written in Dutch and are not available in English. These resources have been used for the desk research on the project, as the project beholds a Dutch case of procurement. The related references will contain a short translation of the Dutch resource title as to make clear on what topic the information of this research has been used and where it can be found.
- The procurement of all works and services within the transportation sector belongs to the so-called 'special sector' companies, formed by all contracting authorities operating in the water, energy, transport and postal services sectors (European Parliament and the Council, 2014b). To these companies slightly different legislation applies than to public procurement in other sectors. This particular legislation has been used for the model, as this research focuses on the transportation sector specifically.

3.6. Identification of flexibilities

Now that the procurement process has been worked out systematically and in detail, an initial identification of flexibilities can be done. In Chapter 4 these flexibilities will be worked out, looking for each of those individually at what the solution options are. Based on this, an initial version of the MC can then be prepared, thus showing the design space defined based on the exposition of the current process. This initial MC will then be further developed in Chapter 5 by improving the morph chart based on expert knowledge within the industry.

Enabling this begins with an initial identification of flexibilities, process aspects that allow for enhancing flexibility for the sake of intermediate changes. Section 3.6.1 will explain how this identification was performed and it will be presented which flexibilities were identified in this way. This overview will be the input for Chapter 4. There, for each of these flexibilities, the solution fragments giving substance to these process aspects are elaborated. This exposition of flexibilities and solution options forms a first overview of the available design space and is translated into the development of an initial morph chart.

3.6.1. Determination flexibility

In section 1.3.3 it has been shown that limited literature is available on identified flexibilities for intermediate design changes in the public procurement process. Based on research of Bajari and Tadelis (2001) and Rigby et al. (2005) two flexibilities could be identified, being the type of procedure and contract.

To enable the identification of more aspects possibly providing enhanced flexibility, a brainstorm with two experience NS-employees was performed. During this brainstorm the current process analysis in IDEF0 was used as a starting point and it was evaluated by the experts which inputs in the diagram are considered to be flexibilities (see yellow marked inputs in figure 3.4 and 3.5). A flexibility herein was defined as being within the available scope of action of the procurer (1) and being assumed to affect the possibilities for intermediate changes to the procured product (2). The result was the identification of flexibilities of two categories, being product- and contract-related aspects.

The analysis of the current process was based on legislation and professional documentation of the NS (see: 3.3.3), which both did not show specific, product-related aspects focussing on innovation. Though, since innovation and optimization is the reason for this research, the brainstorm was extended with the identification of product-related flexibilities focussing on innovation specifically, based on expert knowledge.

In table 3.1 below it is indicated how all process aspects identified, by the IDEF0 and brainstorming, to provide flexibility to the process were translated (and merged) into the formulation of flexibilities as used in this research.

Table 3.1: Formulation of Flexibilities based on IDEF0 and Brainstorm.

Formulated flexibility	Input
Product-related	
The degree of cooperation between procurer and supplier	Additional (A212)
The structure of the delivery	Delivery
The selection criteria evaluating the submitted product plan	Technical Specifications Functional Specifications
The specifications used to define the tendered product	Technical Specifications Functional Specifications
Innovation specific	
The structure of the development of innovation compared to the main product	*Brainstorm*
The way in which innovation is tested	*Brainstorm*
Contract-related	
The procedure type	Type of procedure
The extra instruments to be deployed in the procedure	Instruments for electronic and grouped procurement
The system of limiting the applicants	Type of procedure
The contract type	Overview of possible contract forms Additional (A212)
The additional organizational structures	*Brainstorm*
The financial structure	*Brainstorm*
The awarding criteria	Awarding criteria Type of trains
The duration of the contract	Deadlines to be set Support
The volume contracted	Amount of trains Quotation of Base Order Composition of (parts of) the product to be tendered
The eligibility requirements for the supplier	Eligibility criteria suppliers Amount of eligibility requirements Content of eligibility requirements

3.7. Takeaways chapter 3

In this chapter the current Dutch public procurement process is studied by functional technical modelling of its process steps. Based on this model, flexibilities have been identified, which has been done by determination of aspects being within the available scope of action of the procurer (1) and being assumed to affect the possibilities for intermediate changes to the procured product (2). This determination has been performed in collaboration with two experts of the NS during a brainstorm. The result was the identification of flexibilities of two categories, being product- and contract-related aspects, complemented by product-related aspects focussing on innovation, which were not (yet) to be found in legislative or internal documentation.

SQ 1: *What does the current public procurement process entail and what opportunities for flexibility in design exist herein?*

It can be concluded that the current public procurement process consists of many detailed process steps, of which the first steps already decide on the aspects so far identified as flexibilities. Most flexibilities have been identified on the right side of the IDEF0, which means it is early on in the process. This means the first steps heavily impact the procurement process as a whole.

The flexibilities itself can be divided into two categories and are as follows:

Product-related:

- The degree of cooperation between procurer and supplier
- The structure of the delivery
- The selection criteria evaluating the submitted product plan
- The specifications used to define the tendered product

Innovation specific:

- *The structure of the development of innovation compared to the main product*
- *The way in which innovation is tested*

Contract-related:

- The procedure type
- The extra instruments to be deployed in the procedure

- The system of limiting the applicants
- The contract type
- The additional organizational structures
- The financial structure
- The awarding criteria
- The duration of the contract
- The volume contracted
- The eligibility requirements for the supplier

These process aspects identified as flexibilities will act as starting point of Chapter 4. Here, for each of these aspects all possible "interpretations", means, will be formulated and explained. After, all flexibilities and interpretations will be translated into a first morphological chart to start the exploration of the design space available.

4

Refinement initial flexibilities

As the analysis of the current process has been finished and the flexibilities thus far have been identified, a first insight in the available design space can been defined. In this chapter an elaboration will be given on the found process aspects providing enhanced flexibility to the process, referred to as "flexibilities". The focus herein will be on the explanation of the solution fragments available for each of those flexibilities, to which will be referred to as "means" in this research. Section 4.1 shows and explains all flexibilities and their means identified so far.

In the second part of this chapter, this elaboration is transformed into a morphological chart. Section 4.5 shows how this initial MC is created and shows the result hereof. In Chapter 5 this initial chart is used as the starting point of the exploration of the design space within the railway sector amongst procurement experts.

4.1. Flexibilities and their means

As elaborated on in Chapter 2.4, a morphological chart focuses on the conceptual design phase. It makes use of combining different potential solutions in one integrated design and in this way collects tools to fulfill a combination of problems, with no particular need for novelty (Borekci, 2018; Smith et al., 2012). This matches with the process design aimed for in this research. Legislation poses a limit to what can be created.

Below, all flexibilities are set out and explained, as well as their means. For some flexibility much information is available on its means, e.g. for procedure type and contract type. In these cases, a more extensive elaboration is given on the definition of these means. All other means are shortly explained together with the elaboration on the flexibility itself. The product-related flexibilities and means will first be presented and after the same will be done for all contract-related.

4.2. Product-related flexibilities

Flexibility: Scope of product

The EU Directive 2014/25 on public procurement by entities operating in the water, energy, transport and postal service sectors (European Parliament and the Council, 2014b) presents two different options to scope procurement, being the asset in total, or dividing this asset into parcels.

The procurement of the *total asset* can be seen as 'general' procurement. The procurer wishes to have a certain product as an outcome of the procurement process and this product is tendered in its entirety within one procedure.

Another option is to divide this aimed for asset into parcels. As a rule, the procurement law requires the division of clustered contracts into lots, as it improves market efficiency. However, it must be taken into account that splitting a contract into lots is not allowed to fall below the threshold value for EU procurement. Also, similar products may not be split up and related supplies may not be pulled apart (PIANOo - Centre of Expertise on Procurement, 2012c).

Dividing the asset to be tendered into lots also offers the possibility to tender the asset separately from the innovation to be developed, which is therefore included as a separate mean. This means that not the asset itself is divided into lots, but the asset and the innovation are tendered separately in lots. Rigby et al. (2005) already showed that the unbundling of a product to be designed within public procurement mitigates risk for both the buyer and seller.

Flexibility: Degree of co-operation

According to TwynstraGudde (n.d.) there are three types of co-operation, based on the degree of outsourcing applied to the procurement process. These means should be interpreted as increasing in the degree to which responsibility lies with the contracted party. Traditional "co-operation" is the first on this increasing scale and is defined as only procuring the realisation of the product. This is followed by integrated co-operation, which beholds outsourcing the process from initial design to realisation or even (part of) the maintenance of the product. Lastly, life-cycle cooperation beholds the procurement of the full process, from the first sketches and requirement elicitation to exploitation, financing and sometimes even the termination of the product. The contracted party has maximum responsibility.

Flexibility: Delivery

When the product is completed, it will be delivered to the procurer. However, it is dependent on the nature of the product is this is or should be done at one, complete delivery, or if this can also be done in batches. This means multiple deliveries are done of a certain amount/part of the entirety. Other options for this delivery are affected by the optional innovation or optimisation of the product. When innovation or optimization is required, this can be done either by continuously updating the already delivered part to align the newly delivered batch or it can be done afterwards. In this situation, all batches are modified ex-post after all has been delivered.

Flexibility: Innovative development

A quite similar structure is available for innovative development. When innovation of the asset is required, this can be done by continuously updating the asset based on the development of the innovation. Another option is to fully develop the innovation, parallel to the realisation of the asset, and implement the innovation as soon as its development is finished.

Flexibility: Testing innovation

Testing innovation for an asset can be done in multiple ways. A living lab beholds the disclosure of the asset to multiple innovations to see what might be successful and what not. The same is done in a pilot, but this aims to test the disclosure of the asset to just one or a few innovations. Testing such innovation can be contracted by including a periodical innovation proposal, which describes an agreement indicating e.g. the frequency in which a supplier must propose an innovation or optimization for the asset. Another option is to include a contractual learning/development space aims to register quite undefined but desired innovation to be established in collaboration between procurer and supplier, which is safeguarded to be within scope by including it in the contract (PIANOo - Centre of Expertise on Procurement, 2020).

Flexibility: Selection criteria

The selection criteria aim to limit the amount of applicants and can be deployed in case two or more rounds of limiting applicants are performed. In such cases, the selection criteria must be defined and substantiated upfront. The Dutch Procurement Law 2012 shows the following examples of these criteria: Quality, Aesthetics, Functional characteristics, Accessibility, Suitability for users, Social characteristics, Environmental characteristics, Innovation, Organization, qualification and experience of the personnel, Customer service and technical assistance and Delivery terms and conditions.

Flexibility: Specifications

In the contract the procurer specifies the targeted result of the procurement. To do so, specifications are used, of which different types exist. The Dutch Procurement Law (2012) shows technical and functional specifications to be applicable for this. Technical specifications describe in detail and quite specifically, mostly quantified, what is required. Functional specifications describe what is required by defining how the asset must function. Apart from these two, the Ministry of the Interior and Kingdom Relations (2012) describes the obligations of result and effort also to enable specifying in public procurement. This uses specifying on a more global level to leave more room to the supplier. Lastly, catalog specifications could be used, which refers to specifying "off-the-shelve" products.

4.3. Contract-related flexibilities

Flexibility: Procedure Type

The EU Directive 2014/25 on public procurement by entities operating in the water, energy, transport and postal service sectors (European Parliament and the Council, 2014b) prescribes that applying a certain type of procedure, must be accompanied by an motivation of why this type of procedure has been used. This decision must be made based on objective reasons and should also consider how many and which suppliers will be included. Underneath the full range of possible procurement procedures will be presented, in which the text will be fully based on Directive 2014/25/EU unless mentioned specifically. Though, these will only be the European procedures, since procurement under the threshold value is out of the scope of this research as explained in section 1.5.2.

Mean: Public Procedure

The public procedure in short beholds one round in which all suppliers can directly submit a bid on the set out tender. After this, all received bids are evaluated simultaneously and it is verified that no exclusion grounds apply to one of the suppliers. When the evaluation is finished, the supplier with the best price-quality ratio is awarded the contract. The public procedure has some clear advantages, such as all suppliers being able to submit a bid and the procedure being objective, non-discriminating and transparent. Its downside however, is that this procedure takes quite a long time and costs a lot on both the procurers as well as the supplier's side. Adding to this, the procedure is tightly defined, leaving limited space for freedom to adjust the procedure to a procurer's specific needs. However, the competitive pressure on applicants resulting from the public procedure results in the most competitive bids.

Mean: Non-Public Procedure

This approach starts with the publication of the tender, after which suppliers can respond if they want to participate in the tender. Two rounds follow, with an elimination of those to whom an exclusion grounds applies and the selection of (mostly five of) the most suitable applicants. These selected applicants receive an invitation to take part in the second round. This round beholds the review of the bids of the selected applicants. Finally, the contract is awarded based on best price-quality ratio.

As with the public procedure, the non-public procedure has its advantages and disadvantages. The option for all suppliers within the market to apply for the tender causes competition and therefore competitive bids, as is also the case for the public procedure. Its objectiveness, transparency and non-discrimination is also a shared component of both approaches. However, the obvious advantage of the non-public procedure is the opportunity to limit the bids to evaluate and therefore the administrative burden on the procurer.

Nevertheless, the non-public procedure causes lower administrative load, it still brings high costs to either the applicants as well as the procurer. Adding up to that, the non-public procedure covers an even longer period of time than the public procedure. This approach also leaves limited space for freedom to adjust the process.

All in all, it shows that the public as well as the non-public procedure differentiate based on their administrative load versus the required period of time for the full process. This distinction leads to both approaches being suitable to different kinds of procurement processes. Though, an expansion of the range of procurement procedures is required.

Mean: Competitive Procedure with Negotiation

To broaden the spectrum of public procurement procedures, the competitive procedure with negotiation is one of the other approaches to choose from. This method has the same start as the non-public procedures as it offers all possible applicants the option to send in a request for participation. After checking the exclusion grounds and selection criteria, the procurer then enables selected suppliers to submit a first bid. Based on those bids, negotiation with one or more of the suppliers then leads to a definitive contract. This approach leaves room for bids including multiple solutions to fulfill the needs of the procurer. By negotiation with the selected supplier(s) the proposed designs can be further developed. In the meantime, suppliers can be excluded according to the extent to which their bid responds to the selection criteria. Based on these detailed designs, the procurer can decide which solution best fulfills its requirements and who will finally be awarded with the contract.

According to the article 2.28 of Directive 2014/24/EU , this procedure may only be applied when one of the following situations applies:

- The available solutions do not fulfill the requirements or adjustments
- Specific circumstances apply: e.g. complexity, financial and legislative risks causing the existence of a dialogue to be vital.
- The procured product is a design to be made or an innovative solution
- Only irregular or unacceptable applications have been received.
- Technical specifications cannot be properly determined in advance.

As this approach gives more freedom in finding the right solution to fulfill the needs of the procurer, this procedure provides a solution in an innovative environment. However, the inclusion of negotiation could possibly cause a biased assessment of bids. Also it causes high work load on both the procurer and the bidder. This procedure is closely related to the competitive dialogue as procuring approach, but its application is restricted to cases in which problems occurred in the previous, original procedure.

Mean: Competitive dialogue

As mentioned above, the competitive dialogue is quite similar to the competitive procedure with negotiation. Directive 2014/25/EU prescribes the same requirements for this procedure to be used. The approach itself starts as the non-public procedure, by selecting 3-5 suppliers to take part in the dialogue, based on the selection criteria and exclusion grounds. In the dialogue that follows, the selected suppliers provide their solutions. The procurer decides what solution(s) fit their needs best and invites the participants to submit their application.

The (dis)advantages of the dialogue are much like those of the competitive procedure with negotiation. It leaves much design space for a suitable solution for the procurer. Also the competitive load is on the suppliers. On the other side could the competitive dialogue lead to more biased assessment and is the procedure accompanied by high work load on both sides of the tender.

Mean: Negotiated Procedure without Prior Publication

A procedure that touches upon the competitive dialogue with its negotiation is the negotiated procedure without prior publication. This approach involves the option to directly award the contract to the preferred supplier. This can follow a negotiation with other suitable suppliers, but this is not evident. To start off this process, engaged suppliers are involved in a negotiation. After this, the procurer writes an official report [proces verbaal] on the procurement and informs the supplier(s) on the contract awarding. After this, the contract is signed and the decision is made public. This full procedure may take place without prior publication of the tender.

Although this procedure might draw the attention based on this description, Directive 2014/25/EU prescribes strict rules of when this type of procedure can be used. This is only possible when:

- No or no suitable applications have been received;
- Only one supplier can do what is asked (e.g. art, technical limitations or exclusive rights);
- The execution has pressing urgency;
- Procurement results from a contest that has been won by the selected supplier;
- The negotiated procedure can be re-performed without notice for works and services that have been awarded in the original public contract for up to 3 years. Requirements in this regard are:
  - The works or services are similar to the base project in the original contract.
  - For the original contract one of the following procedure types was followed:
    * Public Procedure
    * Non-Public Procedure
    * Competitive Dialogue
    * Competitive Procedure with Negotiation
    * Innovation Partnership (see chapter 4.3)
    * Procedure for Social and other Specific Services
  - The additional works or services have to be part of the object of the original contract;
  - Scope of the additional works or services were already included in the original estimation;
  - In the publication of the original contract it has been announced that the additional contract can be awarded without publication.
- Additional supplies can be delivered without notice when:
  - Those supplies are used for renewal of the original supplies;
  - If, up to 3 years from the original contract, a change in supplier would lead to purchasing material with different technical specifications, making the original delivery incompatible with the new equipment.
- Other options for application are:
  - For supplies bought on a commodities market;
  - When buying is extremely beneficial in case of a bankruptcy of a supplier;
  - When supplies are meant for educational or research objectives and do not have commercial purposes.

The benefits of this specific procedure are in the short time span and the extensive options for supplier and procurer to find a solution, or a suitable contract for both parties. It also leaves room to take into account past experiences within the procedure. However, disadvantages are also present. The limited presence of competing suppliers causes low competitive pressure. On top, this procedure is less transparent than earlier mentioned procedures.

Mean: Contest

This typical approach beholds a contest with the aim of the contestant providing their best design or concept. A jury then decides which design or concept is the best and can only be performed for services. Entering as a contestant can be limited by the procurer by first applying a (non-) public procedure. Furthermore, the general principles of procurement find their effect in the requirements for a contest, being as follows. The jury will consist of natural persons with no relationship to the contestants and will assess all applications anonymously. Also, if a certain occupational qualification is required for contestant, at least one third of the judges need to have at least the same level of qualification. When the contract awarding exceeds the European threshold for services (see chapter 3.5, the procedure of a Negotiated Procedure without Prior Publication must be executed. The same regulations applicable to this the negotiated procedure also apply to this procedure when the threshold is exceeded and can be read in Chapter 4.3.

As with the negotiated procedure, also this approach leaves fairly much room for creativity. Since the winner of the contest does not get the contract awarded directly as a result, but a negotiation follows, the contest and the contract awarding stay separated. It could be combined, but this has to be explicitly decided and communicated. However, disadvantages of this method lie in its independence of the jury to be composed and the fact that less regulation is at hand. The lack of legislative guidance causes a necessity of thorough documentation of the process, with a focus on the motivation of decisions made.

Mean: Concession

A concession agreement beholds a contract on the performance of works or services. The *quid pro quo* of this performance consists of the right to exploit, but also the risk of this. This concession agreement is limited by legislation on a maximum period of 5 years. If it is reasonable that the investment of the supplier/exploiter is not returned within this time frame, it can be extended to a period in which this might be expected. Awarding a concession contract consists of publishing the tender and communication of the exclusion grounds, selection criteria technical and functional specifications. After this, the type of procedure which is adhered to, as well as a time schedule is communicated to all suppliers in the process. Without changing the communicated criteria, negotiation is then possible. Next, the procurer bases its choice for the concession holder on the selection criteria and publishes this decision, when the suspension period of 20 days has been exceeded. Compared to the other procedures, the concession process is focused on the procurement of exploitation rights for a period of time in exchange for a set level of performance made possible by the concession holder.

Mean: Innovation Partnership

The Innovation Partnership is a fairly new approach in public procurement. It has been introduced to give room to procurement for the aim of innovation, as it focuses on procuring goods, services or works that are not yet available on the market. The concept of this partnership is that a procurer sets out a description of their problem to be solved and the requirements of its solution. Suppliers can answer this quest by sending in their design as solution. After completing a research and development process, the created innovation can be sold commercially, as agreed on at the start of the innovation partnership. Innovations in this context can be demarcated as being products, works and services that are not on the market yet or not the required level of performance has been achieved. Determination of if an innovative solution is necessary for the problem formulated must be done by a thorough study of the market.

The method of the innovation partnership consists of three phases, being the competitive, research and development and commercial phase. The first phase is quite similar to the negotiated procedure without prior publication, but as the procedure is of an innovative nature, so is the content of the negotiation. In this first phase, the requirements and criteria are determined and communicated, as well as the exclusion grounds. It is in this phase where the negotiation (rounds) take(s) place and in which it is defined how the intellectual property will be contracted.

After the negotiated procedure is finished, the research and development phase is started. In this phase the realization takes place, which enables testing of prototypes, production and performing pilots. Lastly, the commercial phase commences. It revolves around buying the innovated 'product'. If more suppliers have made it through the partnership, they can all submit a commercial application to the procurer.

The advantages of this quite new procedure lie in the freedom of this partnership. It causes more freedom in interaction between procurer and supplier(s). Also, it leaves space for intermediate termination of the contract, in how the intellectual property is assigned and for directly buying the innovation without interference of a new procurement process. Furthermore, innovating in collaboration with the industry leads to higher impact (Cerqueira Gomes, 2021).

Nevertheless it takes a considerable amount of time to go through the full process of an innovation partnership. The degree to which the 'procured product' is innovative has a significant impact hereon. Moreover is the commercial phase limited to the partaking suppliers. Which means that by the time the partnership reaches the commercial phase, no products of suppliers outside of this pool can be bought, even if other suppliers have come up with a suitable solution as well.

Flexibility: Compound Grouped Electronic Procurement Instruments

The following three types of procedures used for procurement processes consist mostly of more than one supplier in the, therefore, grouped procedure and all make use of an electronic system. Generally, these are combined or used within other public procurement procedures, such as the (non-)public procedure and the competitive procedure with negotiation.

Mean: Framework Agreement

A framework agreement is a procurement method, but does not directly procure a product. This agreement involves one or more suppliers and one or more procurers for the aim of setting out a stream of future orders and follows a (non-)public procedure (PIANO - Centre of Expertise on Procurement, n.d.). For a defined duration and under agreed conditions following the requirements, the framework agreement enables short-term procurement by skipping the first selection of suppliers based on criteria, requirements and exclusion grounds. The non-public and public procedure are used to select the suppliers to enter into the framework agreement.

Mean: Dynamic Purchasing System

The dynamic purchasing system beholds an electronic process for the purchase of more general products. All suppliers that want to enter the system have to fulfill the clearly defined criteria to do so and get access. Exclusion grounds and eligibility criteria can also be applied to the admission of suppliers to the system. However, this method may only be applied in case of 'commonly used or off-the-shelf products, works or services which are generally available on the market' (European Parliament and the Council, 2014b).

Mean: Electronic Auction

The electronic auction is not a procurement method itself, but an auctioning system that can be applied as an additional phase within a (non-)public procedure and the competitive procedure with negotiation. It can also be used prior to the usage of the Framework Agreement or even the Dynamic Purchasing System.

The concept of an electronic auction is that subscribed suppliers can bid in rounds by lowering the cost of their application as a reaction to other bidders. The expiration of the predetermined duration of the auction ends the bidding round(s). Subscribing to the auction for suppliers is only possible after the procurer has reviewed the suppliers' compliance to the awarding criteria.

4.3.1. Flexibility: Limitation of applicants

In the explanation of the procedure type as flexibility, it has been mentioned that limiting the applicants can be done in different ways. It showed that limiting the applicants can be done in one round: based on the submitted bids a decision is made, but also two or multiple rounds of gradual reduction can be applied. The procurer is obliged to communicate in advance clearly what is required in which round, if more than one, and based on what criteria a selection will be made (European Parliament and the Council, 2014a; PIANOo - Centre of Expertise on Procurement, 2012b).

4.3.2. Flexibility: Contract Forms

According to TwynstraGudde (n.d.) the main categories of possible contracting types run from traditional to life-cycle contract. These categories should be interpreted as increasing in the degree to which responsibility lies with the contracted party. Apart from the presented contracts, also hybrid forms of these contracts are possible, but these merged forms are not explained here as it combines what is already mentioned.

Mean: Classic

The traditional contracts contain solely procuring the realisation of a new-to-build product. Deciding on the requirements, the design and engineering is all performed by the procurer. After realisation the asset is delivered to the procurer whereby the responsibility of the supplier stops. The contract also does not include any more involvement of the supplier in the following phases, such as maintenance.

Means: E&C, D&C and Building Management

An approach that involves integration of steps of the procurement process leaves more risk and responsibility to the procured party. Apart from building, as with the traditional contracts, also most of the design process now is the responsibility of the chosen supplier. The key characteristic of these procedures is process optimisation. Combining consecutive steps stimulates the procured party to optimize and could therefore result in the occurrence of communication disruptions. Ultimately, this could cause a shorter duration of the process and possibly even better quality of the procured product (PIANOo & Dutch Water Authorities, 2016). Integrated contracts are: Engineer & Construct, Design & Construct and Building Management.

In Engineer & Construct the supplier is responsible for engineering what is to be constructed and the construction itself. The design component is relatively small as it covers just the engineering of what needs to be constructed. This type of contracts is mostly used for variable maintenance or repetitive construction projects (PIANOo - Centre of Expertise on Procurement, 2016a). A Design & Construct contract is quite similar, but also includes the design phase. This means the supplier is also responsible for the determination of required works (PIANOo - Centre of Expertise on Procurement, 2012a).

Mean: DBFM(OT) and Concession

The most radical outsourcing in public procurement is done by procuring not only the design and realisation stage, but also the maintenance and sometimes even the study, exploitation and/or financing steps are integrated in these contracts (TwynstraGudde, n.d.). In such contracts, maximum responsibility lies with the procured party.

A DBFM(OT) contract essentially procures a service instead of a product. The Design, Build, Finance, Maintenance (and even Operation and Termination) are outsourced to the supplier. This affects maximum use of supplier's expertise and creativity as well as efficiency (Ministry of Infrastructure and Water Management, n.d.). The concession contract is quite similar to a DBFMO contract, but uses different compensation. Whereas with DBFMO the procurer pays a remuneration to the supplier for its work and services, the compensation of a concession is done by granting the right of exploitation to the supplier (PIANOo - Centre of Expertise on Procurement, 2012e).

4.3.3. Flexibility: Additional organizational structure

Apart from the contract type chosen, additional organizational structures can be applied to the PPP. First, a building team can be applied, which is a collaboration in which supplier and procure start co-operating in the design phase, so before the realisation. This enables improved use of expertise amongst the collaborative parties (PIANOo - Centre of Expertis on Procurement, 2012). Also, there is an option to enter an alliance, which means one or more phases of the procurement which are generally performed by either the supplier or the procurer are now done jointly. Here the same advantage of improved use of expertise applies (Rijkswaterstaat, n.d.).

4.3.4. Flexibility: Financial structure

The financial structure can affect incentives and risks of the PP process (Suhonen et al., 2019). In general, the procurer pays remuneration to the supplier as agreed on in the contract, however other options are also available. Co-financing is another available option and beholds the option for the procurer to collaborate with another party, such as a private partner (de Mello & Sutherland, 2015). Also pre-commercial purchasing is an optional financial structure in which only the development of a specific design is procured and its prototype purchased in small quantities, which means this structure focuses on financing research and development for a specific issue (PIANOo - Centre of Expertise on Procurement, 2012d). Furthermore, the option of including a dedicated innovation budget within the procurement contract is available. This means a reservation is made in the procurement budget for which it is clearly defined what is required of the supplier to receive the budget. The goal of this structure is to keep stimulating innovation during the procurement process (PIANOo - Centre of Expertise on Procurement, 2020).

4.3.5. Flexibility: Awarding criteria

The Dutch Procurement Law (2012) presents three possible awarding criteria to be deployed for the awarding of the contract to one supplier, being lowest cost, lowest price and price-quality ratio. In principle, the price-quality ratio is used for awarding criterion. Application of lowest price or lowest cost must be motivated by the procurer.

4.3.6. Flexibility: Duration

The duration of the contract is affected by the nature of the asset to be procured (Fazekas & Blum, 2021). Though the procurer can decide on the duration of the contract as long as this is communicated publicly in advance. The means formulated for this flexibility are: Full term (long), Mid term (Medium) and Short term (Small).

4.3.7. Flexibility: Volume

The same line of reasoning can be applied to the volume as flexibility. It is up to the procurer to decide the volume scope of the contract to be set out as long as this is communicated clearly to the suppliers in advance. Assuming a procurement process is started, the volume can either be all or part of what is required by the procurer (Fazekas & Blum, 2021). The means are therefore: total and partial necessity.

4.3.8. Flexibility: Eligibility requirements

Eligibility requirements set requirements for the applicant with the aim of verifying the applicant's ability to carry out the tender. The minimum requirements must be met by an applicant in order to participate in the procedure. The Dutch Procurement Law (2012) formulates the eligibility requirements to be: Financial and economic capacity, Technical competence, Professional competence and Professional qualification.

4.4. Designing a Morph Chart

A morphological chart provides a systematic way to explore and widen the design space and subsequently generate conceptual designs herein (Moultrie, 2016). In its most left column, the decomposed sub-functions of the concept to be designed are shown, being called the *categories*. These are followed on the right side by the possible solutions found for each sub-function, being the *means*. All means are presented in an own cell and must be interpreted individually, no relation to other means is assumed (Chawla & Summers, 2019; Richardson III et al., 2011).

Generation of a design by using the MC is done by making a choice for one mean for each category. This is based on the two principles of the morphological chart: (1) *mutually exclusiveness*, meaning the choice for one mean excludes a choice for all other means in that category and (2) *collectively exhaustiveness*, referring to all means of one category together presenting the full range of possibilities for that category (see: 1.6.2).

4.5. Initial design Morph Chart

Since this research aims to create an overview of the possible institutional designs enhancing flexibility, the aspects now identified to do so have to be worked out into what design space is available for each flexibility. When applying this methodology, these aspects are therefore seen as "sub-functions" of the institutional design to be created by the MC. For each flexibility a variety of means, "optional solutions", are formulated. Translation to the MC leads to the flexibilities to be presented in the left column as categories, with their means to the right. The result is shown below and forms the starting point for the expert interviews.

4.5.1. Initial Design Morph Chart

Morph Chart - Initial											
Product											
Scope of product	Total asset	Asset in parcels	Asset and innovation in different parcels								
Degree of co-operation	Classic	Integrated	Life cycle management								
Delivery	Complete delivery	Batches	Batches with increasing, iterative development	Complete delivery with ex-post adaptations per batch							
Innovative development	Incremental innovative nature	Parallel development innovative product	No development								
Testing innovation	Living lab (disclosure to mulitple innovations)	Pilot (testing of one/a few innovations)	Periodical innovation proposal	Contractual learning/ development space	No testing						
Selection criteria	Quality	Esthetics	Functional characteristics	Accessibility	Suitability for users	Social characteristics	Environmental characteristics	Innovation	Organization, qualification and experience of the personnel	Customer service and technical assistance	Delivery terms and conditions
Specifications	Technical specifications	Functional specifications	Targets - Obligation of result	Targets - Obligation of effort	Catalogus specifications						
Contract											
Procedure type	Public procedure	Non-public procedure	Competitive procedure with negotiation	Competitive dialogue	Negotiated procedure with prior publication	Contest	Concession	Innovation partnership			
Instruments	Framework agreement (Grouped, electronic)	Dynamic Purchasing System (Grouped, electronic)	Electronic Auction (Grouped Electronic)	None							
Limitation of applicants	Selection of best candidate	Two rounds of gradual reduction	Multiple rounds of gradual reduction								
Contract type	Classic (Traditional)	Engineer & Construct (Integrated)	Design & Construct (Integrated)	Building management (EPC(M) (Integrated)	DBFM (Life Cycle)	DBFMO(T) (Life Cycle)	Concessie (Life Cycle)				
Additional organizational structure	Building Team (Traditional)	Alliances	None								
Financial structure	Co-financing	Pre-Commercial Purchasing	Dedicated innovation budget	Contracting body pays remuneration to producer							
Awarding criteria	Lowest cost (based on cost effectivity)	Price-quality ratio	Lowest price	Best Value Procurement							
Duration	Full term (Long)	Mid term (Medium)	Short term (Small)								
Volume	Total necessity	Partial necessity									
Eligibility requirements	Financial and economic capacity	Technical competence	Professional competence	Professional qualification							

Figure 4.1: Initial Design Morph Chart based on Performed Desk Research

4.6. Takeaways chapter 4

This chapter has provided a first insight in the design space available for flexibility for intermediate design changes in the PP process. The process aspects providing flexibility have been elaborated on and for each the full range of means has been presented.

After, these flexibilities and their means have been translated to a first design of a morphological chart. The flexibilities became categories in the most left column, being followed by their means on the right. This provided a first overview of the identified design space, which is required to find an answer to the third sub question. The created initial MC is not repeated here, but can be seen as the main takeaway from this chapter.

SQ 3: *What process aspects have been experienced to generate flexibility in PP processes?*

In order to answer this SQ, in Chapter 5 an exploration of this design space is performed. This is done based on the initial MC as created in this chapter. By conduction of expert interviews, the design space is evaluated in an iterative manner between each interview to result in an MC capturing as much expert knowledge existing within the sector.

5

Exploration design space

Now an initial design of the morph chart is generated resembling a first map of the design space for flexibility, the exploration of this design space is commenced. This MC-representation of the design space offers guidance herein: the chart is submitted to experts in public procurement in the railway sector. By doing so, the morphological chart provides a framework to be modified, structuring the variety of topics to possibly be discussed in the semi-structured expert interviews (see: Appendix B). In the first part of this chapter, in section 5.2, the results of these interviews are presented. This is done based on the type of modifications made, being: the classification of categories into chapters, splitting, changing, deleting and the addition of new categories, means, chapters and external impacts. These modifications are based on all suggested adjustments made during the interviews, which have been weighed in the context of this research. A detailed elaboration of the (optional) adjustments made in its original order and the trade-offs existent herein are presented in Appendix D. There a discussion can be found for each category or mean modified per interview, with a prior description of what kind of adjustment have been made.

In the second part of this chapter, in section 5.3, the substantiated modifications made by the researcher to finalize the diagram are elaborated. After, the resulting MC is presented in section 5.3.2. This matured MC shows the design space resulting from the exploration and also allows for plotting trends for flexibility observed during the interviews, which will be explained in Chapter 7. In parallel, this exploration also resulted in input on how to use the morph chart in this institutional context, of which all gathered data has been processed and presented in Chapter 6.

5.1. Introduction

The interviews were conducted in a random order, based on the replies of the respondents on the invitation to be interviewed (see: B.1 Semi-structured interviews in Appendix B). The structure of these conversations was set up in two parts, first discussing a case experienced by the interviewee and second his/her feedback on the morph chart. The proposed modifications as identified during the interviews will be discussed here. The retrieved feedback on the morph chart as a design method is presented in Chapter 6.

Since the aim of the morph chart is to give an insight into what impacts flexibility in public procurement, all suggestions and statements by respondents are carefully considered and weighed. This way redundancy of any kind is avoided as much as possible, enhancing the readability and understanding of the diagram. The initial diagram has been adjusted according to the input gathered in the eight expert interviews. The end result is an improved MC, which has been finalized by the researcher, as shown in figure 5.9.

5.2. Development diagram: Initial to end

5.2.1. Chapter Classification

During the development of the morphological chart, first two and later three chapters were used, being Product, Contract and Market Approach. When making changes to the MC, it has always been analysed if a category concerned the product and its characteristics (Product), the process of contracting (Contracting) or how suppliers were approached (Approaching market) later on in the MC-development process. Every category is added or shifted to the chapter it belonged to.

5.2.2. Split

Some categories and means were identified to behold more than one 'definition' or were better represented when separated. Therefore these factors have been 'split' into two or more new means or categories. In this section, it is explained why and how this was done. In figure 5.1 the effect on the MC is shown.

Testing innovation

Split into: *Testing innovation* and *Contracted initiative for innovation and optimisation*
The category testing innovation initially included both the explicit methods to test innovation, being the *Living lab* and *Pilot*, and methods to enforce innovation, being the *Periodical innovation proposal* and the *Contractual learning/development space*. As these means fulfill different roles in the process, this category has been split into two new categories. The first category *Testing innovation* was kept constant and the means *Living lab* and *Pilot*, as well as *No testing* were still included here. The second category derived is named *Contracted initiative for innovation and optimisation* and includes the means *Periodical innovation proposal* and *Contractual innovative clause* and also the default option *No initiative* is added. Later on, the mean *Latest-and-Greatest technology requirement* (See: 5.2.6) was added to this category. This second category was moved to the *Contract* chapter, as it focuses on how the initiative to innovate is contracted and does not concern the product directly.

Pilot

Split into: *Pilot - Real life* and *Pilot - Digital*
When maturing the diagram, it became apparent that two options for a pilot exist, being a pilot in real life and digital. The difference between these options within the contract, finances, responsibilities, ownership and so on, were the reason a distinction was desirable. The result is that the mean *Pilot* has been split into two new means being *Pilot - Real life* and *Pilot - Digital*.

Co-financing

Split into: *Co-financing (collaborating parties)* and *Co-financing - EU subsidies* In the initial diagram only *Co-financing* was included as a mean of *Financial structure*, but during the interviews two types of co-financing appeared to exist. The two means *Co-financing - EU subsidies* and *Co-financing (collaborating parties)* have been added. The first mentioned logically includes subsidies to be received from EU-organisations supporting innovation. The second mentioned represents co-financing as being collaborating parties fulfilling different roles, jointly financing (part of) the procurement.

Alliances

Split into: *Knowledge, Financial* and *Purchasing alliance*
The initially included *Alliance* as part of the category *Additional organizational structure* appeared to be too general. Three different types of alliances can be identified of relevance to this diagram, being a *Knowledge, Financial* and a *Purchasing alliance*.

The *Knowledge alliance* is defined as being stakeholders participating in an alliance to avoid a vendor lock-in. This means knowledge is shared amongst the involved stakeholders of the alliance. This mean is included in the diagram in the category *Additional organizational structure*.

The same is done for the *Purchasing alliance* as a mean of this category. This alliance focuses on procurers collaborating in an alliance for the aim of purchasing a certain product. This mean is closely related to the *International collaboration* but these have been separated to emphasize their differences, based on the (non-)international character.

Last, the *Financial alliance* has been created as mean of the *Financial structure*. This alliance could be mixed up with the mean *Co-financing (collaborating parties)*. The *Financial structure* reflects a collaboration between two similar parties, as two procurers, whilst the *Co-financing (collaborating parties)* mean represents a collaboration between parties fulfilling a different role in the procurement process. To avoid the means getting mixed up, a short description is added to both means in the MC.

Morph Chart - Split							
Product							
Testing innovation	Living lab	Pilot - Real life (testing of one/a few innovations)	Pilot - Digital (testing of one/a few innovations)	No testing			
Contract							
Financial structure	Co-financing (collaboration parties fulfilling different roles)	Co-financing - EU Subsidies	Pre-commercial purchasing	Dedicated innovation budget	Procurer's contribution (Remove unprofitable peak)	Financial alliance (collaboration similar parties)	Contracting body pays remuneration to producer
Contracted initiative for innovation and optimisation	Periodical innovation proposal	Contractual innovative clause	Latest-and-Greatest technology requirement	No initiative			
Market approach							
Additional organizational structure	Building Team	Knowledge alliance	Two-phases approach	Purchasing alliance	International collaboration	Mixed team	None

Figure 5.1: Development MC by Splitting: Results in MC

5.2.3. Change

A few changes have been made to the naming and spelling in the diagram. Below these corrections are explained and in figure 5.2 the result of these corrections are presented.

Nomenclature criteria

In the initial diagram the nomenclature was not used similarly to legislation. This incorrect naming has been changed. The initially named category *Selection criteria* is corrected to *Sub-awarding criteria*. The new category *Selection criteria* is introduced and beholds all criteria used to limit the amount of suppliers. The means of this category are *size of the company, type, amount* and *quality of references* and *the quality of the resumes* (PIANOo - Centre of Expertise on Procurement, 2017).

Procurement tools

In the first MC *Procedural instruments* was the overarching category of the *Framework agreement, Dynamic Purchasing System, Electronic Auction* and later on the *Market consultation*. During the development this topic appeared to be hard to understand. As the inclusion of the mean *Market consultation* was desirable, a more generic term was aimed for. Thus the name of this category has been changed to *Procedural instruments* and *Market consultation* was included as mean.

Spelling Batch

The spelling of the word 'badge' has been changed to 'batch'. This had been done wrong initially, but in this research the definition of 'batch' is meant and therefore imposed, also in retrospect.

Morph Chart - Change						
Product						
Delivery	Complete delivery	Batches	Batches with increasing, iterative development	Complete delivery with ex-post adaptations per batch		
Sub-awarding criteria	Quality	Esthetics	Functional characteristics	Accessibility	Suitability for users	…
Contract						
Procurement tools	Framework agreement	Dynamic Purchasing System	Electronic Auction	Market consultation	None	
Selection criteria	Size of company	Amount of references	Type of references	Quality of references	Quality of resumes	

Figure 5.2: Development MC by Changing: Results in MC

5.2.4. Delete

Maturing the morphological chart did not only result in the addition of categories and means. In some cases means and even a full category have been deleted from the diagram. Underneath an explanation will be given on this removal and in figure 5.3 the changes in the MC are shown.

Degree of co-operation

In the initial MC, the category *Degree of co-operation* was mentioned. During the development of the MC it became apparent that this degree was reflected in the *Contract type*, the *Hierarchy of relationship* and other categories, mostly of the *Market approach* chapter. The *Degree of co-operation* is thus deleted.

Concession

In the *Contract type* and *Procedure type* categories, the mean *Concession* was included. Nevertheless these have been deleted from the diagram, because this contract/procedure type was out of scope. A separate framework exists in legislation dealing with the application of a concession and this mean is therefore removed from the MC.

Best Value Procurement

The mean *Best Value Procurement* was included in the *Awarding criteria*. However, European Procurement Directive 2014/23 (European Parliament and the Council, 2014a) only mentions *Lowest cost*, *Price-quality ratio* and *Lowest price* as awarding criteria. Additionally, it appeared that *BVP* can be seen as an approach resulting from process choices made and employs as the *Price-quality ratio* as an awarding criteria herein. Leaving *BVP* would not only be factually incorrect, but also violates the MC-principle of being mutually exclusive because of overlap with another mean. The result is that *BVP* is removed from the *Awarding criteria*.

Morph Chart - Delete									
Product									
Degree of co-operation	Classic	Integrated	Life cycle management						
Contract									
Contract type	Classic	Engineer & Construct	Design & Construct	Building management	DB(F)M	DB(F)MO(T)	Custom agreement	Collaboration agreement	Concession
Awarding criteria	Lowest cost (based on cost effectivity)	Price-quality ratio	Lowest price	*Exemption ground (only in case of the exemption ground as procedure)	Best Value Procurement				
Procedure type	Public procedure	Non-public procedure	Competitive procedure with negotiation	Competitive dialogue	Negotiated procedure with prior publication	Contest	Innovation partnership	*Exemption ground for research and development	Call for innovation	Concession

Figure 5.3: Development MC by Deleting: Results in MC

5.2.5. New categories

When comparing the initial morph chart with the end version of the diagram, it can easily be seen that many categories have been added. Below each new category will be elaborated on and in figure 5.4 these categories are presented.

Start usage

The way of starting the use of the procured product has been mentioned to be of impact on the flexibility of the product. Products of a certain nature, e.g. network products, could require the start of their usage to be all at once or per batch. Enabling flexibility in the construction phase could lead to the delivery not being of the same nature as the required type of commissioning of the product. Being able to differentiate between these two categories therefore allows for more flexibility. This results in the new category *Start usage*, representing the choice for a type of commissioning the product into its use. Its means are *All at once, In batches* and *One by one*.

Financial distribution over time

The *Financial distribution over time* is a new category in the MC. It represents the choice to be made by the procurer on enforcing the supplier's activities by deciding on the distribution of financial resources throughout the process. By putting more emphasis on provisions of these means earlier in the process, or at least being more flexible in this provision, innovation and optimisation can be supported more accurately. A strategic, more flexible allocation of financial resources over time will lead to more flexibility in the process and innovation as a result. The options available are *All financial resources available upfront*, a *Flow of financial resources during the process* and *All financial resources available at completion*. To be complete, the option of *No financial resources to be received* is included too, in case a future case of PP surfaces in which other incentives are created than financial remuneration.

Contracted future modifications

The category *Contracted future modifications* has been added to the MC. This category speaks for itself as it includes all possible changes that are included in the contract by the procurer from the start. If the contracted modifications are then encountered, this is still within scope and there is no substantial amendment requiring a new PP process. The inclusion provides more flexibility to changes within the existing contract. The means of this category have been stated to be: *Changes in legislation, Accidents concerning the product* and *Defined technical alterations*, such as software updates. To fulfill the principles, not including any of these future modifications is added to the category as default option. As employing multiple options of this category is possible, the category is changed to be multiple choice.

Innovation clause

The category *Innovation clause* has been created as a result of the category *Contracted future modifications*. Last mentioned was supplemented by new means such as *Hourly rates for types of modifications* and the *Price tag catalog for components* and more. However, it showed that a twofold existed in this category. On the one side there were literal modifications to be included in the contract to avoid significant changes leading to the obligation of a new procurement procedure. One the other side were constructs created to use in the contract to create more grip on innovations and optimisations to come. These 'construct' means were changed into a new, separate category, being *Innovation clause*.

Awarding surplus

Inserting *Awarding surplus* as a new category is done to account for the procurer including the incentive for suppliers to add possible variants to their bid. Defining a surplus in a PP contract adds to flexibility as it allows valuation of variants on the procured product. Mostly, it avoids extra engineering, and thus extra costs, by suppliers removing additional value from their basic product to match what is requested. No more options can be found as means for this new category than either the *Surplus taken into account* or *No surplus* in the contract.

Nature of co-operation

Nature of co-operation is an important category to add to the MC. It describes the characteristic of the relationship between procurer and supplier, or even more suppliers. When enhancing flexibility, uncertainty leads to the impossibility to define the result and stages in between of PP and asks for different measures in the co-operation between involved parties. A shift towards co-operation in the form of a *Partnership*, between *Two partners, Multiple partners*, or even *All chain partners*, creates conditions in which the partnership establishes its own, shared values and objectives. The adjustments necessary to reach these common goals will then be made within the partnership. To show the importance of choosing how to approach the co-operation as a procuring party, this new category and the mentioned means are included in the MC, with the default option being the more traditional *Procurer-Supplier* relation.

Hierarchy of relationship

The new category *Hierarchy of relationship* is added to the MC to represent the attitude of the procurer towards the supplier. This position is crucial to the success of the process relationship and roughly consists of two options. First, a *Vertical* approach can be executed, this quite old-fashioned hierarchy of a top-down relationship between procurer and supplier has proven itself over the past. However, its counterpart, the *Horizontal* approach, has been getting more attention. A *horizontal* approach tends to approach a collaboration setting, leaving the top-down approach behind. The line of reasoning for this new category is similar to *Nature of co-operation*.

Management relationship

Subsequently, the category *Management relationship* has been added to the MC. This category is created in association with the two categories above, *Nature of co-operation* and *Hierarchy of relationship*. Since 'new' types of co-operation are introduced, managing the relationship must accommodate this by providing means to do this. Therefore the *Management of relationship* has the option to appoint a collaboration manager to smoothen the process between involved partners. Also the relation can be managed by just *Specifying the interaction* in the contract, by accommodating a *Dialogue on a mutual understanding of the contract*, or the default option *Via a contact person*.

Risk determination

In case mostly functional specifications, or, on an even higher level, targets are used in the contract, this enables much flexibility in the process. The supplier is in charge of the solution design, which makes it hard for the procurer to determine risks of the possible range of solutions. Accounting for this is done by including the new category *Risk determination*, which leaves room for making this the responsibility of the supplier as part of their bid. As means, the *Supplier(s)*, the option to do this *In collaboration* and the default option *Procurer* are included.

Risk mitigation

The last new category directly aiming on risk is *Risk mitigation*. It is created to show that apart from the default option to *Focus on achieving specified objectives*, risks can also be mitigated differently. Including flexibility in the process creates, as mentioned before, more uncertainty when stipulating specific (quantitative) goals and/or determining if these goals have been reached. Working around this uncertainty can be done by choosing to *focus on process and collaboration* values to be reached.

Risk profile

Determining the *Risk profile* of a suppliers' project plan can be done by asking a specific value to be obtained by the risk profile of the bid. However, being flexible in the process could cause decreased options to determine the exact risk profile. To account for this, a bandwidth could be defined. All project plans resulting in a risk profile within this bandwidth then have an acceptable risk profile for the procurer. Choosing this solution allows a process focused on flexibility to adjust their goals, risk profile in this instance, to 'move along'. The means of this new category are the *Bandwidth* and the default option of a *Fully covered profile*.

Ownership of innovation

Ownership of innovation is added as a new category. Incorporating flexibility in the process is done for the aim of optimisation or innovation of a (part of) the procured product. Thoughtful allocation of ownership of these improvements can rearrange responsibilities and incentives amongst involved parties (Sweet & Eterovic Maggio, 2015). When increasing flexibility in PP, e.g. by using more high-level specifications (functional, targets) or focusing on process and collaboration instead of specified objectives, creating incentives for the supplier to deliver their best possible result in the contract is required. By allocating the ownership of innovation to the supplier, such a drive can be created. This can be done in varying degrees. The result is its means being either the *Supplier* or the *Procurer* having ownership, with the first having different options. Ownership can be fully granted to the supplier, but also less impactful options are available. *Supplier - Usus* describes the exclusive right to decide on the utilization of the innovation, *Supplier - Usus fructus* goes beyond this and also includes the right to the proceeds of the innovation. It could be perceived logical to include *Supplier - Abusus*, the right to deny others the right to the use and the proceeds. However, as this MC is written from the perspective of the procurer, handing over these *abusus* right to another party does not support public procurement, but only causes more risk to the procurer. Thus, this mean is not included in the new category. To fulfill the MC principles, a default option is added too, being *No innovation*.

Intellectual property

The exact same line of reasoning as explained for the *Ownership of innovation* above, the intellectual property of an innovation or optimisation can be allocated in various ways. Considering this new category explicitly could lead to improved flexibility. The means are similar to the *Ownership of innovation*, being *Procurer, Supplier, Supplier - Usus, Supplier- Usus fructus* and the default *No innovation*, but a sixth mean is introduced. *Shared with market* is an extra mean covering the option to register the supplier's commitment to share the knowledge acquired with other parties in the market. This can be used in case only the development of an innovation is procured and a new PP process is started after, to procure the actual resulted product. In this case, this strategy results in more competition compared to procuring all stages in one PP procedure, but requires the gathered knowledge from the first process to be shared with the market.

System integration

With exploring options to procure innovation separate from the product, a gap appears between procedural strategy and creating successful procurement in reality. Closing this gap must be done by the integration of the created innovation/optimisation and the concerned product. Allocation options of this integration are the *Procurer's responsibility, Supplier's responsibility* or a third 'party can be attracted in the form of a *Independent team coach* to supervise the integration. To fulfill the MC-principle of collectively exhaustiveness, the option of *No integration* is included. It must be noted that the *Independent team coach* must not be mistaken to be the same as the *Collaboration manager* being mean of *Management*

relationship. The *Independent team coach* is defined as being solely focused on guiding the system integration and not the partnership. Contrary, the *Collaboration manager* focuses on smoothing the partnership, of which the integration can be an aspect but not necessarily.

Continuity teams involved in procurement - asset management

In fairly new process approaches, people taking the lead, spreading their philosophy, is of vital importance to its results. This mindset should not only be present in the procurement team, but must be transferred to the team(s) involved in later stages as well. The result is the inclusion of the new category *Continuity teams involved in procurement - asset management*. Although this percentage could be any number between zero and hundred percent, this cannot be represented in the MC. The readability of the diagram would be violated when all possible values would be included in the diagram. Thus, it has been chosen to include four 'range' means, being *Totally different teams*, *Less than 50% overlap teams*, *More than 50% overlap teams* and *Same teams*.

Morph Chart - New Categories						
Product						
Start usage	All at once	In batches	One by one			
Contract						
Financial distribution over time	All financial resources available upfront	Flow of financial resources during the process	All financial resources available at completion	No financial resources to be received		
Contracted future modifications	Changes in legislation	Defined technical alterations	Accidents concerning product	None		
Innovation clause	Hourly rates for types of modifications	Price tag catalog for components	Right to benchmark modification plan in the market	Right to have a third party check modification plan	None	
Awarding surplus	Surplus taken into account	No surplus				
Market approach						
Nature of co-operation	Procurer - Supplier	Partnership (Two partners)	Partnership (Multiple partners)	Partnership (All chain partners)		
Hierarchy of relationship	Horizontal	Vertical				
Management relationship	Collaboration manager	Specifying interaction	Dialogue on mutual understanding of contract	Via contact person		
Risk determination	Procurer	Supplier(s)	In collaboration			
Risk mitigation	Focus on process and collaboration	Focus on achieving specified objectives				
Risk profile	Fully covered profile	MU-value of bandwidth				
Ownership innovation	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	No innovation	
Intellectual property	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	Shared with market	No innovation
System integration	Procurer's responsibility	Supplier's responsibility	Independent team coach	No integration		
Continuity teams involved in procurement - asset management	Totally different teams	Less than 50% overlap teams	More than 50% overlap teams	Same teams		

Figure 5.4: Development MC by Adding New Categories: Results in MC

5.2.6. New means

Apart from totally new ones, some categories did not cover the full optional design space. Focusing on options to add flexibility to the process, the design space of some categories has been expanded by adding one or more new mean(s). For each addition, it is presented to which category it is added and its definition is given. Also, a short explanation of how this mean contributes to flexibility is given, as well as an overview of the new means in the MC in figure 5.5.

Innovation only

Category: *Scope of product*
Reducing the *Scope of the product* to the *Innovation only*, meaning not the 'total product' is considered for procurement, but the innovation to the product is procured on its own, separately. Including this mean allows e.g. co-financing to be combined with just the innovation to be created. Initially, this was not included as the mean *Total asset* could also be interpreted in such a way, that the innovation was the total asset. But since the mean *Asset and innovation in different parcels* is in the scope, it must be explicitly pointed out that procuring the innovation on its own can also be considered, enlarging the design space.

Research and development of innovation

Category: *Scope of product*
Another mean that became apparent when analyzing the *Scope of the product*, was the possibility to procure only the *Research and development of innovation*. For example when an international collaboration (see 5.2.6) is deployed, this could be done for just the *Research and development of innovation*. After, the collaboration partners establish each their

own construction of the innovation. Enabling the scope to account for these types of procurement is done by including this mean. This affects flexibility positively as the development innovation is supported, but the construction phase can be adjusted to the needs of each party involved.

Upfront development

Category: *Innovation development*
Instead of developing an innovation alongside the 'main' product, it must be noted that it is also possible to develop innovation before the procurement of this main product starts. This mean is included as *Upfront development*.

Competence in systems engineering

Category: *Sub-awarding criteria*
Inclusion of *Competence in systems engineering* as a *Sub-awarding criteria* is used to evaluate to what degree a possible future supplier is capable of partnering in a process in which systems engineering plays a crucial role. This approach could be deployed for more flexibility in the process, which requires evaluation of the ability of supplier's in this field.

Collaboration capabilities

Category: *Sub-awarding criteria*
The exact same line as for *Competence in systems engineering* holds for the new mean *Collaboration capabilities*. This mean is therefore also included as *Sub-awarding criteria*.

Competence on innovation

Category: *Sub-awarding criteria*
The exact same line as for *Competence in systems engineering* and *Collaboration capabilities* holds for the new mean *Competence on innovation*. This mean is therefore also included as *Sub-awarding criteria*.

Target - Obligation of vision goals

Category: *Specifications*
Enabling specifications on the highest level requires targets to be set on such a level. The mean *Target - Obligation of vision goals* is introduced in the category *Specifications* hereto. This option accounts for specifying procurement goals on the level of the vision of the procurer (or even of the procurement partnership). These vision goals differ from the *Obligation of result* and *Obligation of result* as the last two set targets on a more detailed level, than the *Obligation of vision goals*, which obliges the supplier to fulfill the highest level goals, the vision of the procurer. Including this mean is done to explicitly show this distinction.

Custom agreement

Category: *Contract type* To incorporate flexibility in the PP process, adjustments are made to established contract types to be a better fit to the innovation/optimisation in the process envisioned. This affects these contracts to become a *Custom agreement* in which it is clearly explained what, why and how the process will be executed. As these contracts do not match the known *Contract types* anymore, the new mean *Custom agreement* is created.

Collaboration agreement

Category: *Contract type*
The *Collaboration agreement* is also included in the category *Contract type*. Although, the custom agreement could account for many different contract types, the MC is meant to explore the design space and report this in a structured manner. Therefore, it is chosen to include the *Collaboration agreement* as a new mean, to clearly communicate the option to shift the focus of the contract type based on the included development stages towards an agreement in which the collaboration has a central role. Before, this focus was missing within the *Contract types*.

Procurer's contribution

Category: *Financial structure*
The category *Financial structure* must be supplemented by the new mean *Procurer's contribution*. This mean involves the financial support of the procurer to the supplier to remove the unprofitable peak of the development of innovation.

Hourly rates for types of modifications

Category: *Innovation clause*
To account for required adjustments in the future, *Hourly rates for types of modifications* can be included in the *Innovation clause*. These contracted rates set a fixed price to different types of modifications to be executed, avoiding overpriced adjustments when a vendor lock-in is already present since the contract is into force (Caniëls & Gelderman, 2005). It is explicitly mentioned that hourly rates are determined for different types of modifications, which refers to multiple rates, for each different sort of modification its own price.

Price tag catalog for components

Category: *Innovation clause*
Another option to include in the *Innovation clause* is to define price tags for different type of components instead of modifications. This way a catalog is created of additional works for components in a structure pricing scheme. Enabling this flexibility avoids discussion by creating contracted common ground upfront.

Right to benchmark modification bid in the market

Category: *Innovation clause*
A third option within the *Innovation clause* is to register the *right to benchmark the modification bid in the market*. Also for this mean, incorporating this right in the contract prevents discussion on the modification bid and avoids overpriced modification bids caused by a vendor lock-in.

Right to have third party check modification bid

Category: *Innovation clause*
The same line of reasoning holds for the option to include the *Right to have a third party check the modification bid* in the *Innovation clause*.

Latest-and-Greatest technology requirement

Category: *Contracted initiative for innovation and optimisation*
To ensure state-of-the-art innovation and optimisation without being able to describe features of this, the option to include a *Latest-and-Greatest technology requirement* is added to the MC. This mean commits the supplier to initiate regular updates of what is procured, which could offer many chances e.g. in long-term processes. Including this option allows for innovation and updates along the program, without requiring a detailed upfront description, which enhances flexibility in the process greatly. It is therefore introduced in the category *Contracted initiative for innovation and optimisation*.

Exemption ground for research and development

Category: *Procedure type*
During the maturation of the diagram a new procedure type appeared to be existing, being the *Exemption ground for research and development*. This procedure is only allowed conditionally and allows purchasing without competition. Multiple exemption grounds exist in procurement, but in the scope of this research only the Exemption ground for research and development is applicable.

The exemption ground may only be used in case the research and development is not fully financed by the procurer or the results do not only benefit the procurer (Orwa, 2023). As in some cases this exemption is deployed as procedure, which provides flexibility by the absence of the obligation to procure, it is included in the diagram. Though, it will be marked with an asterisk (*).

Exemption ground

Category: *Awarding criteria* Avoiding violation of the collectively exhaustiveness of the MC, the mean *Exemption ground* is added to the category *Awarding criteria*. It is marked with an asterisk (*) as it can only be chosen in case the *Exemption ground for research and development* is chosen as procedure type. This restriction is shortly mentioned in the MC to clarify the mean.

Call for innovation

Category: *Procedure type*
A *Procedure type* lacking previously, was the *Call for innovation*. This call aims to receive various solutions to the set out problem formulation, but includes no commitment to purchase the found solutions. Setting out such a procedure sparks creativity, explores the design space for solutions, based on which the procurer can decide the procurement to set out in the market. This option was not yet covered in the MC and is thus included in the diagram as a *Procedure type*.

Two-phases approach

Category: *Additional organizational structure*
The *Two-phases approach* introduces the separation of the design and construction phase in PP. Further, this known approach involves the suppliers early on in the process, which leads to collaboration and better utilization of expertise. Both of these aspects lead to more flexibility, which is why this mean has been added as a *Additional organizational structure*.

International collaboration

Category: *Additional organizational structure*
Another mean to be included in this category is the option of an *International collaboration*. Joint procurement of innovation, with possible later adjustments to the unique requirements of each involved partner, leads to lower transaction costs and more options for innovation.

Mixed team

Category: Additional organizational structure
The *Mixed team* is the third mean added as *Additional organization structure*. The mixed team consists of all involved parties in the contract, to emphasize their work as a team and even leaves room to include more team members of parties outside the contract, to support the process.

Morph Chart - New Means									
Product									
Scope of product	Total asset	Asset in parcels	Asset and innovation in different parcels	Innovation only	Research and development of innovation				
Innovation development	Incremental innovative nature	Parallel development innovative product	Upfront development	No development					
Sub-awarding criteria	Quality	Esthetics	Functional characteristics	Accessibility	Suitability for users	...	Competence in Systems Engineering	Collaboration capabilities	Competence on Innovation
Specifications	Technical specifications	Functional specifications	Catalogus specifications	Targets - Obligation of result	Targets - Obligation of effort	Targets - Obligation of vision goals			
Contract									
Contract type	Classic	Engineer & Construct	Design & Construct	Building management	DB(F)M	DB(F)MO(T)	Custom agreement	Collaboration agreement	
Financial structure	Co-financing (collaboration parties fulfilling different roles)	Co-financing - EU Subsidies	Pre-commercial purchasing	Dedicated innovation budget	Procurer's contribution (Remove unprofitable peak)	Financial alliance (collaboration similar parties)	Contracting body pays remuneration to producer		
Innovation clause	Hourly rates for types of modifications	Price tag catalog for components	Right to benchmark modification plan in the market	Right to have a third party check modification plan	None				
Contracted initiative for innovation and optimisation	Periodical innovation proposal	Contractual innovative clause	Latest-and-Greatest technology requirement	No initiative					
Awarding criteria	Lowest cost (based on cost effectivity)	Price-quality ratio	Lowest price	*Exemption ground (only in case of the exemption ground as procedure)					
Procedure type	Public procedure	Non-public procedure	Competitive procedure with negotiation	Competitive dialogue	Negotiated procedure with prior publication	Contest	Innovation partnership	*Exemption ground for research and development	Call for innovation
Market approach									
Additional organizational structure	Building Team	Knowledge alliance	Two-phases approach	Purchasing alliance	International collaboration	Mixed team	None		

Figure 5.5: Development MC by Adding New Means: Results in MC

5.2.7. New chapter

Market approach

Development of the diagram led to many new categories and means being added to the diagram, expanding the MC greatly. After analysis of the categories, it became evident that a new tendency could be identified, being categories concentrating on the relationship between the supplier and the market. The relationship between procurer and supplier, as well as risk and responsibility aspects were central in many categories. Improving the MC's readability is done by adding a new chapter, to divide the categories in three instead of two creates a more structured overview. Combining this with the category analysis leads to the inference of the new chapter to be *Market approach*. All categories concentrating on the relation between procurer and supplier(s) in a broad sense are moved to this chapter. In figure 5.6, an overview is given of this new chapter and its categories and means.

Morph Chart - New Chapter							
Market approach							
Volume	Total necessity	Partial necessity					
Duration	Full term	Mid term	Short term				
Nature of co-operation	Procurer - Supplier	Partnership (Two partners)	Partnership (Multiple partners)	Partnership (All chain partners)			
Hierarchy of relationship	Horizontal	Vertical					
Management relationship	Collaboration manager	Specifying interaction	Dialogue on mutual understanding of contract	Via contact person			
Risk determination	Procurer	Supplier(s)	In collaboration				
Risk mitigation	Focus on process and collaboration	Focus on achieving specified objectives					
Risk profile	Fully covered profile	MU-value of bandwidth					
Additional organizational structure	Building Team	Knowledge alliance	Two-phases approach	Purchasing alliance	International collaboration	Mixed team	None
Ownership innovation	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	No innovation		
Intellectual property	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	Shared with market	No innovation	
System integration	Procurer's responsibility	Supplier's responsibility	Independent team coach	No integration			
Continuity teams involved in procurement - asset management	Totally different teams	Less than 50% overlap teams	More than 50% overlap teams	Same teams			

Figure 5.6: Development MC by Adding a New Chapter: Result in MC

5.2.8. External impact

Phases of Technology Readiness

A morphological chart is a tool used to systematically explore the design space, which means all that can be affected by the 'designer' can be included. This MC is created from the perspective of the procurer, which means that all factors not being within the procurer's scope of influence are left out. The Technology Readiness Level (TRL) of innovations is one of these aspects. Nevertheless, an innovation's TRL has a decisive effect on the PP process to be designed and can indirectly be influenced by the procurer as many means influence this level by maturing an innovation. Hence it has been decided to include the TRL in the diagram. The extra chapter *Impacts* is created and added to the diagram in a contrasting color, to show it being of a different character than the rest of the diagram. Also, readability is enhanced by not including each TRL separately, but the overarching phases as presented by Netherlands Enterprise Agency (RVO) (2022). The options for the *Phases of Technology Readiness* are therefore as follows: *Discovery phase (TRL 1,2 and 3), Development phase (TRL 4,5 and 6), Demonstration phase (TRL 7 and 8)* and *Deployment phase (TRL 9)*. In figure 5.7, the inclusion of this external impact in the MC is shown.

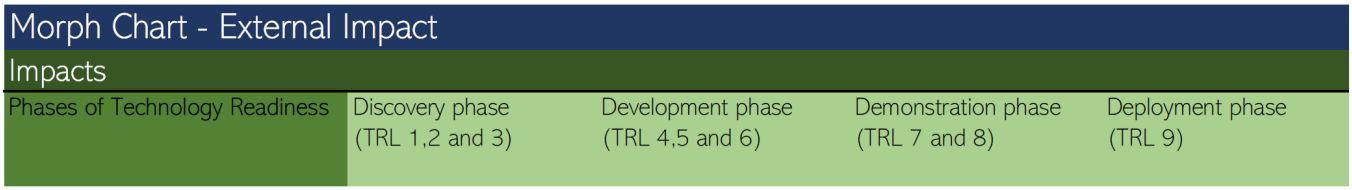


Figure 5.7: Development MC by Adding External Impact: Result in MC

5.3. Overall modifications

The effect of all interviews has been plotted on the MC, of which an overview can be seen in figure D.11 in Appendix D. As the morph chart is created as a useful tool for the exploration of the design space and subsequently concept generation. To enable the tool to be useful, high readability and easy understanding of the diagram are essential, which is mostly done by simplification without loss of information (see: 6.2 Characteristics MC) (Smith et al., 2012). From that perspective some changes have been made to further improve the MC with a focus on its usefulness. Below these adjustments will be explained shortly and in figure 5.8 it is shown what these changes look like.

5.3.1. Changes

Contract type and means

As mentioned in 5.2.6 Custom Agreement, contract types are adjusted to the needs of the process and the aimed flexibility. This results in procurers modifying contracts in such a way that eventually more or less all contracts become *Custom agreements*. It has been stated that as long as a transparent description is given in the procurement process of what is expected and why, a contract can be adjusted as desired. This means that the current presentation of contract types is not very informative, adjustments are made to established contract types to be a better fit to the innovation/optimisation in the process envisioned. Still it is important what process stages are included in the contract, meaning that the focus shifts towards the *Contract scope* instead of the *Contract type*.

In the MC this change is made to the category and the means are therefore modified to being possible process steps to be in- or excluded in the contract. The category is changed to a multiple choice category, to enable choosing the different contract stages included. The new means of the *Contract scope* are: *Research, Engineer, Design, Construct, Finance, Maintain, Operate, Terminate* and finally *Collaboration* is added. Last mentioned is not a process stage on its own, but accounts for contracts in which the focus is not on the scope defined in process stages but concentrates on contracting the collaboration itself.

This affects these contracts to become a *Custom agreement* in which it is clearly explained what, why and how the process will be executed. As these contracts do not match the known *Contract types* anymore, the new mean *Custom agreement* is created.

Sub-awarding criteria and means

A similar change has to be made to the category *Sub-awarding criteria* and its means. To support readability, the MC should be kept as concise as possible. During the interviews, the *Sub-awarding criteria* have not been mentioned often, it was skipped or passed swiftly by respondents and not much has been changed or considered to this category. The addition of the three means *Competence in innovation, Competence in systems engineering* and *Collaboration capabilities* has been the only focus on this category. A trade-off between being concise on the one side and the informational value on the other side, results in the decision to remove all means of this category and replace these by adding a mean being *Other*. This way violation of the MC is still collectively exhaustive, *Other* represents all *sub-awarding criteria* which are supposed to be known by the users of this tool, experts in procurement. The three newly added means are still presented in this multiple choice category.

Language used

The sequential development lead to the introduction of a new category in the last stage, being *Management relationship*. Looking back, it can be read that earlier on the use of language was mentioned, to underpin different communication causing an improved relationship. This *Language used* is therefore in retrospect added to the category *Management relationship*. This mean represents the conscious choice for language used to enhance a better collaboration between procurer and supplier, e.g. by avoiding the use of 'procurer' and 'supplier', but starting to use 'partners', being in a 'partnership' recorded in a 'collaboration agreement'.

Multiple choice

As changed for *Contract scope*, also other categories showed to be multiple choice. During the development, it was shown that more categories than indicated had means that could be combined. This applied to the *Financial structure*, the *Management of relationship*, the *Contracted initiative for innovation and optimisation* and the *Additional organizational structure*, which have been changed accordingly.

Awarding surplus

Enhancing the conciseness of the diagram, for each category its informational value must be evaluated. Reviewing the *Awarding surplus* shows there is a binary choice. When determining its informational value specifically, it can be seen that such a surplus can be considered to be an option to include in the *Innovation clause*. To support simplicity in the diagram, the mean *Surplus taken into account* is added to this category and the category *Awarding surplus* itself has been deleted.

Morph Chart - Overall Modifications									
Product									
Sub-awarding criteria	*Other*	Competence in Innovation	Competence in Systems Engineering	Collaboration capabilities					
Specifications	Technical specifications	Functional specifications	Catalogus specifications	Targets - Obligation of result	Targets - Obligation of effort	Targets - Obligation of vision goals			
Contract									
Contract scope	Research	Engineer	Design	Construct	Finance	Maintain	Operate	Terminate	Collaboration
Financial structure	Co-financing (collaboration parties fulfilling different roles)	Co-financing - EU Subsidies	Pre-commercial purchasing	Dedicated innovation budget	Procurer's contribution (Remove unprofitable peak)	Financial alliance (collaboration similar parties)	Contracting body pays remuneration to producer		
Innovation clause	Hourly rates for types of modifications	Price tag catalog for components	Right to benchmark modification plan in the market	Right to have a third party check modification plan	Surplus taken into account	None			
Contracted initiative for innovation and optimisation	Periodical innovation proposal	Contractual innovative clause	Latest-and-Greatest technology requirement	No initiative					
Awarding surplus	Surplus taken into account	No surplus							
Market approach									
Management relationship	Collaboration manager	Specifying interaction	Dialogue on mutual understanding of contract	Language used	Via contact person				
Additional organizational structure	Building Team	Knowledge alliance	Two-phases approach	Purchasing alliance	International collaboration	Mixed team	None		

Figure 5.8: Overall Modifications: Result in MC

5.3.2. Matured MC

The MC resulting from the development and the overall modifications made after is presented in figure 5.9. This version of the MC is used in the following stages of the research.

Morph Chart - Matured									
Impacts									
Phases of Technology Readiness	Discovery phase (TRL 1,2 and 3)	Development phase (TRL 4,5 and 6)	Demonstration phase (TRL 7 and 8)	Deployment phase (TRL 9)					
Product									
Scope of product	Total asset	Asset in parcels	Asset and innovation in different parcels	Innovation only	Research and development of innovation				
Degree of co-operation	Classic	Integrated	Life cycle management						
Delivery	Complete delivery	Batches	Batches with increasing, iterative development	Complete delivery with ex-post adaptations per batch					
Start usage	All at once	In batches	One by one						
Innovation development	Incremental innovative nature	Parallel development innovative product	Upfront development	No development					
Testing innovation	Living lab	Pilot - Real life (testing of one/a few innovations)	Pilot - Digital (testing of one/a few innovations)	No testing					
Sub-awarding criteria	*Other*	Competence in Innovation	Competence in Systems Engineering	Collaboration capabilities					
Specifications	Technical specifications	Functional specifications	Catalogus specifications	Targets - Obligation of result	Targets - Obligation of effort	Targets - Obligation of vision goals			
Contract									
Contract scope	Research	Engineer	Design	Construct	Finance	Maintain	Operate	Terminate	Collaboration
Procurement tools	Framework agreement	Dynamic Purchasing System	Electronic Auction	Market consultation	None				
Financial structure	Co-financing (collaboration parties fulfilling different roles)	Co-financing - EU Subsidies	Pre-commercial purchasing	Dedicated innovation budget	Procurer's contribution (Remove unprofitable peak)	Financial alliance (collaboration similar parties)	Contracting body pays remuneration to producer		
Financial distribution over time	All financial resources available upfront	Flow of financial resources during the process	All financial resources available at completion	No financial resources to be received					
Eligibility requirements	Financial and economic capacity	Technical competence	Professional competence	Professional qualification					
Selection criteria	Size of company	Amount of references	Type of references	Quality of references	Quality of resumes				
Contracted future modifications	Changes in legislation	Defined technical alterations	Accidents concerning product	None					
Innovation clause	Hourly rates for types of modifications	Price tag catalog for components	Right to benchmark modification plan in the market	Right to have a third party check modification plan	Surplus taken into account	None			
Contracted initiative for innovation and optimisation	Periodical innovation proposal	Contractual innovative clause	Latest-and-Greatest technology requirement	No initiative					
Awarding criteria	Lowest cost (based on cost effectivity)	Price-quality ratio	Lowest price	*Exemption ground (only in case of the exemption ground as procedure)					
Procedure type	Public procedure	Non-public procedure	Competitive procedure with negotiation	Competitive dialogue	Negotiated procedure with prior publication	Contest	Innovation partnership	*Exemption ground for research and development	Call for innovation
Limitation of applicants	Selection of best candidate	Two rounds of gradual reduction	Multiple rounds of gradual reduction						
Market approach									
Volume	Total necessity	Partial necessity							
Duration	Full term	Mid term	Short term						
Nature of co-operation	Procurer - Supplier	Partnership (Two partners)	Partnership (Multiple partners)	Partnership (All chain partners)					
Hierarchy of relationship	Horizontal	Vertical							
Management relationship	Collaboration manager	Specifying interaction	Dialogue on mutual understanding of contract	Language used	Via contact person				
Risk determination	Procurer	Supplier(s)	In collaboration						
Risk mitigation	Focus on process and collaboration	Focus on achieving specified objectives							
Risk profile	Fully covered profile	MU-value of bandwidth							
Additional organizational structure	Building Team	Knowledge alliance	Two-phases approach	Purchasing alliance	International collaboration	Mixed team	None		
Ownership innovation	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	No innovation				
Intellectual property	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	Shared with market	No innovation			
System integration	Procurer's responsibility	Supplier's responsibility	Independent team coach	No integration					
Continuity teams involved in procurement - asset management	Totally different teams	Less than 50% overlap teams	More than 50% overlap teams	Same teams					

Figure 5.9: Matured MC: Result of Development

5.4. Takeaways chapter 5

All in all it can be concluded that the development of the morphological chart has led to an extensive diagram, which kept being adjusted by the experts interviewed. Analysis of the adjustments made clearly shows the tendency of experts to focus on the market approach. The relational aspects of procurement, in the broadest sense, were added to the diagram, which even led to the addition of the new chapter *Market approach*. This chapter consists, apart from three categories, of totally new categories. Considering the interviews focused on questioning experts in the railway sector about what they did to accommodate flexibility in the procurement process, a trend to focus on these relational aspects can clearly be identified. As the initial morph chart was created based on aspects to be found in literature and professional documentation, it shows that current public procurement documentation lacks focus on relational factors and a shift is now starting towards a focus on market approach.

Another conclusion to be drawn from the MC-development is that, except for some minor means added and one extra category (*Start usage*), the *Product* chapter was not subject to much change. Based hereon, it could be questioned if the aspects in this chapter might already be so evident to experts, that not much attention is given to this when questioning how to enhance flexibility. Pushing this conclusion to its limits, it might even be stated that this chapter could be left out of the diagram. As the lack of attention to these categories could be interpreted as decreased importance compared to the

other chapters' categories.

SQ 3: *What process aspects have been experienced to generate flexibility in PP processes?*

This chapter enabled answering this third sub question. It can be concluded that the matured MC (see: 5.9) shows the design space available, with its categories being the process aspects generating flexibility to the PP process, which varies according to what mean is chosen for each aspect.

Based on the overview of the development of this MC, it can be stated that foremostly the relational aspects in the market approach chapter, have been added to the design space. Clearly, common or promising practices from an expert's point of view focus foremostly on the relational aspect of public procurement.

Additionally, many other means and categories have been added. However, in the product chapter, not so much has changed, which could imply that a focus on product-related process aspects for flexibility was either already complete or it might not have a great potential for providing flexibility to the process.

It can be stated that the matured MC shows a strongly increased and evaluated chart and therefore design space, especially when compared to the initial MC this development started with.

In chapter 7 this version of the chart will be used to capture trends as identified in the experts interviews. These trends will be "drawn" into the MC, forming so-called *design lines*. These design lines will later be validated and classified based on their characteristics, in order to systematically answer the main RQ.

But first Chapter 6 will dive deeper into the application of the morphological chart for institutional design, accommodating this research in finding the aimed for flexibility.

6

Research parallel: Morph chart for institutional design

Along the data gathering concerning flexibility in public procurement, the responses of the interviewees towards the morph chart and its use were collected and observations made by the researcher were noted (see: Appendix B). This means this chapter aims to answer how the morphological chart can be deployed for institutional design, which is a parallel research objective within the context of the study on flexibility in PPP. A visual representation of this structure can be found in figure 1.1, which clearly shows this chapter to be not in "line" with the other chapters but next to it providing methodological support to finding an answer to the RQ.

To do so, this chapter first explains how this lateral data collection has been performed in section 6.1. Then, the four construction rules established to make the MC suitable for institutional design are presented in section 6.2. This is followed by section 6.3 in which the methodological adjustments resulting from the interviews are presented. The same is done in section 6.4 with the adjustments required by the researcher to produce and modify the MC to be suitable in this institutional context.

The resulting modifications are used to adjust the MC accordingly. This version is further used for the representation of the trends for flexibility in chapter 7 and 8.

6.1. Data collection

Three types of data were collected to do so. First, the audio input, translated in a transcription, was analyzed on literal expressions of how the use of the morph chart was perceived. Second, observations were collected by the researcher, which could mostly be observed in the transcription as well, but were refined for interpretation using the audio recording. Third, it has been registered what issues the researcher encountered in the process of employing the morph chart for institutional design within this study.

The literal and interpreted observations made during the interviews, were both noted in the last part of the summaries of each interview in Appendix C. The literal observations were included in the same way and style as the 'content statements', with first the interview number followed by the statement indicator, e.g. 1NN. The interpreted observations were noted differently, as 'OBS' followed by the indication of the interview and an observation specific number, e.g. OBS1.3. The issues as perceived by the researcher have been listed during the previous stages of this study and will be presented, explained and mitigated or solved in the second part of this chapter.

6.2. Characteristics Morph Chart

As elaborated on in 1.6 in Chapter 1, the morphological chart adheres to its principles of being *collectively exhaustive* and *mutually exclusive*. The principle of collectively exhaustiveness requires the morphological chart to include for each category a full range of options in such a way that the sum of means covers all possible options. The principle of mutually exclusiveness on the other hand is fulfilled when every mean is completely individual, meaning it has no overlap with another mean.

Applying this to the desired institutional design starts by creating a category for all identified flexibilities. Subsequently, for each category means have been formulated by consideration of all possible choice options per flexibility. Executing this for the procurement process leads to four more construction rules that should be followed when using the MC for institutional design, being within the scope of action (1); readability (2); abstraction level (3) and informational value (4).

The first construction rule of being *within the scope of action* is a result of the practical goal of the MC as a tool. Since the MC is used as a design tool for, in this case, the procurer, it must only contain categories which actually have the opportunity to be directly affected by the designer. If not, this category is out of the scope of action and must be left out of the chart.

The second construction rule is based on *readability*. The usefulness of the MC is dependent on readability, which is impacted by the degree to which the diagram is independently understandable, well-structured and visually clear. This results for example in a trade-off between including more text to define a mean versus the diagram becoming too much to process by having much text in the cells.

The third construction rule is formed by the *abstraction level* of the means. To stay comprehensible and enable equal comparison between means, the abstraction of these choice options should be on the same level as much as possible.

The fourth and last construction rule is based on *informational value*. For each category its value is determined based on the degree to which this category adds to the aimed objective of the diagram. Based on this value, elimination must be considered to uphold the readability of the diagram. This applies differently to the means, which can be merged in case of low informational value, but not eliminated to avoid violation of the collectively exclusiveness.

6.3. MC as a method: Interviewees

As explained earlier, the respondents provided feedback on the use of the MC as a method directly and indirectly (see: Appendix B). In this section, the findings of the analysis of this data will be explained.

The main themes identified were *Understanding, Design, Scope, Personal experience & Dynamics* and *Usage*. For each of those, it will be explained what notes of feedback were provided by respondents and, if adjustments were made based hereon, what the effects were.

6.3.1. Understanding

The understanding of using the MC as a design tool has been noted to be of impact. This feedback is twofold, on the one hand definitions were unclear and on the other hand, the methodology was mastered easily.

Observed was that definitions of topics were often unclear to respondents. In many cases the interpretation of topics mentioned in the morph chart were checked with the researcher, to see if these were aligned with the intended definition. In other situations unfamiliarity with topics was presented, whilst the used topics were assumed to be common knowledge to experts in the field. One time even a wrong assumption was made obviously caused by a different interpretation of a topic in the MC. Combining the importance of the definitions of categories and means to be clear and aligned amongst users of the MC with the outcomes of this analysis calls for a solution to take care of communicating definitions.

As the MC should be a useful design tool, the inclusion of long definitions in the chart should be avoided. However, including the definitions in the MC in a certain way is required. Options to do this could be:

- Interactive image: clicking on each cell in a digital MC presents a short description of the topic
- Double MC: the MC is accompanied by an extra version in which short descriptions are included in the cells to clarify its meaning and is solely used to inform on definitions, but the 'normal' MC is used as tool
- Manual: a manual in text is created and accompanies the MC
- Instruction video: a video is created in which the use and definitions of the MC are explained

Contrary to the definitions, the concept of using the morph chart as a methodology to design a procurement process with enhanced flexibility appeared to be easily understood by respondents and the introduction showed to be clear. This result was supported by the observation of respondents 'playing around' with the means and categories in the MC instantly in the intended manner. It was shown they were almost immediately comfortable with using the diagram.

6.3.2. Design

The appearance of the MC was another evident topic in the feedback and observations on its use, being split up in aspects of the construction itself and the combination of means for multiple purposes.

Many aspects of the design construction need attention, to either be improved or anticipated on when applying a MC for institutional design. One aspect requiring attention is the fact that in some cases each column of the MC was perceived to be a complete conceptual design, instead of the tool providing freedom in choosing one or multiple means from each row to create a design line. Only in one instance, this methodology needed an extra introduction. Also, the principles of the MC (see: 6.2 Characteristics Morph Chart) and the multiple choice character of some categories were sometimes forgotten. A short reminder by the researcher was of immediate effect. Focus also seemed to be required to the appearance of the exemplary MC of the beverage container (see: Appendix B), which caused confusion. Initially numbers were put above the means in this example, which resulted in distraction. The numbers were mistakenly interpreted as the amount of designs to create or again supported the assumption that the column underneath the number was a 'pre set design'. These numbers have been deleted to avoid this. Lastly and contrary to all mentioned above, it was also found that the MC was perceived to be well-structured and interesting. Additionally it has been mentioned that the order of categories and means is of importance, how this should be encountered can be read in section 6.4.1.

Incorporating this feedback in the construction of the MC is required to improve the tool. The introduction of the methodology provided by mail (see: Appendix B) was perceived to be clear, but as columns were sometimes perceived to be an instant design, this could be added more explicitly in this introduction. Additionally, the principles of the MC and the option for multiple choice in some cases could be emphasized more herein. This combination could affect better understanding of the

methodology. Also, to avoid future confusion of the meaning of the numbers in the MC example of the beverage container, these were deleted.
It was noted that three different aspects of the lack of combinations in the MC were mentioned. First, it was observed that some means cannot coexist. Second, coherence exist between certain means, which beholds that choosing a certain mean could lead to a fixed choice for another mean, e.g. in certain procedures the duration is limited. Third, some 'hidden' aspects emerge when means are combined in the MC. In all three instances the representation of these relational aspects is lacking, which could cause important information not to be represented in the MC.

Showing the coherence, emergence or impossible combination of two or more means is difficult. Subtle lines could be added to show a dependent relation between means, but this relation needs more details, which should then also be added to explain the shown dependence. Adding these lines or even supplemental details would make the diagram chaotic and harder to use. As the users of the tool are assumed to have a certain degree of knowledge on public procurement, these additions are skipped in this version. The goal of the tool is to explore the design space for PP and this way structure the discussion on new to be designed PP processes with enhanced flexibility. It could therefore be stated that providing much in-depth information on the specifics of certain means is not required. However, it must be said that this relational information would improve the informational value of the MC. To meet this desire, the earlier mentioned option of producing an interactive image (see: 6.3.1) can be expanded to inclusion of the relations as well. A concise outline could be that choosing for a certain mean leads to means being highlighted (coherence), faded (impossible) and the use of some small text boxes explaining emergent effects (emergence).

6.3.3. Scope

In some cases the suggestions made by the interviewees to expand the design space, were out of scope. Also other respondents asked for reassurance about the scope of the MC. This means the scope was not clear to all. However, apart from the option to also emphasize the scope of the MC more in the introduction, no other measures will be created to mitigate this. The aim of the tool is to explore the design space and structure the discussion on the process design, which means that seeking the boundaries of the scope should be encouraged, even if this will sometimes result in suggestions being out of scope. The tool is applied when designing the process, the detailed development of procurement procedures will be done very carefully after. This means, apart from communicating the scope more clearly in the introduction, nothing should be changed according to this observation. In contrast, thinking outside the perceived boundaries, even if it is the scope, should be emboldened.

6.3.4. Personal experience & Dynamics

Furthermore, the statements and observations made showed interview specific aspects to be of influence on the use of the MC as institutional design tool. An example of this is the notion that it was often mentioned that the MC provided a new perspective, which was appreciated by the respondents. Specifically the novelty of the method was pointed out, combined with surprise about this method not being used earlier.

During the interviews, not only observations were made directly on the use of the morph chart, but also on how the MC was influenced by or impacted itself the dynamics of the conversation. A distinction in these dynamics could be made, being the dynamics of the interview itself when more than one respondent was interviewed at once (Duo), how the MC impacted the interview (Conversational support) and how the respondent was individually affected by the MC (Expert).

Duo

When analyzing the interview dynamics in general, it was obvious that in all interviews with two respondents, one expert was more dominant than the other. The dominant one answered more questions and referred to the morph chart more. Only in one case the less dominant expert was significantly less experienced than the other, which does not explain this difference in the other interviews.

Also, the MC affected a discussion between the respondents, which aligns with the main goal of the MC. The fact that a discussion emerged on design choices between respondents should not be impacted, but its importance can only be underpinned. Though, the dominance of one over the other respondent should be kept in mind. When deploying the MC later on, the 'moderator' should be made aware of this dominance. This person must take the initiative to include all opinions. However, this should be done by moderators of an (expert) discussion in general (Barbour, 2007).

Conversational support

The observations showed that during the interviews the MC structured the dialogue. Even though this might come across as being evident, as the interview partially revolved around the diagram, this is not entirely right. Detected was the tendency of respondents to elaborate on a certain topic and then return to the MC-structure. In two cases a contrast could be seen. In these instances the respondents initiated to use the case as a structure to go through the MC instead. After some time the case was let go of, but it did help starting the MC-analysis.

The MC functioning as conversation structure is aligned with its main goal as a tool, which is why no adjustments or suggestions were made based on this observation. The fact that the case supported the dialogue about the MC in some cases does not require action, apart from the notion that in case the MC is used in the future, the moderator should be prepared to use a case known to all participants to the discussion. This case can then be used if the discussion on the MC does not come to life.

Expert

Observing how the respondent was individually affected by the MC showed three main effects. First, it was mentioned that letting go of the own perspective is hard when looking at the MC. Second, participants showed some time was needed to process the totality of the MC. In order to avoid overwhelming respondents and wasting time, it was decided to introduce the respondents to the MC and its method before the interview began. Initially, the respondents were introduced hereto during the interview, but after the first interview this was already shown to be too much to process and the approach had immediately been changed. Third, it was observed that in some cases when respondents did not understand how to apply the MC, they became reluctant in using it and making statements, even though they were experts in the field.

Because the intended MC-use is to be utilized by a party in charge of constructing a process or other institutional design, no suggestions are made based on difficulties letting go of the own perspective. Such design will always be created from a certain perspective. To avoid overwhelming respondents and wasting time, the strategy to introduce the MC was already changed during the process, by sending an overview of the MC and an explanation of the method in advance. Outside of continuing this change, emphasizing importance to do so, no adjustments or suggestions are made. To avoid reluctance of participants in using the MC when the methodology is unclear to them, the only solution to focus on providing a correct and clear introduction of the usage.

6.3.5. Usage

During the interviews some recommendations for usage of the MC were suggested. First, it was stated that drawing on a paper version of the MC would make its use even easier. Second, it was recommended to create support by the board to enable better embedding of the MC as a design tool within organizations. The third recommendation was to use the MC as guidance in designing dialogues, which is aligned to the goal of the chart. Fourth and last, it was mentioned that the tool simplifies decision-making for less-experienced (institutional) designers.

The recommendation to use drawing on a paper version of the MC must be taken into account for future application. Creating options to physically 'puzzle' within the diagram could improve its impact as a tool. The same holds for creating support in the board to use the MC, use it as guidance in designing dialogues and as support for less-experienced decision-makers; these factors are taken into account for future application.

6.4. MC as a method: Researcher

When employing the morphological chart for discovering the flexibilities in the design space for public procurement processes, the researcher encountered aspects requiring improvement for the application for institutional design. These "struggles" are found to be either based on the design of the MC or its content. In this section these struggles will be addressed and, if possible, a solution or mitigating measure will be suggested.

6.4.1. Design

Apart from the principles of the morphological chart, the diagram must adhere to certain guidelines as well, as explained in Chapter 6. One of these guidelines is the degree of readability. This aspect refers to the level of usefulness of the diagram and if it can be independently used as an institutional design tool. Improving readability includes many aspects and has been done during the development of the MC, but also some aspects have been identified to be of importance for future application, which will be elaborated on below.

Order

As can be read in section 6.3.2, the order of categories and means has been mentioned and observed to be of importance to the use of the MC. Respondents point out that the order of categories should be based on the decision-making process as much as possible; design choices to be made first, should be presented at the top of the MC to the 'last' design choice to be at the bottom of the diagram.

To meet the remarks made, the categories are ranked in such a way that the order of decision-making in reality is approached as much as possible, as far as this can be determined when designing the MC. However, complying with the readability condition of the MC (see: 6.2) has resulted in the introduction of chapters in the MC. If the sequence of categories is changed to meet the 'real' decision-making order these chapters will be tangled and overview is lost.

A trade-off between this feedback and readability leads to the conclusion that readability is preferred to real order. Underlying this choice is the difficulty to determine real order in decision-making, which means that even if this would be preferred over readability a certain order cannot be substantiated. Therefore, the chapter format is preserved and within these chapters it is attempted to approach reality when ranking the categories.

Diminished attention

Following up on the order, the researcher noticed the remarkable trend of respondents to pay most attention to the first means of the MC. During the interviews, the MC was printed on an A3-sized paper which, unintentionally, made it more obvious to the researcher what part of the diagram was payed attention to mostly. It could be clearly seen that respondents read and reacted most to the 'left side' of the diagram, being approximately the first six means of each category, which

caused an outlier like the category *Sub-awarding criteria* not to be read often. Based hereon it could be argued that an outlier is not preferred as attention diminishes, which affects the results of the tool.

Moultrie (2016) states that preferably no more than ten means should be included, which would reduce the means of *Sub-awarding criteria*. Still this would be too much compared to other categories in this research, when taking into account the diminishing attention of the interviewees. It is therefore suggested to approach a rectangular shape of means in which anomalies are avoided as much as possible.

Even though this shape is preferred to create effective use of the MC in which all means are equally weighted in the design, removing means results in a violation of the principle of being collectively exhaustive. A measure offering prevention here for is the introduction of a collapsing mean. Such a mean represents the means skipped in a category as these are assumed to be common knowledge in the sector. This collapse takes care of means to not be shown, but 'hidden', making room for the inclusion for the means on which the design is focused. In the section Overall modifications, this is done for the category *Sub-awarding criteria and means* (See: 5.3.1) by replacing the basic sub-awarding criteria in the collapsing mean *Other*. By including this mean and its hidden layer, the principle of collectively exclusiveness is not violated.

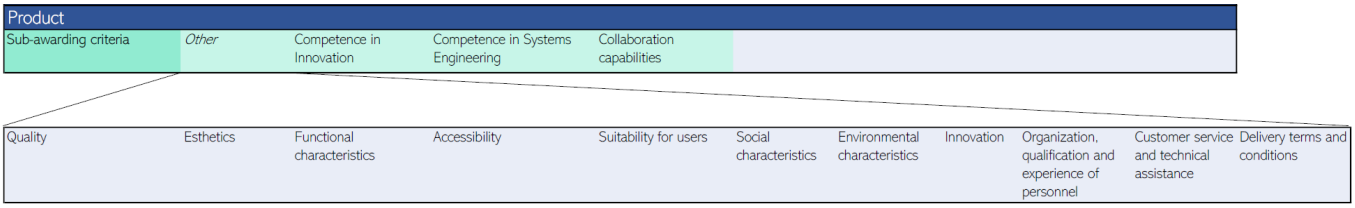


Figure 6.1: Collapsing Mean

It must be pointed out that the introduction of a collapsing mean must be executed consciously. In case an outlying category consists of means not being considered to be common knowledge in the field, this mean cannot be used. If in this case the collapsing mean would be used and means to be considered in the design would be left out, the methodology would defeat the purpose of the chart: to give insight into the institutional design space.

Merging categories

A trade-off between improving readability and violation of the mutually exclusiveness principle also emerges when considering to merge multiple categories into one. Combining mutually exclusive categories into one results in a violation of this exact principle. On the contrary, if multiple aspects are binary, existent or non-existent, and fall under the same topic, including each aspect separately then leads to an extensive amount of rows in the MC. Also, including these binary aspects in individual rows adds comparably low informational value to the design, only to avoid violation of mutually exclusiveness.

This is were the introduction of multiple choice is created. When a category is marked as multiple choice this actually represents binary categories that were merged. As shown in figure 6.2 this consolidation results in one line representing a topic, in this case *Specifications* of which each 'mean' is a separate, binary aspect, which is either existent (chosen within design) or not existent (not chosen in design). This is highlighted in the MC by using a different shade of color to mark the difference between these and general categories. This way, including multiple choice functions as a method to enhance readability whilst not violating the principle.

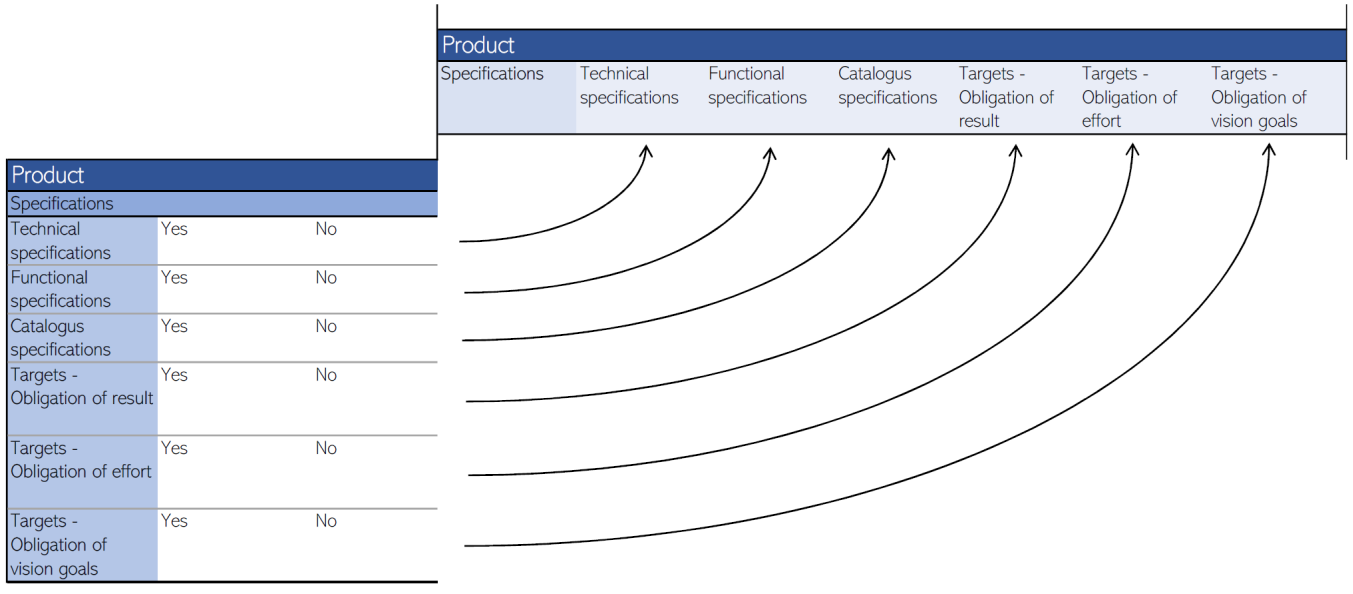


Figure 6.2: Merging Categories

Detailed descriptions

When designing and developing, the temptation exists to include definitions of topics, more details or specific information in cells of the chart, mostly for means. Though including too much text in the morph chart must be avoided as it will expand the diagram to an incomprehensible size, detracting from its readability.

Types of text to be included are: details to a mean, distinctive information about two similar means, contextual factors concerning the topic and relational data of a mean to other means. To regulate this, the following strategy is chosen: each category and mean is mentioned by its topic, so the definition only, which is as short and summarized as possible. Only if more detail is required to emphasize a distinction between multiple means, this can be included in small text in the cell. In all other cases, the options, mentioned in section 6.3.1, must be considered.

6.4.2. Content

In the section above attention was given to the more physical aspects of using the MC. In this section however, the focus is on the mean and category content.

Informational value

Earlier, the informational value as a guideline for the MC has been elaborated on in 6.2 Characteristics MC. When developing and finalizing the researcher has been taking this into account, which resulted in the notion that continuous evaluation of the structure of categories is required. The informational value is not only aimed to review the additional quality of each mean, it must also account for the (re)assessment of the structure of categories. When adding, changing, deleting and splitting means and categories, the overall result for each category must be analyzed and adjusted accordingly.

In the MC created in this study the category *Contract type* was initially included. After several modifications, additions in this instance, it became clear that the options for this category were quite limitless. As long as the contract explained clearly what was asked, why and how it was permitted. This meant that including the contract type with its means being specific contract types was not covering reality. The informational value of this category was low as it did not present the full available design space. Instead of the specific contract type it arose to be more interesting to just know which procedure steps were included in the contract. Therefore, the category was changed to *Contract scope*, with its means being the possible stages to be contracted, which also caused the category to change to multiple choice. This (re)assessment of each category reaching its goal increases the informational value.

External impacts

As the diagram is meant to design institutional concepts by systematically exploring the design space, it means only factors to be in the procurer's scope of influence can be included and all else is left out. Nevertheless some omitted factors appeared to have a decisive impact on the design, which made their exclusion seem spurious.

This has been handled by introducing a new chapter type in case these omitted factors had both a decisive impact on the design and to be indirectly influenced by the procurer. This new chapter is called *External impact* and functions similar to the other chapters, apart from its categories being of a different nature. It needs to be said that including categories in the *External impacts* chapter must only be done after careful consideration: inclusion should be restricted to those factors that cannot be left out.

Input variables

When designing institutional concepts, a variety of variable types must be able to be included in the diagram. In current use, the morph chart is filled with independent design concepts of sub functions of an equal abstraction level (see: 6.2). This is done by either drawings or short text in the cells. Deploying this diagram in an institutional context though leads to the necessity of including different types of variables as well. For variables of a nominal character this appeared to be quite straight forward. However, difficulties arose during this research when trying to include variables with a non-nominal character, being ordinal, interval or ratio (Stevens, 1946). A solution to introduce these variables in the MC as well, is required. The visualization used to do so can be found in Appendix F.

Moultrie (2016) describes the morphological as to be a "visual way to capture necessary product functionality" and also emphasizes sub-solutions should be made visual wherever possible. Although most institutional sub-functions can not be illustrated in the MC without losing its informational value, visual representation could be the solution for the variables of a non-nominal character.

6.5. Application design MC

Morph Chart - Definitive									
Impacts									
Phases of Technology Readiness	Discovery phase (TRL 1,2 and 3)	Development phase (TRL 4,5 and 6)	Demonstration phase (TRL 7 and 8)	Deployment phase (TRL 9)					
Product									
Scope of product	Total asset	Innovation only	Research and development of innovation	Asset in parcels	Asset and innovation in different parcels				
Delivery	Batches	Batches with increasing, iterative development	Complete delivery with ex-post adaptations per batch	Complete delivery					
Start usage	In batches	One by one	All at once						
Innovation development	Incremental innovative nature	Parallel development innovative product	Upfront development	No development					
Testing innovation	Pilot - Digital (Testing of one/a few innovations)	Pilot - Real life (Testing of one/a few innovations)	Living lab	No testing					
Sub-awarding criteria	*Other*	Competence in Innovation	Competence in Systems Engineering	Collaboration capabilities					
Specifications	Targets - Obligation of vision goals	Targets - Obligation of result	Targets - Obligation of effort	Functional specifications	Technical specifications	Catalogus specifications			
Contract									
Contract scope	Collaboration	Research	Engineer	Design	Construct	Finance	Maintain	Operate	Terminate
Procurement tools	Framework agreement	Market consultation	Dynamic Purchasing System	Electronic Auction	None				
Financial structure	Dedicated innovation budget	Procurer's contribution (Remove unprofitable peak)	Financial alliance (Collaboration similar parties)	Co-financing (Collaboration parties fulfilling different roles)	Co-financing - EU Subsidies	Pre-commercial purchasing	Contracting body pays remuneration to producer		
Financial distribution over time	Flow of financial resources during the process	All financial resources available upfront	All financial resources available at completion	No financial resources to be received					
Eligibility requirements	Financial and economic capacity	Technical competence	Professional competence	Professional qualification					
Selection criteria	Size of company	Amount of references	Type of references	Quality of references	Quality of resumes				
Contracted future modifications	Changes in legislation	Defined technical alterations	Accidents concerning product	None					
Innovation clause	Hourly rates for types of modifications	Price tag catalog for components	Right to benchmark modification plan in the market	Right to have a third party check modification plan	Surplus taken into account	None			
Contracted initiative for innovation and optimisation	Latest-and-Greatest technology requirement	Contractual innovative clause	Periodical innovation proposal	No initiative					
Awarding criteria	Lowest cost (Based on cost effectivity)	Price-quality ratio	Lowest price	*Exemption ground (Only in case of the exemption ground as procedure)					
Procedure type	Competitive dialogue	Innovation partnership	Call for innovation	Exemption ground for research and development*	Competitive procedure with negotiation	Negotiated procedure with prior publication	Contest	Public procedure	Non-public procedure
Limitation of applicants	Selection of best candidate	Two rounds of gradual reduction	Multiple rounds of gradual reduction						
Market approach									
Volume	Total necessity	Partial necessity							
Duration	Full term	Mid term	Short term						
Nature of co-operation	Partnership (All chain partners)	Partnership (Multiple partners)	Partnership (Two partners)	Procurer - Supplier					
Hierarchy of relationship	Horizontal	Vertical							
Management relationship	Collaboration manager	Specifying interaction	Language used	Dialogue on mutual understanding of contract	Via contact person				
Risk determination	In collaboration	Supplier(s)	Procurer						
Risk mitigation	Focus on process and collaboration	Focus on achieving specified objectives							
Risk profile	Bandwidth value	Fully covered profile							
Additional organizational structure	Building Team	International collaboration	Knowledge alliance	Purchasing alliance	Mixed team	Two-phases approach	None		
Ownership innovation	Supplier - *Usus fructus*	Supplier - *Usus*	Supplier	Procurer	No innovation				
Intellectual property	Supplier - *Usus fructus*	Supplier - *Usus*	Supplier	Shared with market	Procurer	No innovation			
System integration	Independent team coach	Procurer's responsibility	Supplier's responsibility	No integration					
Continuity teams involved in procurement - asset management	100 90 80 70 60 50 40 30 20 10 0			Units: Overlap percentage [%]					

Figure 6.3: Definitive MC: Found Methodological Principles Applied

6.6. Validation of usage

Validation of the use of the morph chart is done by the organization of a focus group (see: Appendix G and leads to the outcome that the MC serves as framework for institutional design successfully, which is discussed as follows:

Understanding and interpretation: While some participants express uncertainties about interpreting certain categories and means, the majority demonstrates a comprehensive understanding of the MC methodology. They have familiarized themselves with the MC principles explained in the introductory video, using the tool freely whilst aware of its underlying principles. Even the deployment of multiple choice options within categories is correctly done without any additional explanation [FG1; FG4; FG13]. Notably, a difference in the interpretation of 'innovation' exists among the participants, with one holding a distinct interpretation compared to the rest of the group. Yet, such differences are resolved through discussions, ensuring aligned understanding of definitions and interpretations [FG8; FG9].

Challenges and clarifications: Some participants find complexities in applying the MC within the context. However, upon further questioning it becomes apparent that their questions reflect a thorough understanding of the MC. The difficulties arise from doubts concerning which means in the morph chart will lead to enhancements [FG2; FG7].

Diverse perspectives: The participants experienced difficulties when attempting to translate their individual perspectives to the analysis of the chart. It becomes evident that the selection of means is not just reliant on the process party one is part of, but also on the specific role fulfilled within that party. This variety of design choices supports discussion and therewith substantiated decision-making [FG5; FG6].

Enhanced clarity and insight: The use of the morphological chart supports explicitly delineating choices, providing insight into decisions and the underlying reasoning. It sharpens discussions, encourages critical self-reflection and triggers the exploration of alternative approaches of process design [FG14; FG16; FG17; FG18; FG19].

Presentation: The visual representation of the MC is evidently clear and comprehensible, as it did not result in any question or uncertainties being raised by the participants. However, the individual presentation of the design lines was perceived to be complex. Isolation of means from different categories within each design line, the contextual information required for better understanding is eliminated. Furthermore, the contrast between means belonging to the same category provides a more nuanced interpretation context, aiding in better understanding and evaluation of the options available [FG10; FG12].

Processing: The MC involves much information and poses a brand new design methodology to experts part of a sector in which institutional design is not a known topic, even a systems engineering-like approach might be new to some. It has been shown that upfront introduction bears fruit, but respondents still need time to carefully read and process the MC, the design lines and questions asked [FG3; FG11].

Positive reception and interaction: Overall, participants find the meetings stimulating and beneficial. It was stated that the MC supports critical thinking and enhances decision-making. Moreover, the desire is expressed to continue discussions based on the MC and emphasize the effective interaction that arose among participants [FG14; FG15; FG20].

All together, despite initial uncertainties and unaligned interpretations, the MC proves to be an effective framework for institutional design. It encourages discussions, supports a critical evaluation of current and future design and facilitates explicit decision-making. It creates a collaborative and interactive environment enhancing informed decision-making processes.

6.7. Takeaways chapter 6

The main takeaway of this chapter is that the morph chart proves to be a successful methodology to be applied for institutional design. The morphological chart is a product design tool used for systematic exploration of design space. Since this research aims to explore the design space for flexibility in the PP process, the usage of the MC is tested in this institutional context and has proven to be a successful. It shows to be a systematic and concrete design tool functioning as guidance in discussions on institutional design.

SQ 2: *How can the morphological chart be used for systematic institutional design of a PP process with enhanced flexibility?*

Answering this sub question requires specifying the continuities of the morphological chart and the modifications made to this tool to make it appropriate for institutional design.

When deploying the MC for institutional design, the principles of the chart as engineering design tool, being *mutually exclusive* and *collectively exhaustive*, must be upheld. The same holds for the four, in this research formulated construction rules, being readability, within scope of action, abstraction level and informational value.

Furthermore, this chapter has provided insight into what must/can be done to support the MC as design tool in this context. First, as adding more categories to the chart requires structure to sustain overview, chapters can be added to support readability. The same can be done for external impacts which are out of scope but cannot be ignored because of their informational value. Also, changing categories to be multiple choice is a new option as to increase readability.

Another aspect which requires attention is the order in the chart. Means on the left side of the MC get most attention of users and so these are considered more in the design. Means with high informational value should therefore be mentioned first. The order of categories must approach the real decision-making process as much as possible, to make the diagram more tangible and easier to understand, improving its readability. Additionally, a rectangular shape of the MC must be aimed for since outliers are often not considered in the design.

To further improve the use of the MC for institutional design, it should be researched how better communication of the principles of and definitions in the chart can be communicated. Also, no method to represent relations between means has been found yet.

The morph chart including these adjustments to its methodology has been validated.

7

Trends for flexibility

Based on the interviews held, the morphological chart has been developed into its final form, content wise in Chapter 5 and as a methodology in Chapter 6. Though, the interviews did not only capture input on how to improve the chart, but also generated data on certain combinations of means. The data collected on relations between means was put together for analysis (see: Appendix B and C).

Based on the flexibility trends found herein, conceptual design lines were created. Earlier it was mentioned that the MC is unable to show relational aspects amongst means in its current form. However, when using the general application of the MC by drawing conceptual designs 'themes' identified in the interviews can be presented. This way the 'coloring' to be derived from the gathered expert knowledge can be presented. This results in the creation of six design lines, which will be explained in section 7.1. Following, an overview of these design lines is presented in section 7.2.

For the use of the MC and these design lines, validation is required. To do so, a focus group was organized with public procurement experts of the NS, all involved in the process from a different perspective. In Appendix G an elaboration is given on the structure of this focus group, the preparations and trade-offs made. This collaborative approach supports the researching the usability of the diagram and additionally tests if the MC reaches its final goal, providing structured guidance in the discussion on flexibility in PP. Furthermore it allows to collaboratively explore a future design concept for the procurement process of the NS. The validation of these trends as a result hereof is elaborated in section 7.3.

Lastly, a classification of the resulting design lines is presented. This distinction is made based on the characteristics of each individual trend and aims to prepare overview as well as clear allocation and delineation of the objective of each design line. These insights enable answering sub question 4 specifically, by diving deeper into what the conceptual designs aim to improve or represent and determining which improve flexibility in the PPP. In Chapter 8 these design lines are used to provide structure to a first exploration of how the morph chart as a design tool can be deployed for the NS and what a possible future design for the NS would look like.

7.1. Creation design lines

In this section the design lines created based on the interviews are presented. When analyzing the interview data five different themes could be identified, being: traditional, only procuring an innovation, collaboration between procurer and supplier, international alliances and network products. Each of these themes has been translated into a design line. A collaborative approach of procurement has been mentioned in many forms and applications and is therefore transformed into two design lines. *Collaboration Light* presents a mild collaborative approach allowing for more flexibility in the process, where *Collaboration Plus* shows an even more non-traditional design concept, changing the approach of current procurement procedures radically.

A short explanation will be given of each design line and what it aims to represent. Two things have to be noted in that context. First, these five aspects leading to six design lines have been chosen as main themes and represent a substantial part of the interview data gathered. However, to avoid overwhelming amounts of lines for validation, not all mentioned themes have been worked out in a design line. Second, the design concepts are presented based on the factors perceived as 'flavour' to the design. The other categories have not been presented in the design, but means are to be chosen from those as well to complete the design.

A few categories have been left out of this design as these have simply been identified to expand the design space for more flexibility in the contract. A specific relation of these categories to other means has not been found. This mostly accounts for multiple choice categories. Since these categories enable 'combining' more means shows already that these means do not necessarily exclude other means and can easily be combined with other means.

7.1.1. Design line 1 - *Traditional*

The first design line to present is named *Traditional* and consists of factors being found to belong to a more traditional approach. Internal documentation of the NS was used as a starting point for this construct and this was supplemented with expert data in which statements were made about a more classic approach to tendering. This design therefore differs

slightly from the other design lines as they are completely based on expert data. However, it is considered valuable to use this approach in order to generate more insight into the development being made compared to the current approach.

Design Line 1: Traditional						
Product						
Scope of product	Total asset	Innovation only	Research and development of innovation	Asset in parcels	Asset and innovation in different parcels	
Specifications	Targets - Obligation of vision goals	Targets - Obligation of result	Targets - Obligation of effort	Functional specifications	Technical specifications	Catalogus specifications
Contract						
Financial distribution over time	Flow of financial resources during the process	All financial resources available upfront	All financial resources available at completion	No financial resources to be received		
Market approach						
Volume	Total necessity	Partial necessity				
Duration	Full term	Mid term	Short term			
Nature of co-operation	Partnership (All chain partners)	Partnership (Multiple partners)	Partnership (Two partners)	Procurer - Supplier		
Hierarchy of relationship	Horizontal	Vertical				
Risk mitigation	Focus on process and collaboration	Focus on achieving specified objectives				
Ownership innovation	Supplier - *Usus fructus*	Supplier - *Usus*	Supplier	Procurer	No innovation	
Intellectual property	Supplier - *Usus fructus*	Supplier - *Usus*	Supplier	Shared with market	Procurer	No innovation

Figure 7.1: Design Line 1: Traditional

When taking into account the purchasing of a train, currently this is procured in total, meaning the asset is not split in parcels for the procurement. Also, this procurement process beholds a long-term duration for the contract, the full life-span of the product [1AA; 1J; 1W; 4A; 7A]. Further, the innovations arising in this context are part of this, which means the procurer automatically receives ownership of innovations and its intellectual property.

Currently, functional and technical specifications are used mostly to define what should be offered by the supplier in their bid and eventually the realized product [1L; 4C; 4H; 4L; 7HH]. Specifying in this detailed manner leads to risks being mitigated by a focus on achieving what has been registered in the contract, the specified objectives.

The internal documents were interpreted in such a way that it is assumed that the financial distribution over time takes place by all financial resources being available at completion. Concerning the nature of the co-operation, this is a classic procurer-supplier relation of a vertical hierarchy [8D]. This mostly results from the use of procedures such as the negotiation and (non-)public procedure [1R, 1S; 2V, 7E].

7.1.2. Design line 2 - *Innovation Only*

Design Line 2: Only Innovation						
Product						
Scope of product	Total asset	Innovation only	Research and development of innovation	Asset in parcels	Asset and innovation in different parcels	
Innovation development	Incremental innovative nature	Parallel development innovative product	Upfront development	No development		
Testing innovation	Pilot - Digital (Testing of one/a few innovations)	Pilot - Real life (Testing of one/a few innovations)	Living lab	No testing		
Specifications	Targets - Obligation of vision goals	Targets - Obligation of result	Targets - Obligation of effort	Functional specifications	Technical specifications	Catalogus specifications
Contract						
Procurement tools	Framework agreement	Market consultation	Dynamic Purchasing System	Electronic Auction	None	
Financial structure	Dedicated innovation budget	Procurer's contribution (Remove unprofitable peak)	Financial alliance (Collaboration similar parties)	Co-financing (Collaboration parties fulfilling different roles)	Co-financing - EU Subsidies	…
Financial distribution over time	Flow of financial resources during the process	All financial resources available upfront	All financial resources available at completion	No financial resources to be received		
Procedure type	Competitive dialogue	Innovation partnership	Call for innovation	Exemption ground for research and development*	Competitive procedure with negotiation	…
Market approach						
Volume	Total necessity	Partial necessity				
Additional organizational structure	Building Team	International collaboration	Knowledge alliance	Purchasing alliance	Mixed team	…
Ownership innovation	Supplier - *Usus fructus*	Supplier - *Usus*	Supplier	Procurer	No innovation	

Figure 7.2: Design Line 2: Innovation Only

The second design line created is named Innovation Only and as the name suggests presents means related to procuring an innovation individually, apart from a related asset [6BB]. Choosing to set the scope of the product to just the innovation is done to establish upfront development, to mature the new product before procuring the related asset starts [6EE]. Detachment of these procurement procedures guarantees innovation performed by a specialized supplier and the possibility to purchase what is developed [2E]. In case upfront innovation did not (yet) lead to the solution living up to the set goals, further development can be continued, even if the procurement of the main asset already started [6FF].

Testing is required when innovating, which can be done easily in advance. The real life pilot is often applied in this context offers the opportunity to physically analyze and evaluate such development upfront [6S; 2U; 6GG; 8DD].

Specifications

Since procuring innovation individually asks suppliers to bring up creative solutions, the specifications must allow a certain degree of freedom. Otherwise innovating would not have been necessary. The procurer must therefore use specifications in which the function of the to-be-designed product has to fulfill (functional), or even what needs to be reached (obligation of result) or what needs to be done at least (obligation of effort). High-level specifications, as the three options mentioned, can be used here for, aiming to provide clear goals but leaving room for suppliers to think along [6G; 6II].

Procedural aspects

Growing creation of such novelties can best be done by choosing the innovation partnership as a procedure, especially because this type is easy to be interweaved with other procurement procedures [5DD; 6S]. Combining this practice with a frame work agreement is mentioned to grant flexibility by requiring a a global description of the procurement objective without immediate need for shaping it directly [2Q; 4CC; 6KK]. This agreement is used in the commercial phase of the partnership [3RR] and mitigates risks by learning during the process and improving jointly, supplier and procurer [5JJ]. However, EU Directive 2014/23 (2014a) restricts the use of the framework agreement to four years, but for PP within the special sector (European Parliament and the Council, 2014b) this is set to eight years, which causes less limitations for the application of this procedure within the special sector. However, the result is that the frame work agreement increases flexibility and even though this is less for the special sector, it does introduce a time limitation [7N]. Nevertheless deploying the framework agreement when procuring innovation only is advised [6LL].

Finances

Furthermore, having a dedicated innovation budget is required for individual procurement [3SS; 6OO] of which is it mentioned that is important to adjust the flow of financial resources during the process to align with what is required on suppliers side, provided that the supplier substantiate this application [6L].

Uncertainty

Apart from the fact that procuring innovation separate from the main asset already can be considered to be the purchase of partial necessity, in this design line this choice for volume is meant differently. It is mentioned that often just a part of the necessary volume of the newly developed product is procured, mostly to overcome uncertainty. This uncertainty is two-folded. First the outcomes, success rate, of the design is unsure and second the possible growth of the market cannot be fully determined upfront. This could lead to a future vendor lock-in; being stuck in a contract with a certain supplier whilst the market possibly offers better quality and lower prices in the future. Mitigation of the risks related to this uncertainty can be done by procuring the partial necessity [3KK; 3VV; 6WW]. Combination with the frame work agreement can overcome the risk of ending up with a different supplier after the next procurement of the remainder [2AA].

Knowledge alliance

Another mitigation of the risk of a vendor lock-in is the use of a knowledge alliance, in which multiple suppliers are jointly involved in designing the innovation [3Y]. This enables learning of all these parties simultaneously [3Z; 3BB]. Additionally, the ownership of the innovation is on supplier's side and allows spin-offs to emerge in the sector [3OO; 8H]. Though it is required that the acquired knowledge is shared with other suppliers, but the alliance has a head start as an incentive to innovate [6PP].

7.1.3. Design line 3 - *Collaboration Light*

A brief explanation is required here, as there are two design lines focused on collaboration. During the analysis of the expert data, it was clearly observed that many 'colorings' of the morph chart were aimed at collaboration. There are clearly gradations in this, from subtle adjustments to the more 'classic' procedures (see: 7.1.1 Design Line 1) to a total change in the view of public procurement. However, a clear division into themes could not be easily indicated. It was therefore decided to draw two collaboration concepts: *Collaboration Light* and *Collaboration Plus*. In *Light*, means are indicated that mildly represent the observed trend towards cooperation. In *Plus*, a number of these choices have been kept the same, but a number of adjustments have also been made. These changes outline a more radical conceptual design. Both versions are explained below, with *Plus* the focus is on what is different compared to *Light*.

Design Line 3: Collaboration Light						
Product						
Scope of product	Total asset	Innovation only	Research and development of innovation	Asset in parcels	Asset and innovation in different parcels	
Specifications	Targets - Obligation of vision goals	Targets - Obligation of result	Targets - Obligation of effort	Functional specifications	Technical specifications	Catalogus specifications
Contract						
Eligibility requirements	Financial and economic capacity	Technical competence	Professional competence	Professional qualification		
Procedure type	Competitive dialogue	Innovation partnership	Call for innovation	Exemption ground for research and development*	Competitive procedure with negotiation	…
Market approach						
Volume	Total necessity	Partial necessity				
Duration	Full term	Mid term	Short term			
Nature of co-operation	Partnership (All chain partners)	Partnership (Multiple partners)	Partnership (Two partners)	Procurer - Supplier		
Risk mitigation	Focus on process and collaboration	Focus on achieving specified objectives				
Ownership innovation	Supplier - *Usus fructus*	Supplier - *Usus*	Supplier	Procurer	No innovation	

Figure 7.3: Design Line 3: Collaboration Light

The third design line drawn is called *Collaboration Light*, a theme describing a general focus on changing the approach of procurement from a quite transactional character towards a process based on a partnership between involved parties.

Size

Since engaging in such a collaboration requires time and effort [8LL], the total asset is procured in this design line. This is related to the duration and volume of the contract to be concluded [8K; 8W]. Investing in a partnership is only worth it when applied to contracts on large volumes (full necessity) on a long term (full term) [4OO].

In case not the full necessity is procured, again the risk for a different supplier exists when a subsequent process is set out in the market [2AA]. Also, it is assumed to give the best deal to procure full necessity at once, since synergy and scaling advantages are not missed out on [7QQ; 8Z]. This is strengthened by the notion that a certain volume allows investments in development from suppliers side as well [8Y].

Additionally, the same line of reasoning is used for the duration of the contract, being full term [4OO]. Accumulation of project experience and knowledge should not be wasted by shortening the contract duration and be used to inspire further development during later phases [8W]. This learning effect should be protected [8K]. Also, a supplier needs commercial certainty, especially in contracts requiring much effort upfront [8PP].

Ownership

Considering the ownership of the innovation in this context, leads to even more support of a full term duration of the contract. Establishing ownership of innovation is important and must be determined as early on in the process as possible, since this avoids discussion later on and supports involvement of the supplier early on [3T; 3U]. Enabling early determination advocates for a full term contract [3X; 3S].

Apart from this context, the ownership of innovation is important to this conceptual line on collaboration. The ownership must be with the suppliers as it puts incentives on the supplier to deliver the most optimal development, results, management, maintenance and operation [3JJ; 4GG; 7SS]. On the contrary, the supplier receives substantial support for the innovation development. This creates a win-win situation, in which the procurer innovates and the supplier learns and exploits the result [5K]. Establishing the incentives in such a way that profitability is guaranteed for both parties is important [8G; 7T].

Partnership

Another aspect of the collaborative design is the definition of the procurement objective. The aim of collaboration is to jointly work towards achieving a set of common goals without the necessity to board up the contract to account for possible future changes. This approach offers flexibility to the process when including specifications aligned with this perspective. It means sufficient room has to be included in the contract, which can be done by using high-level specifications focused on functional objectives (Functional and Obligation of vision goals and results) [3NN; 4B; 8HH]. This leaves room for the supplier to come op with their design best able to fulfill the procurer's objectives, instead of detailed description of what the solution must be, bringing together demand en supply [2C; 3G; 6W].

In this design line focus must be on the financial and economic capacity as an eligibility requirement. When entering such a partnership, the procurer must ensure the supplier having a healthy proposition, healthy margins. This financially robustness is a vital condition to the collaboration, especially in long-term, high risk contracts [5R; 7TT].

The procedure enabling this partnership best is the competitive dialogue [2C; 2V; 3E]. Before deciding with whom to enter into collaboration, a thorough exploration of the market must be done. This can best be done by entering the competitive dialogue, to see what these parties come up with. It offers flexibility to the supplier in suggesting solutions to posed challenges [2C; 2V] and enhances improved mutual understanding and results in the supplier being imbued with the program objectives of the procurer [8LL].

All in all, this leads to the nature of the co-operation to be a partnership between procurer and supplier. As mentioned earlier in relation to this design line, the transactional character shifts towards a partnership in which procurer and supplier leave their fixed 'positions' and start being partners in collaboration [5K].

It must be noted that yet no explanation of the inclusion of focusing on achieving specified objectives is given. This way of risk mitigation is part of the *Collaboration Light* design to highlight the contrast between this design and *Collaboration Plus*, of which an elaboration will be given below.

7.1.4. Design line 4 - *Collaboration Plus*

The design line *Collaboration Plus* follows up *Collaboration Light* and is the more radical version of the two. As mentioned before, some aspects have not changed from *Light* to *Plus*, being:

- Scope of product: Total asset
- Eligibility requirements: Financial and economic capacity
- Volume: Total necessity
- Duration: Full term
- Ownership innovation: Supplier - Usus fructus

Regarding the specifications, a small adjustment has been made, which will be explained.

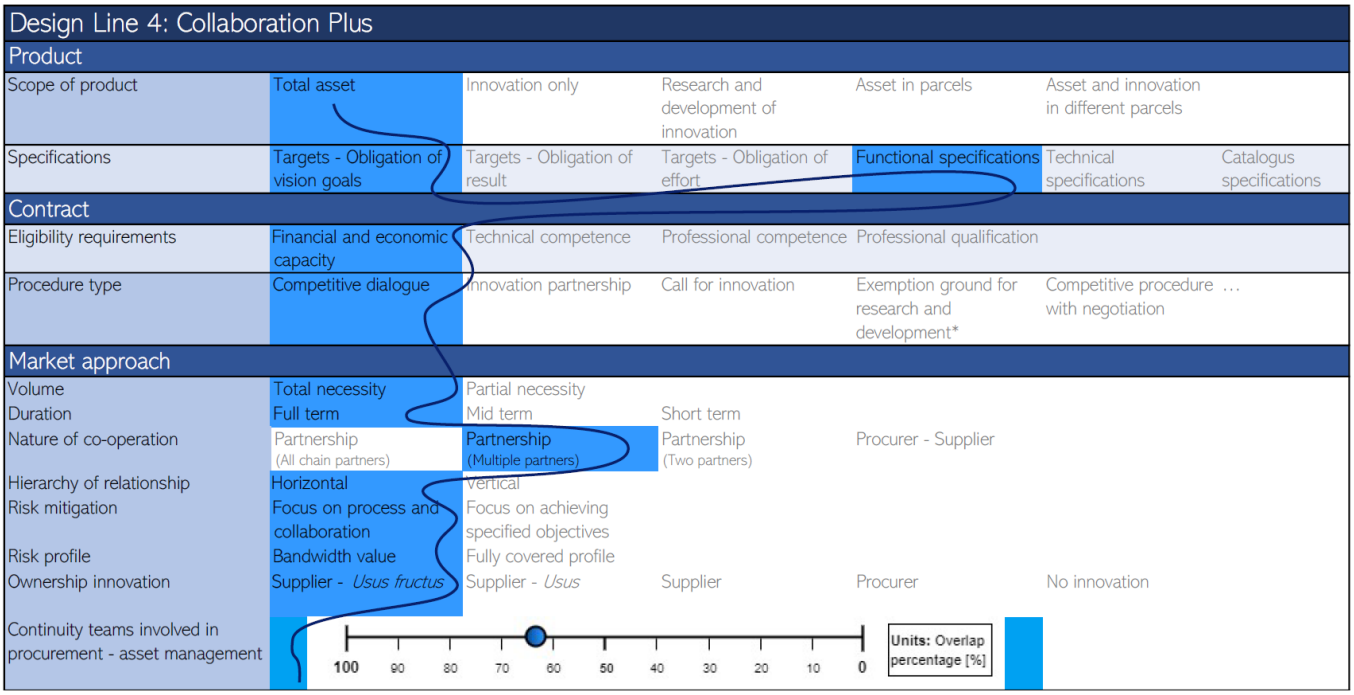


Figure 7.4: Design Line 4: Collaboration Plus

In *Collaboration Plus* the same type of specifications are used, being the obligation of vision goals and functional specifications. Though, the obligation of result is skipped in this concept. This is done because in relation to more extreme, radical collaborative procedure designs the vision goals and functional specifications were still mentioned, but specifying targets for results was left out [8L; 8F]. The focus was mainly on specifying the vision goals to enhance flexibility most [3M; 4FF; 7T; 8F].

Collaboration

More flexibility is also provided by including multiple parties in the co-operation [5M], which approaches a system engineering-based approach of joint commitment. Forming one team with involved parties changes the approach of collaboration from a traditional procurer-supplier relation to an integral approach of cooperatively reaching the objectives aimed for [8D; 5O; 5TT; 5L]. This leads directly to the hierarchy of the relationship, which is in this design line fully focused on a horizontal connection between partners. Having a vertical relationship automatically resulted in a rigid approach [5O], whilst flexibility is required [5TT]. A horizontal approach in collaboration is important [5SS; 8D], which is an innovation in itself [5R].

Risk

As described in 7.1.3 Design Line 3, risk mitigation can be done differently in *Collaboration Plus*. In the milder *Collaboration Light* partnerships were supported, but still risks were mitigated by a focus on achieving objectives as written in the specifications. Whereas in the more radical *Collaboration Plus* this has shifted to a focus on process and collaboration [5L]. By recording in the contract how the collaboration will be shaped and what process agreements have been agreed on, risks are mitigated [3I, 8E]. This moves away from the idea that everything has to be boarded up [5Z]. Especially in case of high risks, a high throughput of financial resources and high societal risks, risk mitigation is more important than costs (proportionally) for which extensive collaboration should be used [5S].

Following up on this, the risk profile in this design line is not fully covered but a bandwidth value is used. To determine the risk profile of a bid, a value is determined to be optimal or most likely and after that the lowest and highest acceptable values are set by the procurer. This creates a range of values to be accepted as risk profile, which leaves room for changes and (unforeseen) future challenges and chances [3F]. This has a positive effect on the flexibility in the process.

Involvement

Lastly, the continuity of teams is involved in this design line. It has been mentioned that in order to enhance flexibility and innovation driving forces are of vital importance. People convinced of this new approach, daring to go off the beaten track, are required to make this approach a success [6Y]. This makes such a shift person-dependent [8P], without this type the application of such a radical collaboration comes to a standstill [6N; 6Z]. Such driving forces must also exist on the management level to ensure success of the approach [6X].

Subsequently, it is not desirable that there are many changes in the personnel involved, which has a two folded impact. Firstly, much effort is put into persuasion of newly involved staff, especially on management levels as commitment on all levels is required [6X; 6Y]. This should be avoided as much as possible, but is out of the scope of influence of the procurer. Secondly, if the team concerned with the procurement successfully chooses a *Collaboration Plus* approach, driving forces

exist within the team. To transfer this belief, mindset, to the asset management team taking over, continuation of this drive must be secured. To do so, continuity is important. In an earlier case, a continuation of eighty percent of the teams led to persistence of this new approach [8N]. Such a substantial percentage positively affects the adoption of these ideas and with that the outcomes of the procurement. The link to specifications and bandwidth value must be mentioned here. If procurers choose to hold on to compliance with the detailed specifications, the supplier will adjust their course towards achieving those. People intrinsically motivated to make this approach a success are of vital importance, on both procurer's and supplier's side [8Q].

7.1.5. Design line 5 - *International*

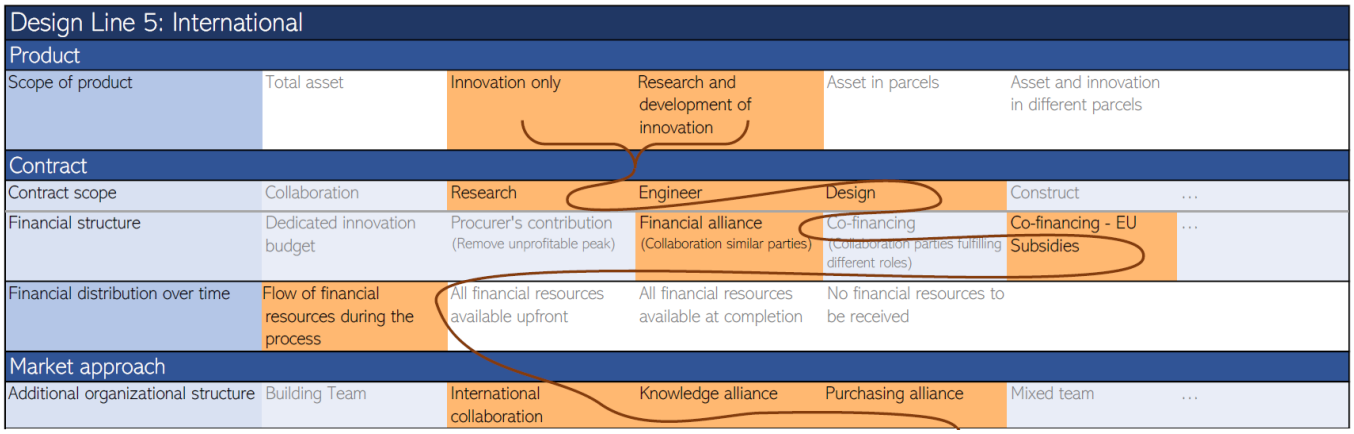


Figure 7.5: Design Line 5: International

This design line presents a quite specific theme identified in the expert data, being the *International* perspective on collaboration in procurement.

It was mentioned that co-operation with similar parties could offer flexibility [4HH, 4JJ]. Entering such a collaboration could be done by creating an alliance. Different options are available to a procurer to do so, being joint financing [4TT], gathering knowledge [6SS] or purchasing [4JJ]. In the design line all three options are included, as all three options are available for exploration in the international context [4II; 4JJ; 4KK]. As explained in 5.2.2 Alliances, the international collaboration has been marked as well, to emphasize the international character of the alliances included.

Innovation

These co-operation structures provide options to procurers to work together in an international context. This has been mentioned to be useful for the procurement of innovation or the research and development of an innovation [7OO] and results in lower transactional costs and an increased sales market [4KK; 6SS]. Additionally EU subsidies can be requested for co-financing of such alliances [4TT; 7NN].

Application of such a cooperation structure has been successfully performed for the research, engineer and design phase. Broader application can be explored, e.g. joint purchase of basic assets with procurer or country specific adjustments afterwards [4KK; 7OO].

7.1.6. Design line 6 - *Product in Network*

Figure 7.6: Design Line 6: Product in Network

Design line 6 has been created based on the last theme identified in the expert data and is named *Product in Network*. This represents the procured product to be part of a network, its functionality and results are largely derived from the network of which it is part. Previous design lines have been based on observed trends in process design, whereas this concept focuses on a process design based on a product characteristic. The identification of this theme is not surprising, as the interviews have been conducted in the context of the rail sector. Though, it must be emphasized that this trend is based on observed flexibilities build in processes of network products specifically, which is different from the other design lines.

Homogeneity

In this design line it is mentioned that the asset should be procured in total, since separating the product into parcels leads to difficult integration. Rapid development of technology part of these products require integral construction [7S], for which the procurer is responsible.

Procurement of the total asset mainly results in delivery in batches forced by production capacity, especially for assets with high complexity [7V, 7CC]. This means that in order to have the products function well in their network, increasing, iterative development must take place in order to keep all products up to date [7A; 7V; 7Z]. Network products are preferably as identical as possible [7CC; 7DD]. Also, this way the risk of the fleet to be (partially) standing still, e.g. because of components that are no longer available [7Y] or changing circumstances during the long-term delivery of these complex products [7X]. Especially this network characteristic affects one change leading to another, which leads to uncertainties and are tried to be overcome by this iteration of development [7B].

The start of usage of these batches can be done in the same manner.Though, in case the network functionality is innovated the results of this innovation rely on the interaction between products in the network [7W]. All products should then be identical, which means they have to be upgraded to the exact same level and taken in use at one moment to support full conversion of the network all at once [7A; 7V; 7W]. The start of usage is therefore dependent on how heavily the results of the network lean on the products being identical.

Testing methods

Testing the developed product as part of the network is of vital importance to its success. Pilots must therefore be executed, both digital and in real life [4SS]. Mostly tests happen to be done in real life, but some test tracks and a test lab are available as well [7EE]. Two examples have been mentioned of piloting with a network product. In the first case this was done by the procurer including an IT-version of the product in the contract, which enabled testing the product before implementing it in the network [7EE]. The second case was a supplier being granted a contract with high-level specifications, e.g. availability. This lead to the supplier building an additional product on their own expenses running in the network to test innovation and optimisations. This was profitable because of the volume and duration of the contract and was enabled by the specifications not defining the number of products but its vision goal, leading to the test product easily being included in the network [7AA].

Updates

To guarantee the network product to be updated to the most recent set up, so that the network is provided with state-of-the-art technology at delivery, the Latest-and-Greatest technology requirement has been introduced [4M]. This requirement secures initiation of innovation and optimisation in the contract. However responsibility still lies on both sides of the contract and attention still has to be paid to remind suppliers of this requirement [4Q].

This Latest-and-Greatest technology defines the initiative and in case a component can be upgraded without additional costs this is supposed to be done, but if extra costs emerge from required engineering or rebuilding, this still needs to be payed by the procurer [4O]. For foreseeable changes, this requirement offers an opportunity to include this in the contract without being specific, whereas this requirement only expands the scope of the contract for unexpected adjustments [4N]. Though, these changes are still within scope of the contract [7C].

Back-up

Additional to this Latest-and-Greatest technology another measure is applied to mitigate risks. In case of radical innovation a back-up option must be available. Total or partial failure of the innovation causes total disruption of the network. The option to deploy the back-up option when the innovation appears not to be successful during the contract is therefore needed. This back-up consists of two designs, one in case the construction phase did not yet start and one for retrofitting an already built train [7J].

7.2. Overview design lines

The six design lines are created and presented individually, but to see how the lines relate to each other an overview is created in the full MC. In figure 7.7 this morph chart is shown.

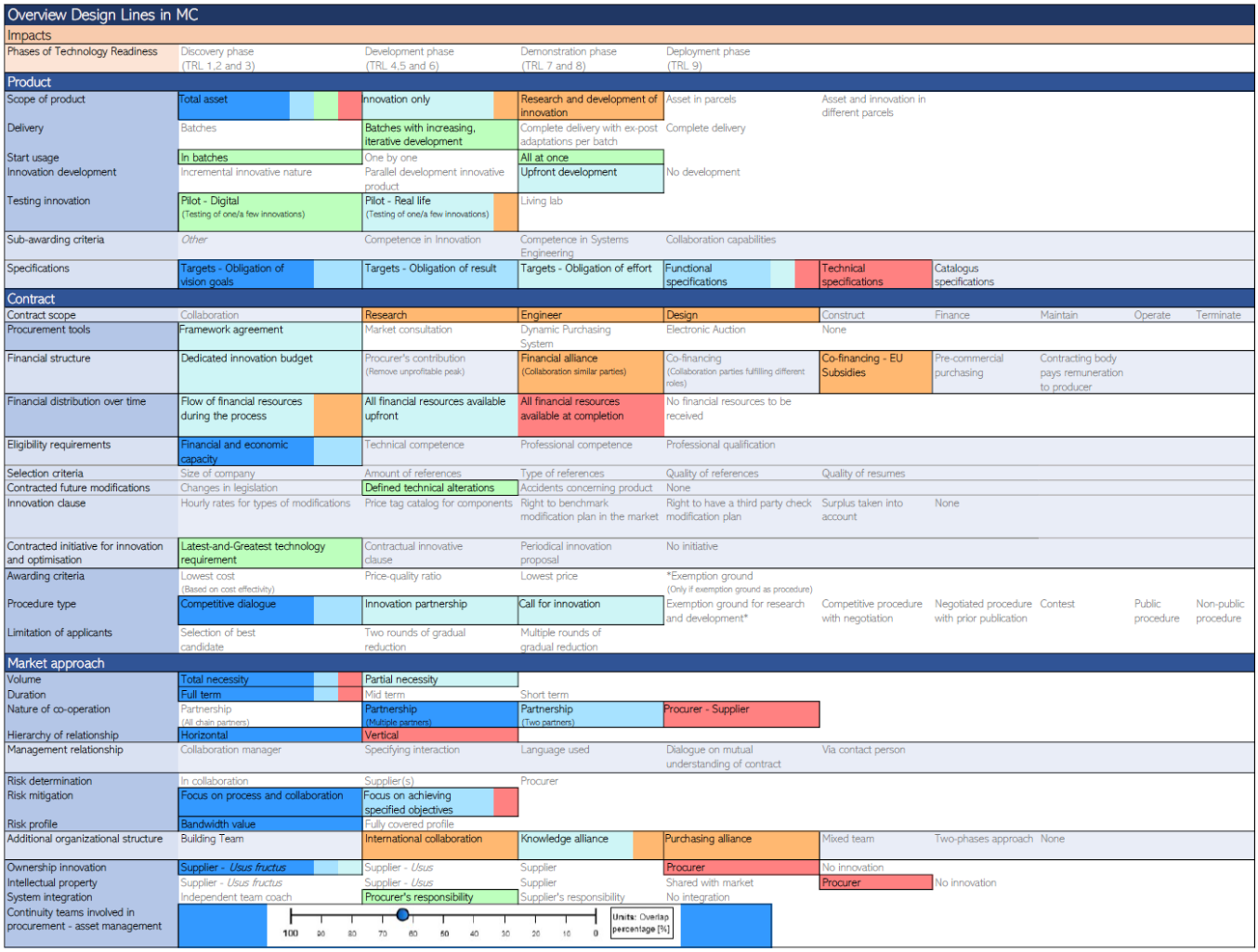


Figure 7.7: Overview Design Lines in MC

7.3. Validation design lines

Initially, all design lines are recognized as a coherent framework of process choices. However, for Design Line 6 *Network Product*, this coherence is not perceived. The name "Network Product" does not adequately inform respondents about the nature of this design line. The understanding that this construct is based on the approach for products with a network function, rather than an individual tendering approach, becomes apparent later in the discussion. It is only then that this design line is well understood. Yet all design lines are validated, apart from some required adjustments, which are set out in table 7.1. For each modified mean it is shown which category it belongs to, the substantiation and effect of the change, followed by the statement supporting the modification made.

Table 7.1: Validation Design Lines - Adjustments

Related category	Adjusted aspect	Reason	Changed to	Statement
DL 1 - Traditional				
Financial distribution over time	**All financial resources available at completion**	This is not a common procedure. In some cases this paying structure is applied, but this is not a common practice.	Flow of financial resources during the process	FG21
System integration	**Procurer**	Not a common practice in reality.	Supplier	FG22
DL 2 - Innovation only				
Procurement tools	**Framework agreement**	Perceived to provide option to procure work without requiring details. Though, a certain quantity is asked from the market whilst there is uncertainty on if this will actually be purchased. It puts pressure mostly on the supplier whilst this is seen as opportunity for joint innovation.	Eliminated	FG25; FG29
Additional organizational structure	**Building team**	Represents the collaborative approach to innovation. Decoupling of design and construction phase is existent both in the design line and the building team.	Added	FG26; FG27
Specifications	**Targets – Obligation of result**	Specifying the result of an innovation to be designed is not feasible.	Eliminated	FG28
Innovation development	**Parallel development innovative product**	Overlap of the innovation development with the starting phases of procuring the main asset is possible.	Added to design line	FG31
Additional organizational structure	**Knowledge alliance**	Supplier does not want to put money and effort into innovation development which is afterwards shared with the market. Focus will shift to more profitable main procurement process.	Eliminated	FG32
DL 3 – Collaboration Light				
Innovation clause	**Right to have a third party check modification plan**	Trust is the basis of collaboration. Involving a third party to check is not perceived suitable in that context.	Eliminated	FG35
DL 5 - International				
Financial structure	**Co-financing – EU subsidies**	Co-financing can and is done by the use of more types of subsidies than just European subsidies.	Co-financing – Subsidies	FG46
DL 6 - Product in Network				
Design line	**DL 6 – Network product**	Confusion about interpretation of design line because of its label. Should provide more clearly that the product is part of a network.	DL 6 - Product in Network	FG49
Specifications	**Targets – Obligation of vision goals**	Global definition of the targets to be fulfilled by the network leaves more freedom to the supplier.	Added	FG54
System integration	**Procurer's responsibility**	The integration of network products is often the supplier's responsibility. Though it is noted that allocation of this towards the procurer could possibly offer chances.	Supplier's responsibility	FG55

7.4. Classification design lines

Looking at the six identified trends, represented in the design lines, a clear classification of the design lines can be distinguished. This section elaborates on this classification in order to better enable answering the main question. This analysis will dive deeper into the aimed effect and suggested impact as found based on the data retrieved from the interviews and focus group.

7.4.1. General classification

A general classification of the found trends is noted, of which a visual overview is given in figure 7.8.

First, a distinction can be made between the design lines that explicitly include a component of collaboration and the design lines where this does not (explicitly) occur. The trends *Innovation only*, *Collaboration Light*, *Collaboration Plus* and *International* belong to the first category and thus the design lines *Traditional* and *Product in Network* belong to the second.

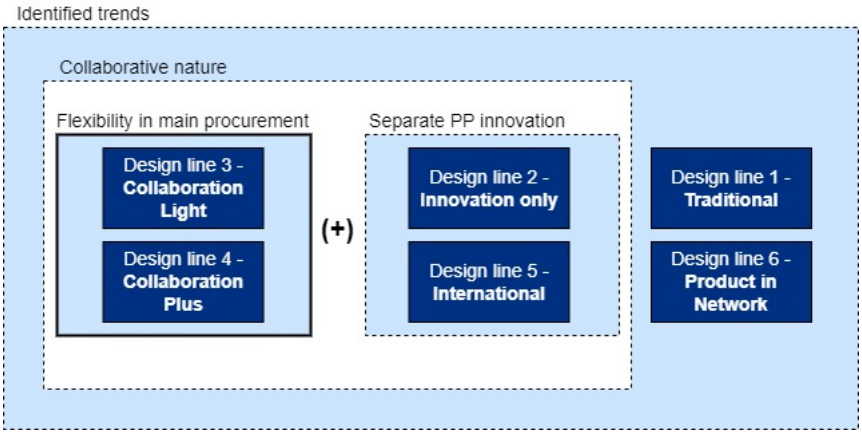


Figure 7.8: Classification Design Lines

7.4.2. Sector practices

Zooming in on this second category, its distinction can be observed: both design lines are identified trends but do not specifically indicate measures to increase flexibility for intermediate design changes. These describe respectively the more conventional institutional design for procurement processes and the specifics of the procurement process of a product in a network, logically found by the research within the rail sector. Nevertheless, these design lines do not contribute specific aspects for flexibility. Based hereon, it can be concluded that analysis of the trends found in this research shows that flexibility for long-term PPP's can be found in cooperation.

7.4.3. Separate procurement innovation

However, even within the design lines with a component of collaboration, it can be seen that distinctions can be made based on procurement focus. The *Innovation only* and *International* trends focus on the procurement of innovation separate from the "main procurement", either by the procurer itself or the joint procurement with international, equal parties. When comparing these with the *Collaboration Light* and *Plus* trends, the difference can be observed easily. Whereas *Collaboration Light* and *Plus* address collaboration in the main tender, *International* and *Innovation only* focus on the separate innovation tender. This may even mean that the combination of *Innovation only* or *International* with one of the collaboration lines need not be excluded.

The trend lines for separate procurement contribute solutions to improve and stimulate the development and inclusion of innovation and optimization in the main procurement. The design line *Innovation only* beholds the separate procurement of the innovation from the main asset. The result is the provision of information on what functional, or even global, specifications are needed to get the desired results from the main procurement process. This decoupling enhances expertise in the market to be deployed in a more optimal way. An example is IT-innovation, for which currently the contracted train supplier is responsible. The separate procurement enables a supplier with IT expertise to take care of this development, expected to result in improved outcomes.

The *International* design line describes the cooperation between equal parties at the international level, which aims to reduce transaction costs for both parties by going from two to one procedure. The resulting product then functions as the base for adaption to the requirements and wishes of both individual parties. Applying this trend to the development of innovation, the reduced transaction costs may provide increased incentive for contracting parties to engage in the development of innovation. It therefore does not directly make the process more flexible, but it certainly contributes to the goal of flexibility in this research: innovating and optimizing long-term assets.

7.4.4. Collaboration

The design lines *Collaboration Light* and *Collaboration Plus* are thus the only design lines expected to directly affect enhanced flexibility in long-term procurement processes for the aim of innovation and optimization. The common thread within these design lines is the focus on a shift towards contracting a collaboration rather than specifying all that is desired in great detail. Underlying this shift is the knowledge that collaborative practices allow easier and improved adaptability of the process for the unforeseeable development of innovation and uncertainty of future scenarios in this regard. Specifying a collaboration and the main goals of the procurement program on a global level, makes it easier to stay within the scope of the tender, also in case of design changes. However, entering into a light or (more) extensive cooperation requires mutual trust in the relationship. Research clearly shows that mutual trust among collaboration partners with diverging incentives and drivers leads to better results (Bstieler et al., 2017; Uyarra et al., 2014).

7.5. Takeaways chapter 7

Analysis of the trends as identified in this chapter shows the trends can be classified based on their characteristics. This classification can clearly be seen in figure 7.8.

SQ 4:*What conceptual process designs can be created to improve flexibility in the public procurement procedure?*

The application of the collaborative design lines *Collaboration Light* or *Collaboration Plus* will create improved flexibility in the public procurement process. Collaborative procurement will allow the procurement to be resilient to uncertain future scenarios of all kinds. Mutual trust amongst the collaboration partners is vital hereto.

Combining a collaborative design line with the separate procurement of innovation is not specifically required for flexibility, but could contribute to innovation and optimization and must therefore be explored.

8

Application NS

The morphological chart has been matured into its final form within this research in Chapters 5 and 6. Also, Chapter 7 has provided six design lines presenting the observed trends for flexibility. All together, this provides insight into how a new institutional design enhancing flexibility can be created, but to find an answer for the NS-specific problem situation this must be applied to the procurement of trains. This chapter therefore shows a first exploration of applying the developed MC and the found design lines to the NS-case by using a focus group of NS-employees.

Apart from validation, the focus group aimed to explore a possible future design for the procurement process of the NS (see: Appendix G). After validating, the five NS-employees were familiar with the definitive morph chart (figure 6.3) and the six design lines (Chapter 7), which laid the foundation for the exploration of a future design concept for the NS. In section 8.1 this exploration is presented based on the two design lines found to be most promising by the participants of the focus group. This is followed by a conclusion in section 8.2.

8.1. Exploration focus group

In this last step of data collection of the focus group and this research, the respondents were first asked to vote for the two design lines of which they thought were the most suitable to a possible future design for the NS. This voting showed clearly that Design line 2 *Only innovation* and 6 *Collaboration Plus* were ranked highest. These two then served to structure the exploration of a possible design for future procurement processes. In this section an elaboration will be given on the results of this design and how these must be interpreted in the context of this study. In Appendix H the summary of the focus group can be found, in which a statement structure has been created for easy referencing. Each statement is preceded by 'FG' and an ascending identification number, to which is referred in this chapter.

8.1.1. Design line 2 - *Only innovation*

During the focus group, *Only innovation* was perceived to be a valid design line by the respondents apart from some minor adjustments (see: 7.3 Validation design lines). The validated version of this line is used as the starting point of this exploration. In this section it will be discussed, based on the focus group, how the design of procuring *Only innovation* could be applied to the NS.

Researching potential

The adoption of the Design Line *Only innovation* was based on its capacity to independently assess and evaluate its compatibility with NS and its train systems. Presently, this evaluation heavily relies on subjective judgment, which necessitates a different approach.

Implementing separate tendering processes would ensure a comprehensive examination of all innovations, assessing their deliverables and determining when and if NS should incorporate them. Current practices lack a thorough evaluation concerning functionality and the potential optimization for maximum benefits. This would be improved much by the application of the design line. Also, it is crucial to acknowledge that innovations are presently deployed solely based on their initial intentions, disregarding their broader potential applications. There is an absence of exploration into diverse deployment possibilities [FG56; FG57; FG58; FG59].

Specifications

When deploying the separate procurement of innovation this could best be executed in such a way that its outcome is a design which is translated into specifications for the procurement of the main asset, the train [FG61]. This necessitates the upfront development of the innovation. Separating innovation from train procurement might lead to collaboration with an ICT company rather than a train builder, which enlarges potential innovative opportunities [FG67].

However, there is a risk that the optimal solution resulting from the separate tender may result in a different design when specified and merged into the train procurement [FG62; FG66]. Mitigation of this risk can be done by specifying in

such a way that its outcome fits the expectations raised according to the innovation procurement, whilst emphasizing that specifying in such a way that one supplier is easily preferred over (an)other(s) should be avoided [FG63]. Another mitigating measure is to try changing the perspective hereon. The explicit definition of functionality and effort ensures the fulfillment of requirements, even if the solution differs from that derived through a separate tender [FG64].

State-of-the-art

Procuring innovation for development of specifications for the procurement of a train is a strategy that requires upfront development of the innovation. Though this might result in an obsolete design when integrated in the train and requires acknowledging that not all elements can be state-of-the-art [FG68]. However, it should be noted that this research was initiated due to the limited, if not absent, possibilities to incorporate state-of-the-art technology into the train tendering process (see: Chapter 1). The upfront development of an innovation to subsequently include it in the train tendering process seems not to differ much from this approach, as the specifications of the innovation are also determined before the contract is awarded.

Though, the implementation of this design line explicitly outlines that, based on the developed innovation and the research into its application scope, it leads to the drafting of functional specifications. These specifications are then included in the main tender. While the pre-developed functionality may not be entirely state-of-the-art upon application, the MC offers numerous possibilities beyond the design lines to address this issue. Categories such as Contracted future modifications, Innovation clause, and Contracted initiative for innovation and optimization present multiple options to incorporate optimization of this innovation into the contract. All in all, this sub-strategy for NS may still result in nearly state-of-the-art technology on the procured train.

Modularity

Discussing how this design line offers flexibility to innovate and optimize in the procurement leads to the notion that the modularity of the main asset is also important, yet this is not part of the MC. The train's modularity significantly influences its adaptability for innovation and optimization [FG69]. For desired flexibility in innovation, a modular product design becomes imperative for implementation. Lack of modularity impedes such developments from being integrated. Also, ensuring modularity mitigates the dependency on train suppliers, but potentially requires the procurer to take more responsibility for system integration [FG70].

8.1.2. Design line 4 - *Collaboration Plus*

During the focus group, *Collaboration Plus* was perceived to be a valid design line by the respondents (see: 7.3 Validation design lines). This design line is therefore used in its original form to start the exploration of collaboration. In this section it will be discussed, based on the focus group, how the design of procuring in collaboration could be applied to the NS.

Radical approach

The Design Line Cooperation Plus was selected due to it being fairly radical in contrast to the prevailing structure of the tendering process within the Dutch Railways. Respondents expressed interest in exploring the potential of this radical approach [FG72]. They express a desire for a shift toward collaboration. Especially because they highlight external factors pressuring NS to adapt, such as a shortage of maintenance personnel. Change appears inevitable, especially concerning future perspectives [FG77].

Culture, behaviour and trust

Earlier, establishment of partnerships has already been the attention of the NS. Also, it is anticipated that in the near future, procurement and maintenance will possibly be contracted jointly [FG86]. However, the prevailing mindset was limited to the parameters of timely delivery upon payment, resulting in minimal substantive collaboration in practice [FG73].

A switch to collaboration is difficult, but necessary. The elements encapsulated within this design line necessitate a significant scope of engagement [FG74]. First and foremost this requires a change of culture within NS-procurement. Establishing collaborative relationships demands increased mutual trust, emphasizing NS's reliance on trust in its suppliers [FG88]. It is suggested that the prevailing distrust within NS towards suppliers shapes the current form of the tendering process. Incorporating Long-Term Service Agreements (LTSAs) in current PPP's is perceived as an interim step towards building trust [FG91]. Also, one respondent sees improvement, citing substantial efforts made to reduce technical requirements compared to other entities [FG83].

Still most respondents recognize a lack of movement toward cooperation in tenders, being causes by the culture of NS: its behavior during the tendering process, but also language is recognized as part here of [FG90]. They suggest a collaboration in which joint prevailing norms and values create a collaborative culture [FG92]. From this perspective the continuity of teams and and involved personnel within collaborative endeavors is essential. Forming a driven cooperative team is advocated, emphasizing the involvement of individuals from the competitive dialogue [FG93].

Conservative sector

Partially, the lack of more collaboration-oriented tendering is attributed to the conservative nature of the railway sector. Some respondents emphasize the market's traditional nature is posing a significant challenge to implementing change. Hence, the limitation on more cooperative procurement is not primarily attributed to NS but largely to the market's conventional practices [FG78; FG79].

To establish collaborative procurement, a party must be found with a similar approach to the NS, willing to engage in cooperation. This is deemed challenging. The diversity amongst train suppliers and the fact that a partnership is not perceived to be feasible with all of those, are two of the market aspects mentioned to hinder such collaboration [FG89; FG91]. It is even noted that perspectives on innovation differ within organisations. While mechanical trains are hailed as a source of pride for many, innovation in IT is somewhat marginalized in the opinions of some individuals [FG78]. Even when it is brought up that numerous examples from other sectors demonstrate collaborative practices can be achieved, this is countered by some respondents arguing that these sectors operate under different organizational structures, with cooperation more deeply ingrained in their culture [FG80].

On the contrary, during this discussion of the conservative culture of the sector, a dissenting viewpoint is raised. The traditional sector and the impact of setbacks in recent years have impacted NS and its culture significantly. Some respondents emphasize the market's traditional nature is posing a significant challenge to implementing change, since it is risk adverse and collaboration is not "in its DNA". This is also supported by the statement that the existing incentive to collaborate has dealt a severe blow from earlier procurement processes, which made people even more risk adverse [FG80; FG81]. It is mentioned that the market has demanded changes, but the NS tends to adhere to the established practices, insisting on precise adherence to the requirements [FG81; FG82]. The question arises whether there's a willingness to depart from this approach to seek alternative solutions [FG82].

Equality

Another factor currently hindering the establishment of cooperative partnerships is the belief that the success of a partnership is based on equality between the NS (Dutch Railways) and its partner [FG75], both financially and in terms of scale. This alignment poses a challenge as not all potential train builders possess the equivalent financial or operational scale required, thereby complicating the establishment of partnerships. On the contrary, some respondents argue that the behavior of the NS underlies this and that equality may not necessarily be required [FG76].

Internal expertise

Finally, it is suggested that the NS should assess the necessary level of specialized expertise internally. Mentioned is that this design line focusing on collaboration requires a continuous examination of the objectives in all actions and decisions made, including the specialized knowledge present. Currently, large teams with numerous specialists are working within the NS programs, yielding excellent results. However, within the scope of collaboration, there could be an exploration into the purpose behind this setup, understanding why such expertise is not sourced from the collaborative partner [FG84]. A clear delineation of required internal expertise and what can be sourced through collaboration would contribute to the collaborative partnership [FG85].

8.2. Takeaways chapter 8

The results of the focus group clearly show both divergence and a shared vision of the future amongst the participants. Inconsistency exists in how participants perceive the extent to which the NS is already engaged in improving the tendering process aiming to prepare for future scenarios. However, it is noted that there is a general conviction that (further) improvement is required.

The design lines serve as a framework for the discussion on procurement in the future, within and in collaboration with the NS. The participants are of the opinion that separate procurement of innovation as well as engaging in collaborative procurement offer promising opportunities.

SQ 5:*Considering the created MC and conceptual design proposals for flexibility, what process design should be explored for application for the NS?*

Answering this SQ results in a two-folded answer. First, separate tendering of innovation is seen as an opportunity to explore and potentially broaden the applications of innovation. However, it is essential to consider the possibility of the procured innovation to eventually be constructed by a different party than the one that developed it. This could be addressed by accurately translating the functionality of the designed innovation into specifications for the procurement of the train. Additionally, a more flexible approach could offer a solution. If the outcome meets the described functionalities, the goal should be achieved and the specific implementation should not necessarily impact it. To conclude this design line, it should be noted that modularity of the train is of vital importance for solely procuring innovation. A lack of modularity makes the implementation of individual innovation (almost) unfeasible and creates dependence on the supplier.

Second, the establishment of an extensive collaboration with one or more suppliers aligns with the desired future scenario of the respondents. Previous attempts have been made to move in this direction, but these did not have the expected results as old habits appeared to be dominant. However, interest exists in developing a design line focused on collaboration. This necessitates an internal cultural shift within the NS. The emphasis to enforce this should be on building mutual trust with collaboration partners. This way higher chances for success are created. However, the conservative nature of the sector and past setbacks, resulting in risk adverseness and adhering to known practices, impact the behavior of market players, including the NS.

To achieve collaboration, it is essential to make sure what the NS genuinely seeks in a collaboration partner and whether equality, specifically in financial terms and scale, is vital to such a partnership. Currently, this is perceived as a barrier.

Additionally, demarcation of the expertise required internally versus the expertise requested from the supplier is required to establish clarity in the collaboration.

9

Conclusion

SQ 1

What does the current public procurement process entail and what opportunities for flexibility in design exist herein?

To analyze the current public procurement process correctly, it must first be determined what the scope of this analysis is. As this research aims to answer how flexibility can be improved, the scope is set to the part of the process in which the shaping of the procedure is decided on, which is before the contract is awarded. Additionally, this research assumes the procurement is going to take place, resulting in elimination of the exploratory phase. Flexibility of the process is therefore to be found in the actual procurement phase, which stretches from the first preparations of setting out the tender in the market until the awarding of the contract.

Determination of specific flexibilities asks for identification of limitations. The current PP process is outlined by the EU Directive 2014/23 on public procurement (2014a), and specifically for application to the NS-case by the EU Directive 2014/25 by entities operating in the water, energy, transport and postal service sectors (2014b). A functional breakdown of the procurement stage is informed by these legislative limitations and professional documentation. Research of Bajari and Tadelis (2001) and Rigby et al. (2005) already showed the contract and procedure type to define flexibility of the procedure. These can be defined as within the available scope of action of the procurer and is assumed to affect the possibilities for intermediate changes to the procured product. Based on these two conditions, more aspects have been identified as flexibilities, being:

Product-related:

- The degree of cooperation between procurer and supplier
- The structure of the delivery
- The structure of the development of innovation compared to the main product
- The way in which innovation is tested
- The selection criteria evaluating the submitted product plan
- The specifications used to define the tendered product

Contract-related:

- The procedure type
- The extra instruments to be deployed in the procedure
- The system of limiting the applicants
- The contract type
- The additional organizational structures
- The financial structure
- The awarding criterion
- The duration of the contract
- The volume contracted
- The eligibility requirements for the supplier

SQ 2

How can the morphological chart be used for systematic institutional design of a PP process with enhanced flexibility?

The morphological chart is a product design tool used for systematic exploration of design space. Since this research aims to explore the design space for flexibility in the PP process, the usage of the MC is tested in this institutional context.

The morphological chart splits an integral product, the PP process in this context, into its sub-functions, being the *categories* in this research. These sub-functions can be fulfilled in different ways, being called the *means*, and jointly show the scope of the design space. Further, the MC adheres to its principles of being *collectively exhaustive* and *mutually exclusive*. These principles respectively require that for each category the sum of all means covers all possible options and that each mean is completely separate and has no overlap with other means.

Applying this to the desired institutional design starts by creating a category for all identified flexibilities. Subsequently, for each category means have been formulated by consideration of all possible choice options per flexibility. Executing this for the procurement process leads to four more construction rules that should be followed when using the MC for institutional design, being:

1. **Within scope of action**: The categories must contain flexibilities in which decision-making is in the hands of the procurer. If not, this category is out of the scope of action and must be left out of the chart.
2. **Readability**: The usefulness of the MC is dependent on readability, which is impacted by the degree to which the diagram is independently understandable, well-structured and visually clear. This results for example in a trade-off between including more text to define a mean versus the diagram becoming too much to process by having much text in the cells.
3. **Abstraction level**: To stay comprehensible and enable equal comparison between means, the abstraction of these choice options should be on the same level as much as possible.
4. **Informational value**: For each category the value is determined, elimination must be considered to uphold the readability of the diagram. This applies differently to the means, which can be merged in case of low informational value, but not eliminated to avoid violation of the collectively exclusiveness.

Development of the content of the MC is done by extensive use of the chart, which resulted in issues encountered applying the MC for institutional design. All issues are related to the two base principles of the MC and the four construction rules just formulated. For each issue a solution or mitigating measure has been found, which is explained below:

Chapters: Adding more categories to the chart requires structure to sustain overview. This can be done by adding extra chapters to the MC, supporting the readability.

External impacts: Even though the construction rules require all categories to be within the scope of action of the decision-maker, some external impacts cannot be ignored in the MC. Due to the informational value, these impacts are included but require careful consideration.

Multiple choice: To avoid violation of the mutually exclusiveness, binary categories must be added to the diagram individually. However, this results in low informational value and readability. Thus, in case an overarching topic exists for those categories, they are merged into one multiple choice category. This is only used as a visualization method, but still represents binary categories and therefore avoids violation of the mutually exclusiveness principle.

Order
Means: Means on the left side of the MC get most attention of users and so these are considered more in the design. Means with high informational value should therefore be mentioned first.
Categories: The order of categories must approach the real decision-making process as much as possible, to make the diagram more tangible and easier to understand, improving its readability.

Rectangular shape: A rectangular shape of the MC must be aimed for. Since outliers are often not considered by users, such categories do not support the use of the full range and therefore decrease readability.

Informative Chart
Definition and Interpretation
To avoid unknown definition of topics in the MC or the interpretation not being aligned amongst users decreases usefulness of the diagram and thus its readability. Multiple solutions are available:

- Interactive image: clicking on each cell in a digital MC presents a short description of the topic
- Double MC: the MC is accompanied by an extra version in which short descriptions are included in the cells to clarify its meaning and is solely used to inform on definitions. The 'normal' MC is used as the actual design tool
- Manual: A manual in text is created and accompanies the MC
- Instruction video: a video is created in which the use and definitions of the MC are explained

Relations: The first two options can also be employed for the visualization of links between means. Currently no excluding, mandatory or strengthening relations between means can be shown, degrading the informational value.

Emphasis in introduction: Apart from the general introduction of the MC, as used in this research, the principles and construction rules as well as the scope and aim of the MC must be emphasized. These factors are most easily forgotten whilst being essential to correct application.

Input variables
Enabling the inclusion of the full range of options is required (collectively exhaustive), but institutional design requires different types of variables to be in the MC whilst securing the readability, for which visualization methods have been

developed. Apart from the explained issues and their solution, some other conclusions can also be drawn from the use of the MC.

Moderation
An upfront introduction of the MC is preferred over first presenting the chart right before using it. This allows the users to process the diagram and its use before application. Also, preparing a case before to initiate the discussion if necessary is found to be helpful. Lastly, the methodology must clearly be reintroduced in case (one of) the users seem to be confused by it.

Effectiveness
Drawing on the diagram physically, using a pen and paper, encourages the use of the MC. It creates the feeling of a physical puzzle, making it more interesting to its users. Further, the boards of the organizations in which the MC is used as design tool must support the use of this methodology to enhance its effectiveness.

Validation
Validation of the use of the MC in this context leads to the conclusion that applying this chart for institutional design results in a framework, which serves as a systematic guidance to the discussion. The presentation is perceived to be clear and comprehensible, but the means should not be presented separate from the MC without explanation, as the lack of context eliminates the informational value. It is stated that this approach provides clear insight into decisions and the underlying reasoning, encourages constructive discussion and critical thinking. The methodology is easily understood and familiarized after an informative introduction, but some time is required to process the content of the MC. Also, definitions or interpretation of topics are not always aligned amongst users, which can cause a little confusion.

SQ 3

What process aspects have been experienced to generate flexibility in PP processes?

After iterative feedback of experts on the contents of the MC, the included categories represent the full range of identified flexibilities in this research. The means show the explored design space for each of those aspects. This results in the conclusion that the morph chart as shown below in figure 9.1 answers this question.

Morph Chart - Definitive									
Impacts									
Phases of Technology Readiness	Discovery phase (TRL 1,2 and 3)	Development phase (TRL 4,5 and 6)	Demonstration phase (TRL 7 and 8)	Deployment phase (TRL 9)					
Product									
Scope of product	Total asset	Innovation only	Research and development of innovation	Asset in parcels	Asset and innovation in different parcels				
Delivery	Batches	Batches with increasing, iterative development	Complete delivery with ex-post adaptations per batch	Complete delivery					
Start usage	In batches	One by one	All at once						
Innovation development	Incremental innovative nature	Parallel development innovative product	Upfront development	No development					
Testing innovation	Pilot - Digital (Testing of one/a few innovations)	Pilot - Real life (Testing of one/a few innovations)	Living lab	No testing					
Sub-awarding criteria	*Other*	Competence in Innovation	Competence in Systems Engineering	Collaboration capabilities					
Specifications	Targets - Obligation of vision goals	Targets - Obligation of result	Targets - Obligation of effort	Functional specifications	Technical specifications	Catalogus specifications			
Contract									
Contract scope	Collaboration	Research	Engineer	Design	Construct	Finance	Maintain	Operate	Terminate
Procurement tools	Framework agreement	Market consultation	Dynamic Purchasing System	Electronic Auction	None				
Financial structure	Dedicated innovation budget	Procurer's contribution (Remove unprofitable peak)	Financial alliance (Collaboration similar parties)	Co-financing (Collaboration parties fulfilling different roles)	Co-financing - EU Subsidies	Pre-commercial purchasing	Contracting body pays remuneration to producer		
Financial distribution over time	Flow of financial resources during the process	All financial resources available upfront	All financial resources available at completion	No financial resources to be received					
Eligibility requirements	Financial and economic capacity	Technical competence	Professional competence	Professional qualification					
Selection criteria	Size of company	Amount of references	Type of references	Quality of references	Quality of resumes				
Contracted future modifications	Changes in legislation	Defined technical alterations	Accidents concerning product	None					
Innovation clause	Hourly rates for types of modifications	Price tag catalog for components	Right to benchmark modification plan in the market	Right to have a third party check modification plan	Surplus taken into account	None			
Contracted initiative for innovation and optimisation	Latest-and-Greatest technology requirement	Contractual innovative clause	Periodical innovation proposal	No initiative					
Awarding criteria	Lowest cost (Based on cost effectivity)	Price-quality ratio	Lowest price	*Exemption ground (Only in case of the exemption ground as procedure)					
Procedure type	Competitive dialogue	Innovation partnership	Call for innovation	Exemption ground for research and development*	Competitive procedure with negotiation	Negotiated procedure with prior publication	Contest	Public procedure	Non-public procedure
Limitation of applicants	Selection of best candidate	Two rounds of gradual reduction	Multiple rounds of gradual reduction						
Market approach									
Volume	Total necessity	Partial necessity							
Duration	Full term	Mid term	Short term						
Nature of co-operation	Partnership (All chain partners)	Partnership (Multiple partners)	Partnership (Two partners)	Procurer - Supplier					
Hierarchy of relationship	Horizontal	Vertical							
Management relationship	Collaboration manager	Specifying interaction	Language used	Dialogue on mutual understanding of contract	Via contact person				
Risk determination	In collaboration	Supplier(s)	Procurer						
Risk mitigation	Focus on process and collaboration	Focus on achieving specified objectives							
Risk profile	Bandwidth value	Fully covered profile							
Additional organizational structure	Building Team	International collaboration	Knowledge alliance	Purchasing alliance	Mixed team	Two-phases approach	None		
Ownership innovation	Supplier - *Usus fructus*	Supplier - *Usus*	Supplier	Procurer	No innovation				
Intellectual property	Supplier - *Usus fructus*	Supplier - *Usus*	Supplier	Shared with market	Procurer	No innovation			
System integration	Independent team coach	Procurer's responsibility	Supplier's responsibility	No integration					
Continuity teams involved in procurement - asset management	100 90 80 70 60 50 40 30 20 10 0 — Units: Overlap percentage (%)								

Figure 9.1: Definitive MC: Overview of Process Aspects Generating Flexibility in PP Processes

SQ 4

What conceptual process designs can be created to improve flexibility in the public procurement procedure?

Apart from the identification of flexibilities and the available design space of these, design lines have been created to show interrelated means. Based on expert knowledge, design trends were observed throughout the development of the MC. Six design lines have been created by merging related means based on the trend context these were mentioned in. The following validated design lines were created:

- Design line 1 – **Traditional** Approach of current procurement process
- Design line 2 – **Innovation only** Separate procurement of innovation and main asset
- Design line 3 – **Collaboration Light** Partnership between procurer and supplier
- Design line 4 – **Collaboration Plus** Extensive collaboration between involved procurement partners
- Design line 5 – **International** International cooperation in procurement with similar parties
- Design line 6 – **Product in Network** Procurement strategy for assets operating in a network

It can be concluded that four of the six design lines focus on a particular form of collaboration. The fifth design line differs from the rest, as it is based on the characteristic of the procured product, being part of a network, whereas the other design lines focus on what type of procurement is desired.

The design lines including some form of collaboration are *Innovation only, Collaboration Light, Collaboration Plus* and *International*. *Innovation only* and *International* focus on a partnership with a specific focus, respectively being collaboration for the development of one or more innovations in advance of the main procurement and collaboration between parties fulfilling a similar role in different countries jointly procuring their asset or innovation. These design lines provide more flexibility by enabling separate development of innovation from the main asset. This leads to a better informed main asset procurement process without the necessity to specify as much as possible and even the retrieval of best expertise on the development of innovation by not including it in the main PPP.

SQ 5

Considering the created MC and conceptual design proposals for flexibility, what process design should be explored for application for the NS?

The exploration of a design for the NS should be started by using design line 2 – *Innovation Only* and design line 4 – *Collaboration Plus* as a framework for the discussion amongst employees concerned with shaping the process internally. NS-employees involved in the discussion show a general belief that (further) improvement of their process design is required to be future-proof.

The possibility to procure innovation separately from the main asset offers the opportunity to explore and expand the application of innovations. The outcomes of this exploration could be accurately translated in functional specifications to be included in the main procurement process. This does emerge a risk of having different parties and therefore different outcomes in the two procedures. However, if the outcome meets the described functionalities, its goal should be perceived as achieved regardless of the specific implementation. Finally, this approach requires modularity of the main asset to be procured. A lack of modularity will make separate innovation unfeasible and affects supplier dependence for the procurer.

Engaging in collaborative procurement is found to be another promising opportunity for the NS which is aligned with the future scenario as desired by the involved NS-employees. Earlier attempts have been made to move towards a partnership, but old habits prevailed. However, this shift is still interesting for exploration. A first analysis of the effects of such extensive collaboration on the NS shows that an internal cultural shift is needed e.g. since collaboration is based on mutual trust between procuring partners, which is currently lacking. Barriers to implement this approach are the conservative nature of the sector and past setbacks impacting the behavior of all involved in the process, including the NS, to be risk adverse and persistent to known practices. To eliminate the barrier of required equality, it must be determined what requirements are essential for a collaboration partner for the NS and whether equality, in terms of finances and scale, is part of this. Additionally, demarcation of the expertise required internally versus the expertise requested from the supplier is required to establish clarity in the collaboration.

RQ

How can flexibility to intermediate design changes within a long-term procurement process be improved within European procurement legislation?

The embodiment of the answer to the main research question is shown by the created morphological chart. The use of the developed morphological chart enables systematic decision-making and structured substantiation of a process design to be produced. It represents the available design space with a focus on stretching the bandwidth of options to enhance flexibility. Using this chart to serve as a framework guiding the discussion amongst decision-makers of a procuring organization enables critical analysis of the current and future process design. It provides a structured way to discuss flexibility in institutional design of the public procurement process, regardless of its capabilities to produce an actual solution for specific cases.

It can be deduced that enhancing flexibility for intermediate design changes is feasible through a joint emphasis on collaboration between the procurer and supplier. The distinguished trends within the research, encapsulated in the design lines, clearly indicate that four out of the six identified themes include an element of collaboration, demonstrating diverse applications thereof. The residual trends observed either adhere to a traditional approach or are specifically oriented towards the network characteristic of the to-be-procured product. This emphasizes the prevalent role of collaboration as a unifying factor in the conceptual process design, fostering adaptability to intermediate changes with the objective of innovation and optimization within long-term procurement processes.

Hence, achieving flexibility for intermediate design changes in the context of long-term public procurement processes necessitates a (more extensive) shift towards collaborative practices. Transitioning from a vertical to a horizontal partnership, between procurer and supplier, where collaboration is of paramount importance, enhances flexibility. This approach mitigates the imperative to predefine all contractual scope elements ahead of the procurement process, specifying the relationship rather than the detailed requirements. This methodology broadens the spectrum of options within scope for intermediate changes without necessitating a new procurement procedure.

Initiating a transition from a vertical to a horizontal approach in the procurer-supplier relationship, with a progressively heightened focus on contracting this relationship rather than specifying its precise outcomes, is imperative. While this shift does not alter the ultimate goal of procurement, it does redefine the trajectory leading to it. Establishing a robust and resilient process that accommodates intermediate design changes necessitates the establishment of a sustainable procurement

relationship. The significance of this is underscored by the long-term nature of the studied processes. This extended time frame not only allows for a proportionately more rewarding 'warm-up time' required to establish such a relationship but also amplifies its effectiveness. Long-term processes are characterized by increased potential for innovative development and possible optimization, albeit accompanied by increased exposure to changing conditions and, consequently, the need for intermediate design changes.

When designing such a process, it is important for each aspect, each category (MC), in which a choice can be made, to go for the option that, where possible, supports a far-reaching cooperative relationship, without abandoning the main goals of the tender. The human aspect is of great importance here. Mutual trust and enthusiasm among the individuals involved is vital for setting up a sustainable cooperation in which there is room for flexibility.

Continuous evaluation is needed: what is the goal and how do we get there? The preconceived structure of a procurement contract is a thing of the past; every procurement requires a custom agreement, which could also overlap or even fully resemble such a preconceived contract structure. A conscious choice must be made for each category, always considering what the goal is and getting there. Bearing in mind that the procurement sector is generally seen as relatively rigid and somewhat conservative, it is important that when evaluating this, the focus is on applying new process aspects where possible and appropriate and not sticking to known practices in order to avoid risk.

All in all, flexibility for intermediate design changes within long-term procurement processes within European procurement legislation can be enhanced by focussing on a collaborative approach of the procurement process. The created morph chart serves as guidance in the institutional design of such a process in the railway sector, focussing on exploring of options, discussing these and making an concrete, substantiated choice for process practices providing flexibility.

10

Discussion

In this chapter a critical analysis and interpretation of the results produced in this research will be given. Further, these results will be elucidated in their practical and scientific context. This will be done for the main results answering the main research question and subsequently for the deployment of the morph chart for institutional design, as research parallel. After the discussion of these results, a deeper dive as well as a broader perspective will be presented into the application and possible impact for the NS when adopting the practices resulting from this research. Next, the validity and limitations of the performed study are elaborated, followed by an explanation of the relevance of this research in relation to the relevance as set out in section 1.7 in Chapter 1. Thereafter, a short policy recommendation will be presented and this discussion is rounded off by suggestions for future research.

10.1. Interpretation results: Flexibility

10.1.1. Design lines

It was concluded that the design lines *Collaboration Light* and *Plus* are the trends that increase flexibility in the procurement process. However, a combined application with the design lines *Innovation only* or *International* shall not be ruled out. It is possible to initiate a procurement process for the development of an innovation, whether or not in cooperation with an international partner, which leads to an innovation implemented as such in the main tender or leads to the preparation of specifications, which the main supplier has to fulfill. In the main tender, a collaboration of a certain degree can then be entered into with the main supplier. The use of a collaboration design line leads to more flexibility in the process. Nevertheless, it should be noted that a shift to collaboration is noted within this research as a measure to increase process flexibility for intermediate changes aiming to innovate and optimize long-term assets, but this also has its down sides.

Despite the fact that when entering into a "cooperation tender" the goal of the programme is fixed, either on a global (vision goal) or more detailed level (functional), a cooperation calls for a move away from the further "imposition" of requirements by the procurer within the process. The focus in collaboration shifts towards joint outlining of the concrete process steps and such. This requires compromises to be made, causing the procurer to possibly end up with inferior results than expected or desired (Meehan et al., 2016). This can be mitigated by sound risk management (Mwesiumo et al., 2021).

Also, the combination or independent use of separate tendering of innovation has its advantages and disadvantages. Applying an international cooperation for the sake of developing an innovation affects lower transaction costs for the contracting parties; there is one instead of two tenders. Yet there are drawbacks to this as well. Joint procurement poses a substantial risk of violation of the Competition Law (1997) to be assessed by the Netherlands Authority for Consumers and Markets.

Additionally, after joint procurement, adjustments need to be made to the developed innovation to fit within the national or organization-specific context of the contracting parties.

Finally, with *Innovation Only*, it is quite possible that the separate procurement will be carried out by a party other than the main supplier. This may be perceived to be a disadvantage; the innovation in the main tender may turn out to be different than expected based on the separate tender. However, it should be noted that this separate tendering offers the opportunity for the innovation to be developed by a party expertise on this specific innovation. The main supplier builds hereon by implementing it in the main procurement: *stick to one's last*.

10.1.2. Design space

Apart from the trends identified, this research clearly shows an overview of opportunities to implement flexibility for intermediate design changes in the PP process of long-term assets. Even without outlining those trends, this overview is of value. It is a first exploration of such flexibility, both within the scientific literature and the industry. "Stretching" this design space as far as possible has contributed to the most comprehensive overview possible of these options and a systematic methodology for making combinations within this design space resulting in a conceptual institutional design.

Analysis of the final result of the MC (see: 5.3.2) compared to the initially created MC (see: D.2), shows that the *Market Approach* was added as a new chapter, which mostly includes newly added flexibilities. This clearly shows that aspects providing flexibility and part of the Chapter *Market Approach* were recognized as possible or common practices of the industry, but were not yet recognized or related as such within the scientific literature. It can also be observed that no adjustments are made to the requirements as set by the Dutch Procurement Law 2012). This is fully in line with what was expected; the legislation was adopted as the limiting framework of this research.

10.1.3. Scope

On the contrary, it was assumed in section 3.5 in Chapter 3 that time could be left out of scope, since it was perceived not to influence flexibility directly. However, it can be observed that time does influence flexibility, though maybe not directly. Procurers do make a trade-off on the possibilities offered, e.g., by starting a new procedure vs. the costs (including time) of such a new procedure. The required time is greatly affected by the start of a new procedure and must therefore be taken into account. Yet, the legislative deadlines and such are assumed to be constant and do not affect the flexibility from the procurer's perspective. On the contrary, the option of e.g. the frame work agreement being of a longer time span (8 years) for the special sectors vs. 4 years in general procurement, has been mentioned to offer chances for flexibility, which can be considered direct impact (PIANOo - Centre of Expertise on Procurement, 2016c).

Analysis of the research scope provides another interesting point of discussion. The Introduction clearly explains the scope of this study (see: 1.5.2), which is framed by, among others, legislation for special sector organizations (European Parliament and the Council, 2014b); procurement contracts to equal or exceed the threshold value, and being within the scope of action of the procurer. Nevertheless, on several occasions during the study, respondents mentioned that what they brought up might be out of scope (see: section 6.3.3 and table E.1). Given the exploratory nature of this research, such "on the edge" statements should not be discouraged, or on the contrary perhaps encouraged. "Stretching" the edges of the design space for flexibility is part of exploration, testing the limits of what is in and out of scope is essential for this. Thus, these observations are of value in this very process. After data collection it can be determined how this input will be processed or omitted in the final results, but even in case such input only serves as inspiration, this supports the exploration of the design space.

10.1.4. Broader application

The overview of the available design space was made specifically for flexible procurement of long-term assets. This research has focused on choices made for the procurement process at the pre-award stage of the contract (see: 3.3.1). However, many of these choices have far-reaching, if not decisive, effects on the process that follows contract signing, i.e., the remainder of the procurement process. And although the content of this MC is tailored for train procurement, in the rail sector, there are no indications that it is not applicable to other long-term asset. However, it should be noted that due to the focus on train procurement, the EU Directive 2014/25 transposed into Dutch Law was adhered to (European Parliament and the Council, 2014b; Ministry of Economic Affairs, 2012). The does not require adjustments to the MC, when applied to assets beyond these special sectors, but does cause a small change in the interpretation of some means. The earlier mentioned example of the framework agreement is also illustrative in this context. This type of agreement may be used for eight years in special sectors, whereas beyond these sectors this is limited to four years (PIANOo - Centre of Expertise on Procurement, 2016c). This causes the application of the framework agreement for long-term assets in non-special sectors expected to have less impact.

Furthermore, the main question explicitly states that this research focuses on long-term processes. Despite the fact that the reason for this research, the failure of long-term assets to be up-to-date with technological developments, is most emphatically evident in long-term procurement, there is no reason to believe that the research findings are not applicable to short-term assets. The main question thereby seems to propose a contradiction of which there is no certainty. It could be that some means are not necessary or worthwhile for short-term assets, but since the MC also includes a "default" option, not applying these means should not be a problem. Research on the application of this research' outcomes for short-term assets would most likely result in different trends identified and therefore changed recommendations for the institutional (re)design of the PP process. An example is the reasoning that entering into a far-reaching collaboration, requiring extensive preparation time and energy and thus costs, is expected not to be the most optimal choice in relation to the relatively short duration in which it can be benefited from. Nevertheless, there are no indications that the content of the MC created would be different for short-term assets. Thus, it can be concluded that, as far as can be determined based on this study, there are no reasons to believe that the matured MC is not applicable for short-term procurement processes. Further research on this application is recommended to find out if this assumption is correct and enable the use of the created MC for short-term assets.

10.2. Interpretation results MC

10.2.1. Application for institutional design

Researching a possible link between institutional and the broader design literature was done by deploying the morph chart, as an engineering design tool, for institutional design. This particular application shows to be successful with the inclusion of some provided adjustments and results as such in a first "bridge" between institutional design and engineering design. Nevertheless, these results are narrow; a specific engineering design tool, yet well-reasoned, was used for institutional

design in a specific context. Generalization of this application is thus not possible, but it does show that opportunities exist to apply design tools from the broader design literature for institutional design. Nor is it possible to say anything about reversing this connection: it cannot be determined whether institutional design tools are also suitable, or even beneficial, for application within the broader design spectrum.

The application of the MC in this context shows a new, structured way to achieve institutional, conceptual (re)design of complex socio-technical systems. Based on the properties of the morphological chart as an engineering design tool (see: 1.6.2), it was expected to be a design tool fulfilling the needs of an institutional design tool required in this research, which proved to be correct. Though, also some disadvantages of the deployment of the MC in this context can be identified.

10.2.2. Characteristics MC

First, literature suggests that a similar level of abstraction should be adhered to for all means (Dym, 2013), although there is also research suggesting that this is not as important (Richardson III et al., 2011; Teegavarapu et al., 2007). In this research an attempt was made to keep the same level of abstraction. For many of the categories this seems to have succeeded, since the means present specific courses of action. For a number of categories this has been less successful. An example of this are the risk-related categories, being *Risk determination*, *mitigation* and *profile*. Their means do provide a global direction for action, but no concrete courses of action. Establishing these requires risk expertise and in-depth research into the application of these risk elements within PPP aiming for flexibility, which should therefore be studied in following research.

Second, the MC uses short descriptions of categories and means in its cells, where, especially for institutional aspects, adding more detail, explanation or nuance would be appropriate. However, there is no "room" for this in the MC; including more text in the cells is possible, but would decrease the concreteness of the chart. The fact that for institutional design the MC cannot always be used independently of a "manual" of any form is detrimental to this methodology.

Third, it appears the MC is unable to reflect which combinations cannot be combined, based on legislation or technical inability. An example of this is the public procedure which is characterized by only having one round in which the best supplier is selected (PIANOo - Centre of Expertise on Procurement, 2016b). In case this procedure type would be combined in the MC with the limitation of suppliers to be done in two rounds, it would become a non-public procedure. This example clearly shows an impossible combination between two means, however, no suitable method has been found to indicate this within the MC.

Apart from these (current) shortcomings of the MC as institutional design tool, a possible consequence of the found results must be noted. The results show (effect not to be generalized) the means on the leftmost side of the diagram to receive most attention. This could be intentionally used by the designer of the MC for his/her own interest. The solution he/she finds best may be placed on the left on purpose, which must be recognized by the users of the diagram.

10.2.3. Broader application

Despite the above mentioned points of discussion and issues to be tackled, the morph chart has shown in this study to be a promising first “bridge” between the institutional design and the broader design spectrum. It provides a concrete and systematic method for institutional design. Wider application of this methodology offers promising perspectives. The morph chart methodology could be applied to the entire procurement process in order to increase understanding of institutional design of the entire process for substantiation and discussion, i.e. without a focus on flexibility. This could support capturing years of expertise in a concrete manner, to pass it on. Experts hereby make their knowledge tangible for the next "generation" of experts, ensuring to gain knowledge and overview of this specific sector more quickly.

The concrete overview provided by the MC also enables improvement of institutional design by collaboration within the sector. This study shows that anonymizing cases does not reduce the informational value of common and promising practices in the sector; analyzing the process does not require the inclusion of company-sensitive information. The focus in this data collection is on *how* something was done and not on *what* was done specifically. Collecting all this data and aggregating it into the MC allows for sector-wide insight into these common and promising practices. In this way, parties within the sector can learn from each other’s institutional design without having to expose themselves more than desired. This principle could also be applied across sectors; there are no reasons to assume this does not apply to other sectors. Also for institutional design in a different context, with a different focus than the enhancement of flexibility in PPP or even reallocation of the focus to a different socio-technical system, could benefit of such a joint learning process.

10.3. Recommendations

10.3.1. NS

This study unequivocally indicates that for the National Railways (NS) to integrate flexibility into their procurement process, a fundamental shift is imperative. This shift comprises a transformation of the current vertical relationship between procurer and supplier towards a horizontal collaborative partnership. The emphasis should shift towards a process where cooperation is central, clarifying program goals at a visionary level and specifically outlining the contours of collaboration within the contractual framework. Based on the findings of this research, it is anticipated that such a shift will provide the NS with a more robust tendering process, affording greater latitude for intermediate changes to the design. However, this might be challenged by the sector’s tendency to rely on known practices. It is noted that also the NS exhibits a somewhat conservative disposition. This results in risk adverse behavior, e.g. by specifying as detailed as possible, and persistence to

known and proven practices.

To rule this out, it is important for NS to let go of being as specific as possible, by articulating exactly what must be received and move to specifying the required functionalities of the train or even just the main goals of the programme. This leaves room for the supplier to create the most optimal design. It should be noted, however, that it is important to know the motives of the parties involved to enable assessment of what must be specified or even what incentives must be provided for the supplier to ensure the desired outcome is achieved (Edquist & Zabala-Iturriagagoitia, 2021).

Furthermore, it is important that NS investigates whether the competitive dialogue as procedure could be applied. This procedure is often used in tenders where cooperation is being sought (see: 7.1.3 and 7.1.4) because it allows room for discussion with the suppliers, something that is necessary to successfully establish cooperation.

Also, it is advisable for NS to explore how the adoption of separate tendering for innovation development could yield improved application results. It becomes clear that the currently available technologies are deployed quite one-sided, even though promising opportunities for more diverse application often exist. Separate tendering could lead to better insights herein. An investigation into the feasibility and market acceptance of implementing this approach either prior to or at the commencement of the primary PP process is recommended.

Though, for the success of a collaborative tender, the focus must extend beyond optimizing specific flexibilities individually. An internal cultural shift is underlying the success of collaborative procurement. Entering into a collaboration in the current procurement environment, will, most likely, not lead to more flexibility. In order to do this to the best of the abilities, an integral approach is needed.

Not only does the process require to be technically designed for collaboration, but the approach to market participants as partners, rather than suppliers obliged to deliver exactly what NS has specified in detail, is also important. Several factors contribute to this, of which a simple yet illustrative example is the use of language in the tender: speaking of a "collaboration" and being "partners" rather than a procurer-supplier relationship, where the supplier merely has to meet the tenderer's stated requirements. This is recommended without implying that in a new institutional design the supplier does not have to deliver according to the set requirements. If so, this would ensure that the goal of the procurement program is not met and is therefore totally contradictory to the goal of institutional (re)design.

Though, it should be clear that an internal culture change is required, where the perception of sticking to the known, proven concept turns into wide-spread conviction that collaboration leads to even better results by increasing or adding flexibility to the process. All employees must be convinced that sticking to the current practice will not lead to a robust process able to accommodate future developments. The immediate involvement of personnel is crucial hereto. This research underscores the importance of the presence of *drivers*, being individuals intrinsically motivated to ensure the success of such a novel approach, for the outcomes of this process transformation.

To create such intrinsic motivation, wide-spread awareness of the need for this shift to collaboration must be raised. If one waits to redesign the current process until the speed of technological development catches up with NS' procurement process, the situation is likely to force the organization to adjust its process. This is not yet inevitable, but with the existing growth of technological developments, the longer NS waits, the greater the risk that forced change will be made, instead of NS itself already initiating this shift and being able to deliberately shape it (Barnett & Carroll, 1995). If this shift is initiated in time, the process will be resilient to these forces, avoiding a situation in which NS is forced to change its process.

Initiation of this shift is done by the start of an internal discussion on the (re)design, by using the morph chart and the design lines in it. Outlining design lines like *Collaboration Plus*, for example, presents an extreme, triggering a critical conversation. The perception of the actual redesign to be similar to *Collaboration Plus* is most likely not realistic, taking into account the tendency to adhere to known practices. Though it does ensure that the stakes are high. The conclusion of an internal "compromise" will thus be more collaborative, compared to starting with the introduction of *Collaboration Light*. Continuing a working group, such as the focus group conducted within this study, involving critical experts to discuss and refine conceptual designs, is recommended for this purpose.

Apart from this "negotiation strategy", it is necessary to start and adhere to an integral approach for the establishment of this shift. The change from a vertical procurer-supplier relationship to a horizontal collaborative relationship requires a change across the procurement board. As described earlier in section 10.1.4, this institutional design has decisive impact on the procurement as a whole, i.e. even after contract award. Such a major turnaround thus also requires an approach that analyzes and engages the PP process as a whole. To increase the success of this turnaround, by promoting staff involvement, it is advisable to identify the facets that make up the "main structure" of the NS tender, such as budgeting, asset management and so on. Setting out this structure should lead to the identification of clusters that can be represented by one or two experts. These can be involved as a *liaison* in the institutional (re)design and or its implementation. In this way, an integral approach to a change of this magnitude can be coordinated and guaranteed by creating points of contact. These liaisons act as *change ambassadors* within the organization.

10.3.2. Railway sector

The recommendations above are presented in the context of improving flexibility in the NS procurement process. However, these do not solely apply to this organization. Except for the last recommendation, these can actually be addressed to the rail sector as a whole. There is a varying degree to which organizations within the sector are already making a shift towards collaborative procurement practices, but generally they are still at the beginning of such a shift. The recommendation to NS therefore also apply to other procuring parties in the railway sector: to initiate or continue an internal change by means of an integral approach; convincing staff of the purpose of the change; creating liaisons to support the integral approach as well as being an internal ambassador and continuously involving staff in the change process.

On another note and without being able to substantiate this statement with recorded observations, it further strikes the

researcher that the procurement sector is quite homogeneous. The adoption of more diversity within the sector, e.g. in age and gender, and the involvement of expertise from sectors where collaboration has long played a central role in contract management, could thereby also lead to a larger and increasingly diverse set of insights. As a result prevailing beliefs would be challenged, discussions triggered and questions answered jointly. This suggestion for more diversity and increased involvement of experts from other sectors does not mean to imply that the current sector is not performing well currently, but purely offers a perspective to consider.

Also the last recommendation to the railway sector is of a different character. It has been observed by the researcher that it is more common for procurers to feel that there is a chance that the supplier might "win" more in the procurement than the procurer itself. Nevertheless, this research and the desired shift to cooperation suggests this view to be adjusted. When the procurer and supplier both achieve/receive the desired result, a win-win situation is established. That should be the goal of procurement. Whether the supplier proportionately wins more is secondary to that. This change of vision is necessary to provide even more room for cooperative relationships between tenderer and supplier.

10.3.3. Policy

Besides recommendations to the NS and the railway sector, an elaboration will be given on the policy recommendations resulting from this research. The first recommendation originates from this study interpreting legislation as a strict limitation. Exploration of the design space has been done within these limits. However, it has often been mentioned by interviewees that the risk of adjustments to the process design resulting in a *significant change*, leads to avoidance of intermediate design modifications for the aim of innovation and optimization, reducing the process' flexibility. It is therefore recommended to explore the potential of modification of the requirements of the significant change in legislation. Even a slight increase of the "threshold" to meet these requirements could possibly result already in confidence on procurer's side to make intermediate changes. Such a legislative modification stimulates innovation, as desired.

As elaborated on in Chapter 1, at the start of this research a lack of flexibility for intermediate design changes available in the public procurement of long-term assets was perceived. This research has used applicable procurement legislation as the limiting framework, leading to the search for more flexibility within this framework. From this research it can be concluded that there is considerable design space to increase this flexibility within the existing legislative framework. Apart from the policy recommendation made, no further suggestions are made regarding increasing the design space. However, it would be advised to policy makers to emphasize the possibilities for innovation and optimization within the legislative framework, as identified in this study, and inform (semi-)public organizations about the use of this space and support and encourage them to do so.

10.4. Validity and reliability

To ensure the quality of the results of this research, its reliability and validity must be increased as much as possible (Thyer, 2009). Reliability is concerned with the replicability and consistency of findings, the degree to which other researchers performing similar observations in the field and analysis such as reading field notes transcribed from narrative data would generate similar interpretation and results. It is stated by Thyer that it is important to carefully document how the design decisions are made and how methods and interpretations evolved, being called an audit trail. This allows a basis for checking the researchers' methods and interpretation. Increasing the reliability of this research has been done by the creation of an "audit trail" of the development of the MC in Appendix D, substantiated by the reference to the specific summarized statements of the interviewees.

Validity of the results can be increased by peer debriefing: test and expose growing insights to critical questions and feedback of "peers". The documentation should contain how this feedback has been processed, as is shown in the validation sections of the chapters 1.6 and 7. An audit trail also increases validity and can therefore be found in Appendix D. The trustworthiness of results is the bedrock of high quality qualitative research. Member checking, also known as participant or respondent validation, is a technique for exploring the credibility of results (Birt et al., 2016). Data or results are returned to participants to check for accuracy and resonance with their experiences. To increase the validity of the data collection in this research, all interviews have been summarized into statements. These summaries of statements have been send to the interviewees, who have all signed the summaries in accordance with its content and formulation. Additionally a focus group was organized. During the focus group five NS-employees have validated the use of the morph chart as a design tool and the design lines, further increasing the validity of the results (Thyer, 2009).

Other aspects also affected the validity of this research. The conducted research involved the development of the morph chart on its content and as a design tool. Eight interviews with eleven respondents caused the sample to be limited. Given the limited time, a trade-off was made between increasing the sample or maintaining thorough analysis of the interviews, exemplary for exploratory research. However, it is stated by Malterud et al. (2016) that the more relevant information a sample contains, the lower the required amount of participants is. Since each of the conducted interviews generated much relevant input, this upheld the validity of the research. Additionally, it must be mentioned that during three interviews two respondents were interviewed simultaneously, which may cause their answers to be biased by the presence of a colleague (Bergen & Labonté, 2020).

Another aspect decreasing the validity of this research is caused by the iterations of the interviews, which were conducted in a random order, based on personal availability over time. However, this random order affected the adjustments in the morph chart as feedback was immediately implemented. After, the next interviewee received this updated version. The matured morph chart might therefore be different in case of another order. However, the alternative was to provide all interviewees with the same, initial morph chart. This would have affected higher validity, because of the same starting point

and thus no influence of order. Nevertheless, it has been explicitly chosen not to do so, for the sake of gathering as much new knowledge as possible. Therefore, feedback was always processed in between interviews.

10.5. Limitations

A limitation of this research is to be found in the fact that not all connections between means have been translated in design lines. This is done to avoid the creation of too many design lines based on very specific cases mentioned. Also, this would have required too much of the focus group to be spent validating the design lines and would have caused the loss of focus of the participants.

Also, theoretical saturation of the diagram has not been reached, which makes it harder to make valid statements on the results. Theoretical saturation would have been reached if the answers to the interview questions no longer provided new information (Braun & Clarke, 2021). In the case of this research, this would have meant that no more adjustments were made to the MC in the last interviews. Even though less modifications were made in the interviews towards the end of the development, no such saturation was reached.

Another limitation present is the possible interviewer bias, which may have been caused by the researcher doing observations (Downey, 2015). These observations have been used to mature the MC as a tool, but there could be personal bias behind the interpretation of the results found.

Further limitations also focus on the performed interviews. For example, it has been found to be best to talk about a finished project in the first part of the interview, the case. If the project is not yet finished, analyzing the effect of the changes made aiming to provide flexibility is hard/impossible. Also, explaining and going through the full morph chart during the interview is too extensive, it takes too much time and head space of the interviewee, to enable an in-depth analysis of the view/opinion of the interview on the morph chart as presented. Immediately questioning their expert view hereon, after introducing the chart, is an additional factor making it too much. Avoiding this is done, after the first two interviews, by sending the morph chart and a short introduction hereto in advance of the interview to all interviewees.

Furthermore, it proved difficult in the time available for an interview to discuss the two parts of the interview structure, the case and the MC, and additionally direct the conversation towards a case similar to the NS case. This resulted in cases being discussed during the interviews that were not all directly comparable to the NS-case, making its interpretation initially more difficult. Since the existing body of literature on flexibility in PPP, and thus the theoretical support for these interviews, was so limited, it was almost impossible to outline a good framework here for in advance. The researcher clearly defining and communicating to the interviewee the required type of case to be discussed can lead to improved outcomes. It is expected that this will not so much lead to a significant expansion of the design space, which is actually broadened by the pluralistic cases discussed, but rather to the identification of design lines that are more specifically focused on bringing flexibility to long-term processes. However, it can be countered that it is questionable whether there are "more" trends to identify within the current procurement sector, or whether the *Collaboration Light* and *Plus* design lines actually already provide a (nearly) complete overview of the best practices known to experts so far.

Lastly, the executed interviews presented using a content manual for the MC to be lacking herein. As explained, the MC uses short descriptions in the cells of the chart, but more explanation can be required. In his research, this was overcome by the researcher providing clarification when needed during the interview. To standardize this "input" to the interview, it would have been better to introduce a manual for this, especially as the MC became more comprehensive. If future research continues the application of the MC for institutional design, it is recommended to do this in order to unequivocally clarify the concepts in the MC.

10.6. Relevance

10.6.1. Society

The overview of flexibilities, and means showing how to "fulfill" those aspects, provides concrete insight to the procurer in the public domain, to enable intermediate changes for innovation. Application of these process aspects could establish a more flexible process, which results in enhancing the level to which an asset is up-to-date. The assets in the public domain aim to serve society in the best way possible, which will be improved by enabling intermediate design changes. This enhanced flexibility of the procurement process in the railway sector provides adaptability to changing circumstances. This causes the ability to innovate and optimize long-term assets of high societal value, e.g. being mobility, during the public procurement process whereas this was limited before. Apart from better procurement results and therefore enhanced results for society, this will cause lower transaction costs of changes, e.g. by lower or even no renegotiation costs or requiring the start of a new PP process for innovation. Since the procurer is a public organization, ultimately this is paid for by society.

10.6.2. Science

The scientific relevance of the conducted study lies in the use of the morph chart for institutional design, the newly developed methodology of the MC attributes to the tangibility of institutional design. Also, the found and systematically presented design space for flexibility in public procurement is new to science and attributes to the body of literature on innovation in procurement (Obwegeser & Müller, 2018).

Going all the way back to the start of this study, this research approaches the procurement process as a functional

technical system being (re)designed. This starts with the analysis of the current process through IDEF0 modeling; each process step is approached as a function of the technical system, with its own inputs and outputs. After identifying the flexibilities and translating them into the morph chart, again the functional technical breakdown of the procurement process as a system can be clearly seen. The same applies to the preparation of the design lines: the institutional design is considered and treated as being the actual "product" of this research. This approach was already specified as Engineering Design Approach (see: 2.1), but has also proven to be a sustainable approach throughout this research. This systematic analysis and approach to the procurement process is not known in the current literature and industry. Providing a structured and integral way to discuss institutional design enhancing flexibility in PP processes is of great value, regardless of its capabilities to find a solution to specific cases.

These findings add to the study of Public Procurement for Innovation (PPoI), as being the study of how public services can be adjusted such that investments in innovation are increased (Edler & Georghiou, 2007; Obwegeser & Müller, 2018), requiring a change of behavior by the procurer. The overview provided by this research adds to this study by indicating what institutional aspects of the procurement process must be specifically designed and substantiated in order to enable intermediate design changes for the aim of innovation. Although, this has been studied in the context of the railway sector, the validated usefulness of the MC and its content shows application of this methodology and content to other sectors might be useful as well, as will be elaborated on later.

Apart from the relevance of the insights on the design space for flexibility, the use of the morph chart as institutional design tool is of value to scientific literature. Applying the MC in this context has shown that the morphological chart can successfully be deployed as institutional design tool. It shows "building a bridge" between institutional design and broader literature on design can and should be explored.

10.6.3. MSc Programme

Following up hereon, this link between engineering design and institutional design aims to spark the interest of students within the MSc programme CoSEM. The practical application of the MC makes institutional design more tangible; no long texts have to be read initially, the MC provides overview by mentioning topics of flexibility. This concrete representation speaks to the imagination, aiming to spark the interest of CoSEM students to dive deeper into institutional design.

10.7. Future research

As mentioned above, this research serves as a first 'grip' for future research on flexibility in procurement and institutional design by the MC. As this is a first exploration, numerous options for new research exist. However, the researcher would recommend to explore the developed MC and design lines by application to real case studies within the railway sector. Application to other sectors might be studied in the future as well, but since this MC is created within EU legislation for special sector organizations, completion of the MC within this sector must be finished before it is applied to public procurement outside the special sectors. Maturing the current morph chart, within the railway sector, would therefore be recommended as a first step. After, it should be studied if and how the MC must be modified to make it applicable to other sectors and additionally with a different focus than flexibility and to different EU countries. Furthermore, the opportunities to apply the created MC for PP processes of short-term assets must be researched. No information was found indicating that this application requires adjustments to the MC. This should be studied in future research, especially since confirmation of this expectation would directly lead to a substantial increase of the scope covered by the MC.

Apart from exploring the broader application of the MC, research on a more detailed level is recommended. Studying how these flexibilities can be implemented in real life situations will give insight on how this should (not) be done and its effects, causing the MC to be adjusted to the findings and therewith improving its content. This should specifically be done for the risk-related categories. As mentioned before, no specific courses of action have been provided for risk determination, mitigation and profile, since this requires expertise and extensive in-depth research into the application of these risk elements within PPP aiming for flexibility.

Another aspect requiring further investigation is the current inability to design the MC in such a way that it visually includes the relations between means. In this research no sufficient method has been found to present the dependence of means in the morph chart without creating chaos. In following research or even a more practical exploration, a deeper dive is needed into how this would best be done. Such research should also focus on how the appropriate definitions, detailing or nuance of categories and means can be included or "attached" to the MC in a way that the chart can be used independently of a manual of any form, without decreasing its concreteness.

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A

Appendix: Full IDEF0 Model

In this appendix a full overview of the created IDEF0 model of the current public procurement process is presented. In Chapter 3 already part of this model is shown to provide insight in how the IDEF0 as a functional modelling technique is deployed, but foremostly to support the identification of flexibilities. As the created model is quite extensive, covering a wide scope of process stages as well as a deep insight into the details of these steps, the full model is presented in this appendix. If only the figures showing the "remaining" parts of the model would have been included here, a loss of overview would be the result.

A.0.1. Model coherence

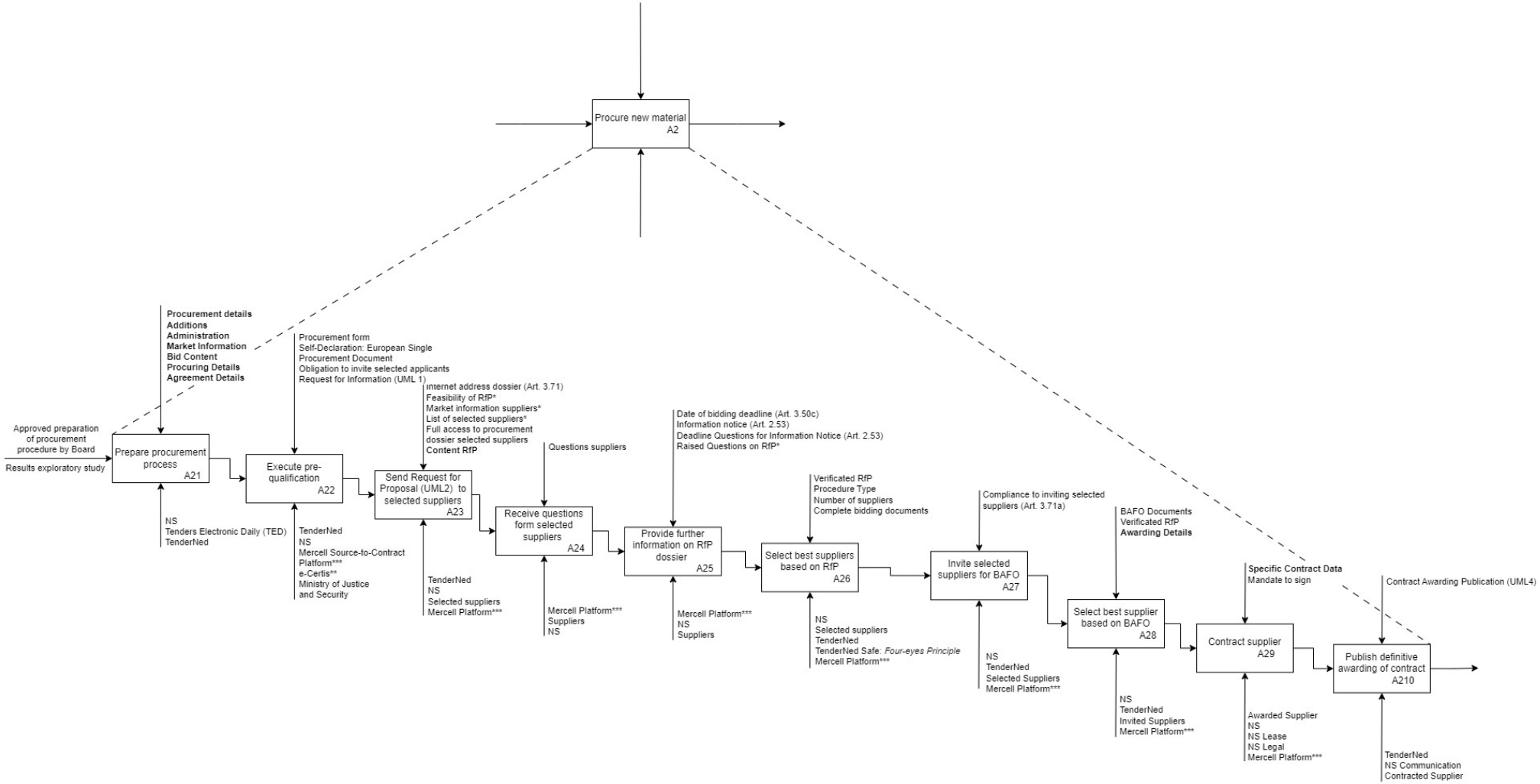
For the preparation of the procurement process in figure 3.4 (A21), the execution of the pre-qualification in figure A.3 (A22), the selection of the best supplier based on the Best and Final Offer (BAFO) in figure A.6 (A28) and contracting a supplier in figure A.7 (A29) the process step is worked out one more level in detail. In the case of sending the RfP to selected suppliers in figure A.4 (A23), one of the process steps consists of sub steps with a considerable importance for the process in general. Hence the verification of the RfP in collaboration with the market (A232) is broken down again and is shown in the lower part of figure A.4. The same applies to the selection of best suppliers based on the RfP as can be seen in figure A.5. In this case, the review and valuation of RfP-proposals is worked out in more detail by adding an extra level of process steps.

Lastly, in figure A.8 a map is created that shows the coherence between all shown process steps. All rectangles of the same color belong together and have earlier been shown together in one diagram. Each diagram has been appointed a roman numeral that can be found in the description of each figure above. This all has been done to support the overview for the reader. It must therefore been said, that this map is not able to provide insight in the details, but is solely created to show how all parts coalesce into the bigger picture.

See next page.

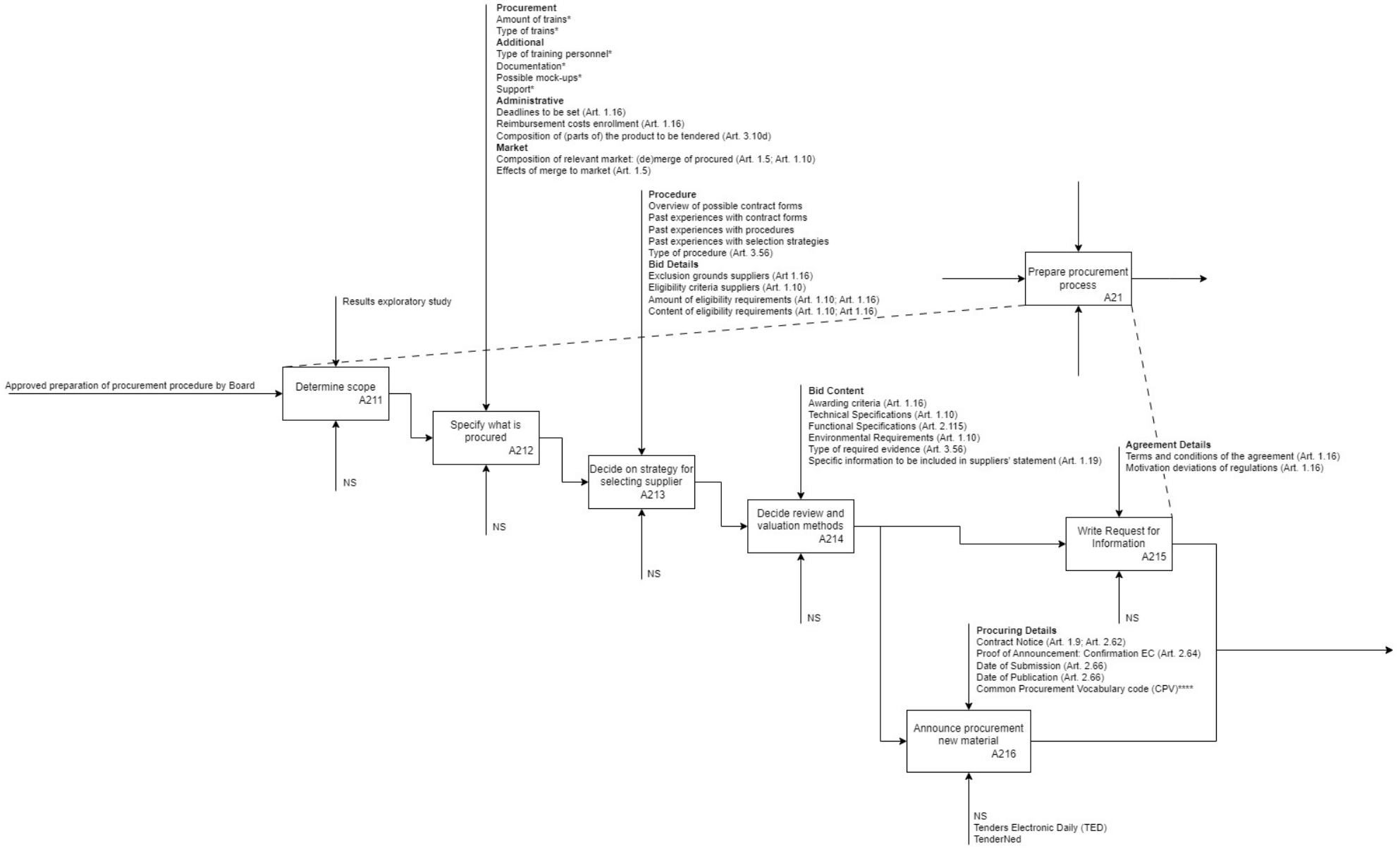
A.0.2. Procurement of New Material

Figure A.1: IDEF0: Process Overview of the Procurement of New Material (A2)



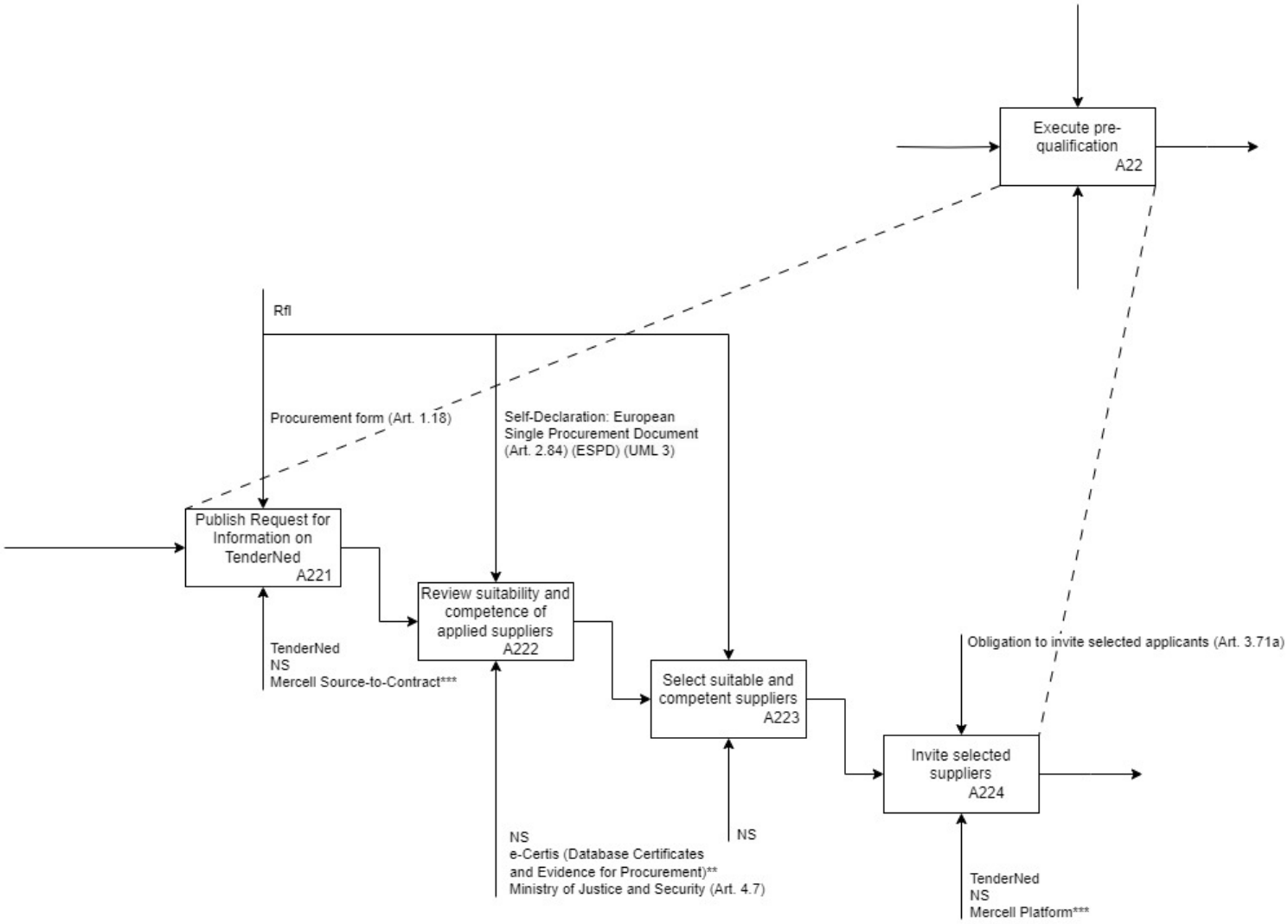
Preparation of Procurement

Figure A.2: IDEF0: Detailed Break Down of the Preparation of the Procurement Process (A21)



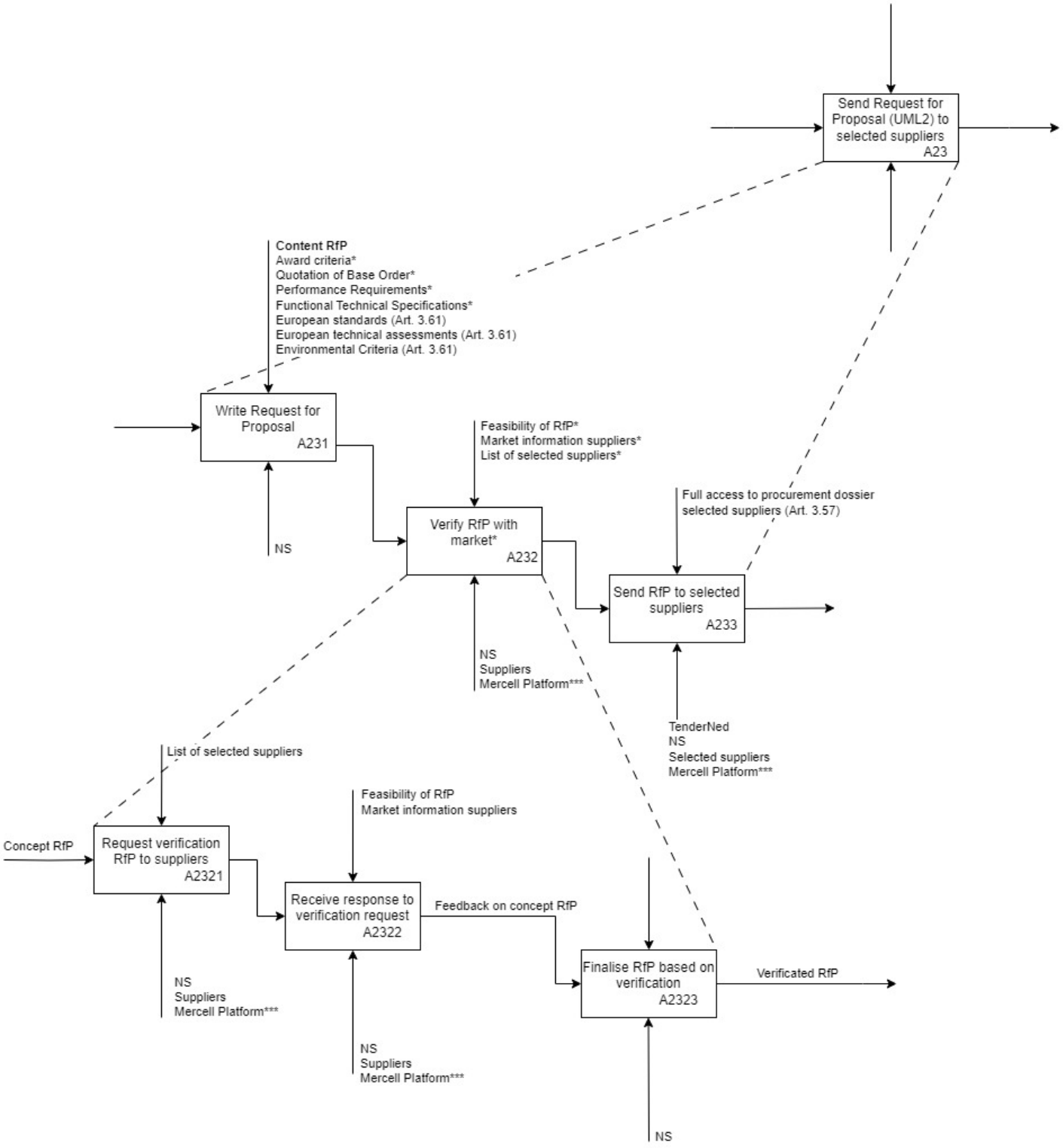
Execution of Pre-Qualification

Figure A.3: IDEF0: Detailed Breakdown of the Execution of the Pre-Qualification (A22)



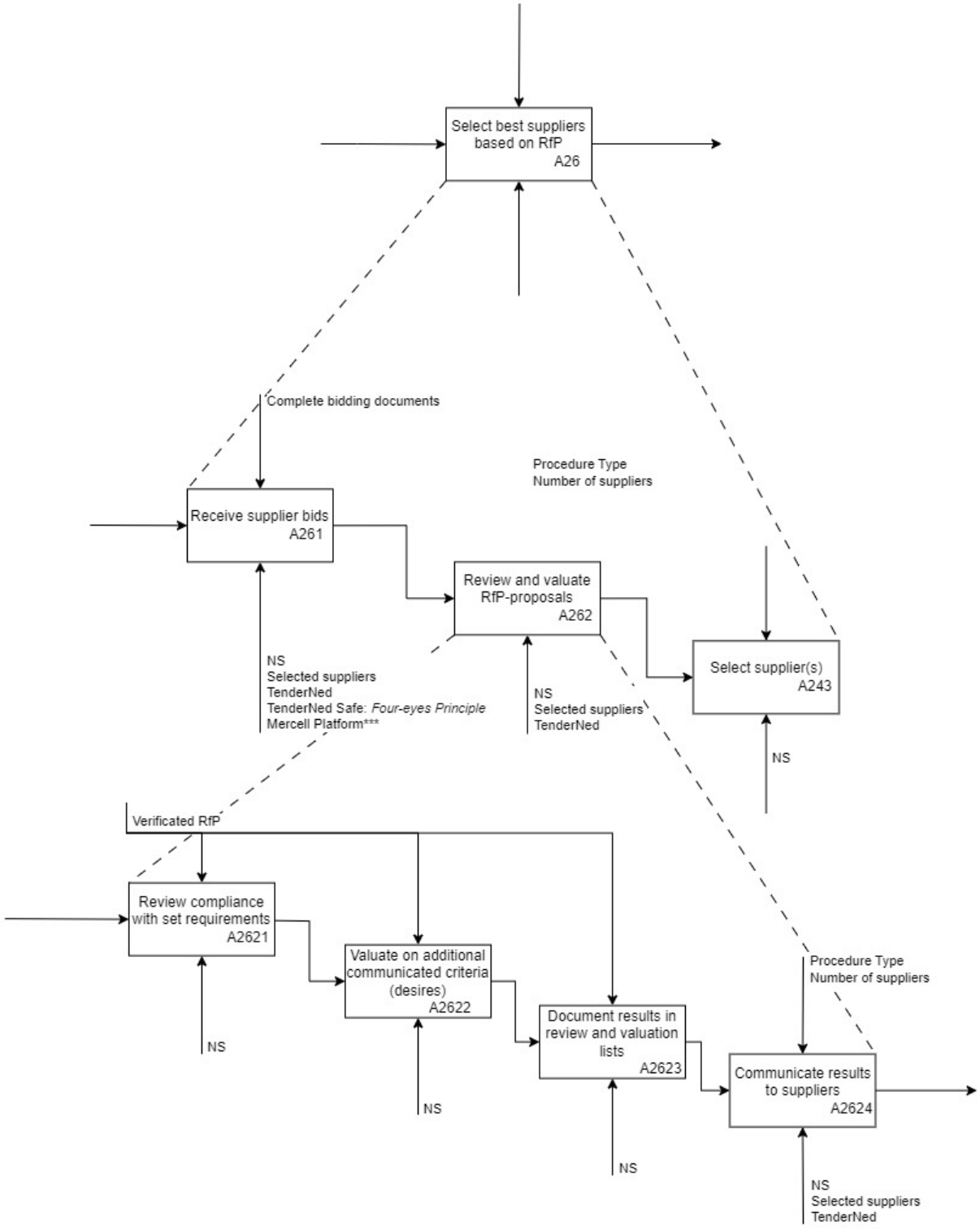
Sending RfP to Suppliers

Figure A.4: IDEF0: Break Down of Sending RfP to Selected Suppliers (A23) and Further Detailing of Verifying RfP with Market (A232)



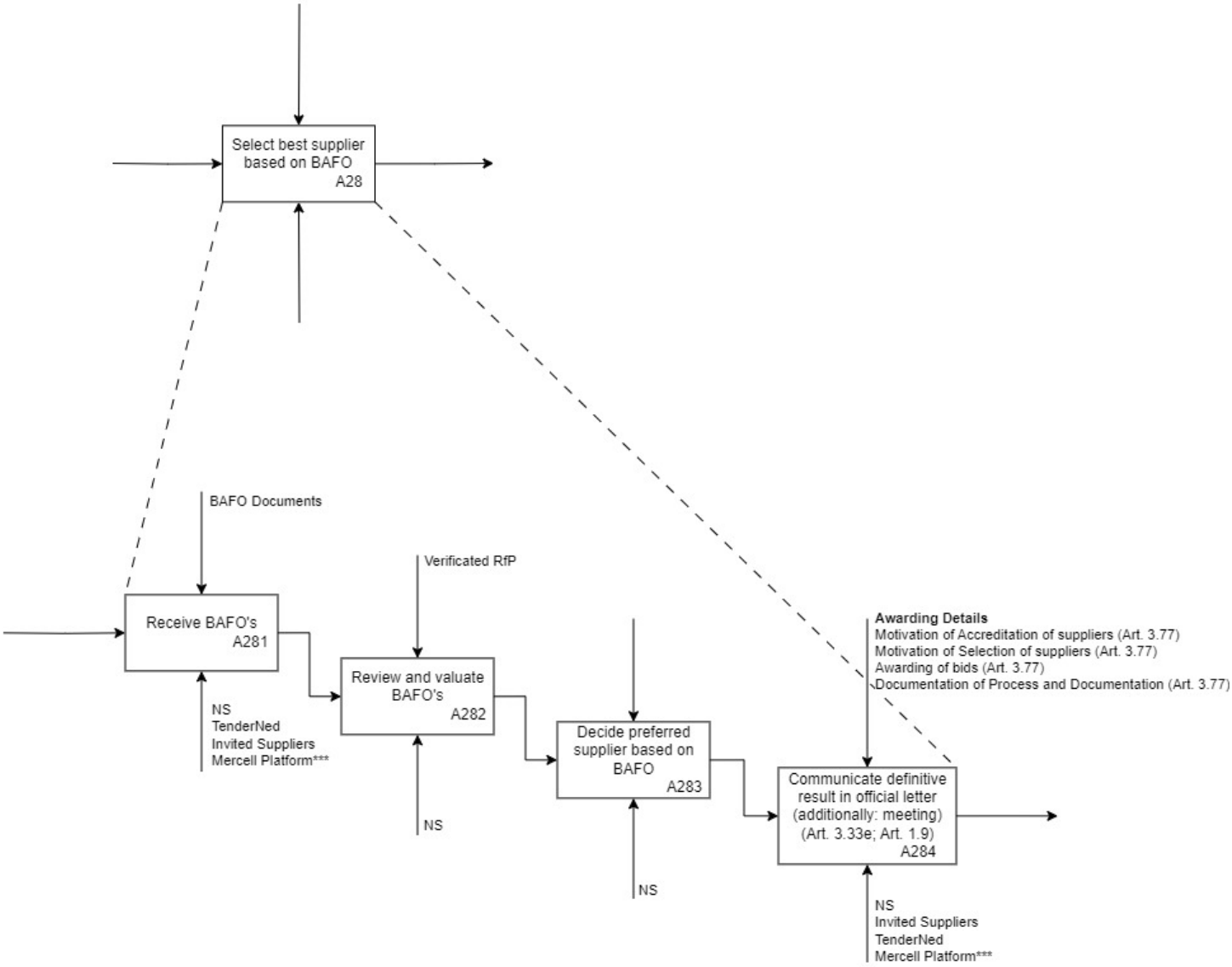
Selection of Best Suppliers - RfP

Figure A.5: IDEF0: Break Down of Selecting Best Suppliers based on RfP (A26) and Further Detailing of Reviewing and Valuating RfP Proposals (A262)



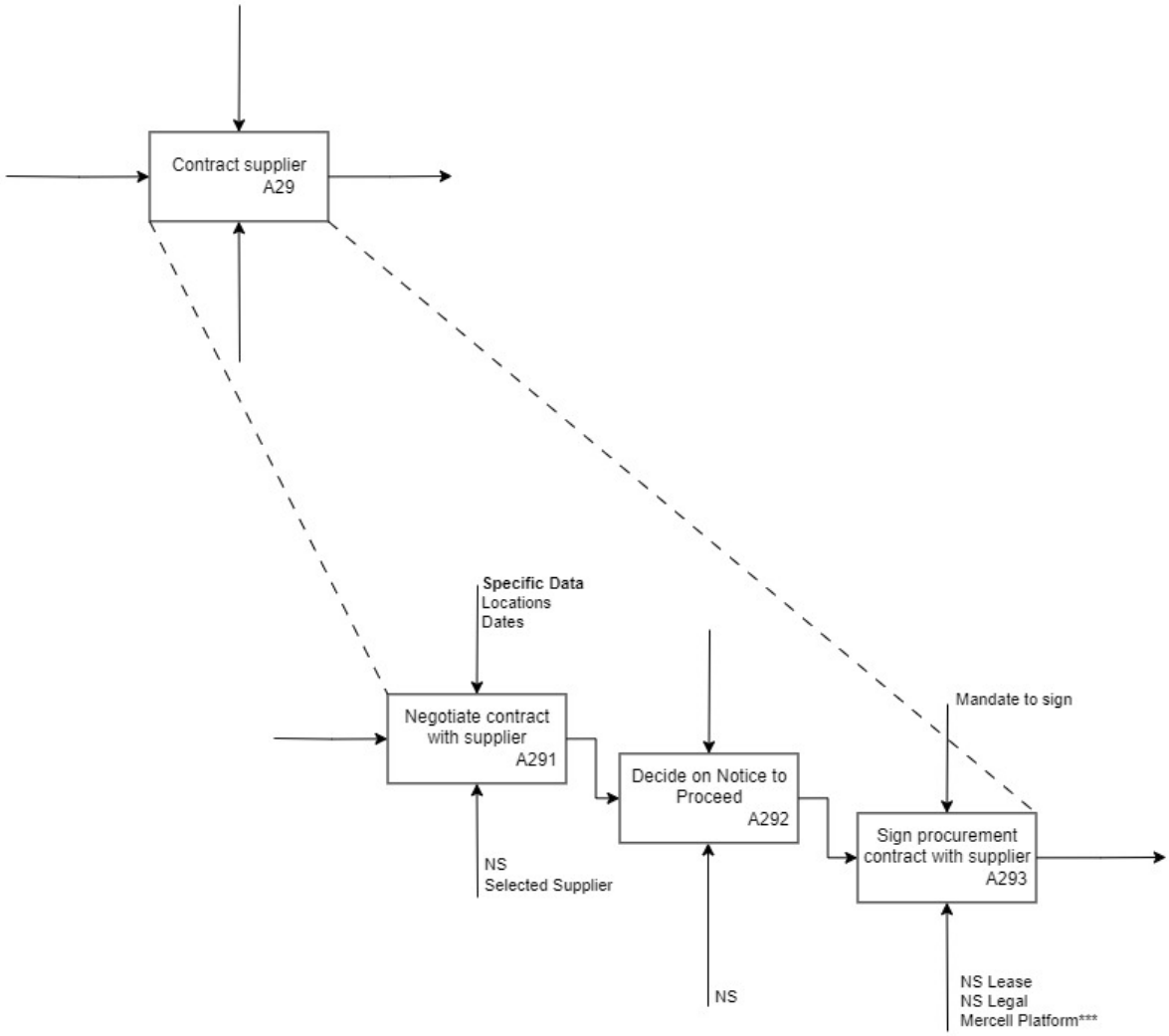
Selection of Best Suppliers - BAFO

Figure A.6: IDEF0: Detailed Break Down of the Selection of Best Supplier based on BAFO (A28)



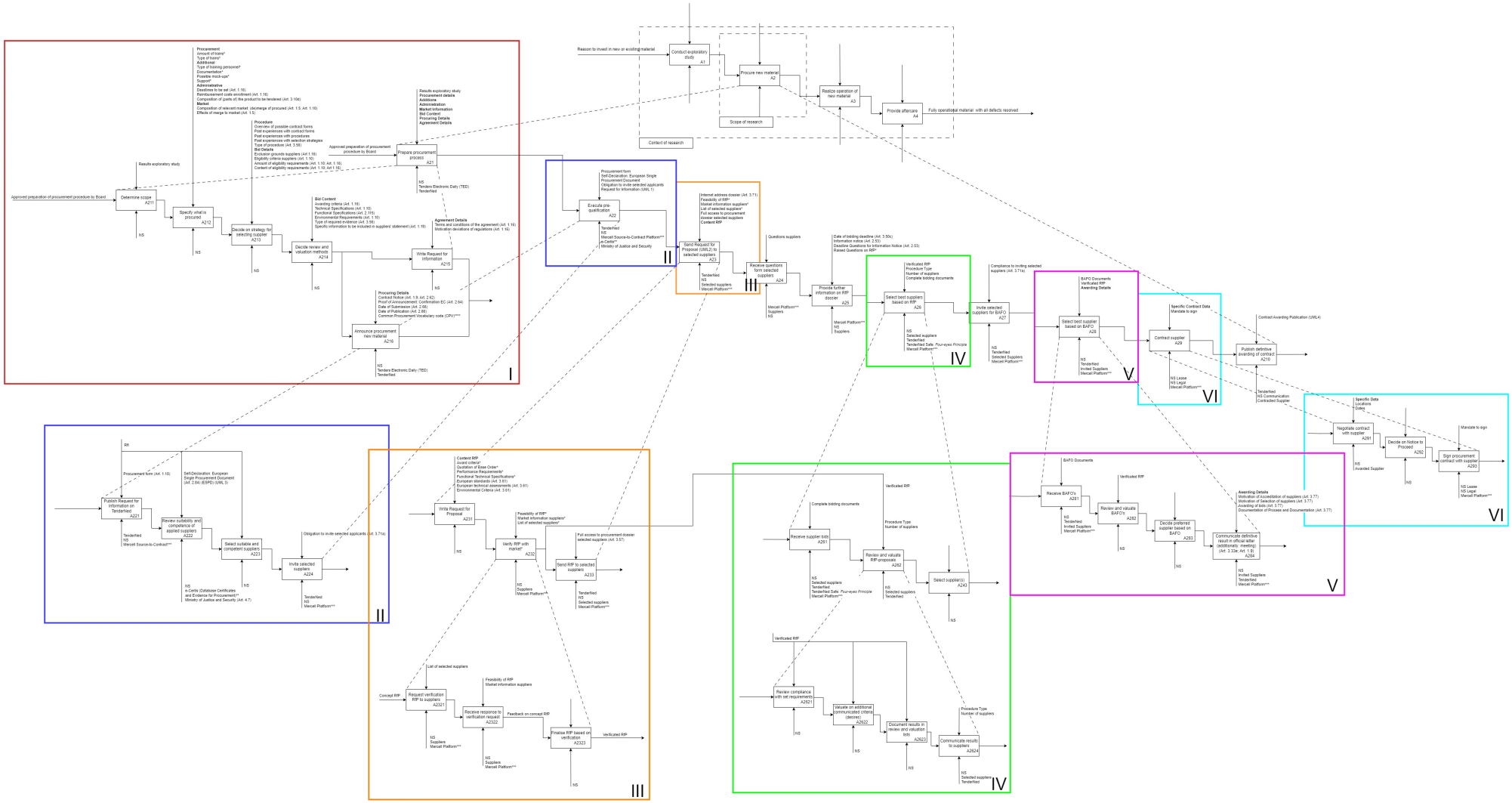
Contract Supplier

Figure A.7: IDEF0: Detailed Break Down of Contracting a Supplier (A29)



A.0.3. Map of Model Coherence

Figure A.8: Map presenting the Coherence of All Shown IDEF0 Process Steps



B

Appendix: Expert Interviews

Below the methodology of the conducted expert interviews is presented. After that, the interview structure is presented, as well as the introduction provided to the interviewees in advance of the meeting.

B.1. Semi-structured interviews

Semi-structured interviews offer a flexible yet systematic approach for the collection of qualitative data. The advantage of using this type of interviews is that this method has been found to support reciprocity between the interviewee and the interviewer (Galletta, 2013). This allows interpretation of the participants individual expressions (Kallio et al., 2016). Also, more in-depth questions can be asked based on the topics coming along during the interview, which leaves freedom to the interviewer (Adams, 2015). To conduct a semi-structured interview correctly, the questions are written in advance of the interview to establish upfront determination of the topics to be discussed and results in very rich data (Bearman, 2019).

This application is required in this research as the goal of each interview is to retrieve feedback on the content of the MC, the usage of the chart and collect data on earlier experiences with flexibility in public procurement of each expert. This way, it is tried to also gather insights on the relations between means in the morph chart. The free but guided structure of the semi-structured interview is therefore a suitable method for these interviews.

The conducted interviews will be recorded and transcribed. These transcriptions are then summarized and signed by the interviewee for approval. Apart from the summary of 'statements', observations based on the mentioned reciprocity are made. This is done to provide more, intangible insides on the use of the MC by interviewees.

Iteration

The interviews were conducted in a random order, which was based on personal availability of the interviewee. However, as the MC was developed in iterations, the interviewee was asked to give feedback on the resulting MC of the interviewee before. This means that the order of interviewees could have an influence on the concluded design. Though, by organizing a focus group for validation, it was attempted to mitigate this effect.

B.2. Interview structure

After Interview II, it has been decided to provide the Introduction - Part II in advance of the meeting. As experts showed they needed some time to process the MC and its use, it was decided to send this introduction upfront. This resulted in less time consumed by familiarizing the interviewee with the methodology and provided them with more time to already think about it.

B.2.1. Part I

Introduction

Welcome!

Today I would like to discuss flexibility in procurement. With this research, I am studying how flexibility can be built in by the procuring party to enable innovation/continuous development of the tendered product before and after the awarding of the contract. The goal is to be able to provide an overview of possible "process designs" that can be applied to create the most flexible procurement process possible within existing legislation.

B.2.2. Questions

1. Can you briefly explain a case you participated in in which flexibility played a role?
2. What was the intended purpose of bringing this flexibility into the procurement process?

3. How was this flexibility introduced into the procurement?
4. Looking back on this case study, was this approach a success or not and why?

If question 1 = no

- Can you explain a case in which you would have liked more flexibility?

Backup question 3

- How would you have approached bringing in this flexibility?
- Why did it turn out differently?

Further questions

- With whom?
- When?
- Why?
- How?

B.2.3. Part II

Introduction

Within this research, the methodology of product design is applied to designing a process in which flexibility is built into the procurement.

First, an analysis was made of the "design space" that exists in procurement processes. To do this, we analyzed what the procurement process looks like, what the known capabilities are herein, and how they can be categorized. The result is a morph chart. This is a diagram in which the various functions of a product, or in this case a process, are plotted along with all the solution options that exist for fulfilling these functions. The morph chart thus not only charts what is possible but also encourages out-of-the-box thinking in terms of solutions.

After coming up with as many 'means' as possible for all sub-functions, designs are generated by choosing a solution for each sub-function to combine with a solution for a subsequent sub-function. It is easiest to explain this methodology using an example. For designing a product from which to drink fruit juice, the morph chart will look like this:

Figure B.1: Explanation Morph Chart Methodology for a Beverage Container

Morph Chart Example						
Means	1	2	3	4	5	6
Feature/Function						
Contain beverage	Can	Bottle	Bag	Box	....	....
Material for drink container	Aluminium	Plastic	Glass	Waxed cardboard	Lined cardboard	Mylar films
Mechanism to provide access to juice	Pull tab	Inserted straw	Twist top	Tear corner	Unfold container	....
Display of product information	Shape of container	Lables	Color of material	....	....	....
Sequence manufacture of juice container	Concurrent	Serial	....	....	....	....

Morph Chart Example						
Means	1	2	3	4	5	6
Feature/Function						
Contain beverage	Can	Bottle	Bag	Box	....	....
Material for drink container	Aluminium	Plastic	Glass	Waxed cardboard	Lined cardboard	Mylar films
Mechanism to provide access to juice	Pull tab	Inserted straw	Twist top	Tear corner	Unfold container	....
Display of product information	Shape of container	Lables	Color of material	....	....	....
Sequence manufacture of juice container	Concurrent	Serial	....	....	....	....

In my research, I did the same for flexibility in procurement. Sub-functions of the procurement process that were identified to influence the flexibility of the process are plotted in the first column. For all these sub-functions it has been worked out what solutions can currently be found in the literature and other documentation to 'fulfill' the function. All this produced the following result:

The most recent version of the MC is presented.

Feel free to take a look at the morph chart. My questions will focus on whether you have any additions or comments on this, which gives you a short preview on what I will be questioning in the next part of this interview.

Part II

5. Are there any "categories" you miss in this morph chart?
6. Are there 'resources' that you miss in this morph chart?
7. Are there any factors included in the morph chart that you think would be better left out and why?
8. Are there any factors that you have experience applying and would you recommend/recommend?
9. Do you see any combinations between "resources" in the morph chart that you know are a good or not a good combination?

C

Appendix: Summaries Interviews

C.1. Summary Interview I

Interview from the perspective of the Nederlandse Spoorwegen.

C.1.1. Case

1A. Vroeger was een trein mechanisch, nu zit er steeds meer software ed. in. Bij oplevering is de software, die een aantal jaren daarvoor gespecificeerd is, al verouderd. Contracten waren vroeger ingericht op dertig jaar rondrijden zonder veel aanpassingen gedurende de levensduur, tegenwoordig vinden er steeds vaker en veel meer tussentijdse aanpassingen/updates plaats.
1B. Tot voor kort specificeerden we binnen tenders, bijvoorbeeld bij een Onboard Information System (OBIS) dat door NS werd aangeleverd, waarbij het de verantwoordelijkheid was van de leverancier dat dit systeem communiceerde met de trein. Nu zetten we stappen waarbij NS meer standaard systemen van de markt koopt op basis van wat beschikbaar is en om daarmee ook meer *up-to-date* te zijn.
1C. Om dat goed vorm te geven wil je het liefst in gesprek gaan met onderleveranciers, maar dat past niet binnen de aanbesteding, waarin we alleen met de treinbouwer spreken als aanbieder. Het is voor de NS een worsteling hier een goede vorm aan te geven.
1D. NS kent twee fases, de leveranciersselectie op basis van de Request for Information (RfI) en daarna de Request for Proposal (RfP) en ga je echt met het product verder. Echter ligt dan de scope vanuit de RFI al wel vast, dit is best lastig. Mogelijke wijzigingen proberen we wel al in de RFI fase kenbaar te maken in de scope omschrijving, zoals softwarematige aanpassingen, maar het blijft een zoektocht hoe we dat goed doen.
1E. Een ander soort flexibiliteit die we vastleggen zit in wet- en regelgeving. We zien nu dat technische wetgeving binnen een paar jaar gaat wijzigen, dan nemen we in het contract op dat de wijzigingen voor contractsluiting voor rekening van de leverancier zijn en maken afspraken, afhankelijk van het soort wijzigingen, over wijzigingen na contracteren en wie de mogelijke consequenties draagt.
1F. In de toekomst zou getest kunnen worden met het vastleggen van momenten in het contract waarop de prijs of exacte invulling van een eerder onbekende innovatie wordt bepaald. Dan kan ook worden besproken wanneer de leverancier dergelijke *Post Delivery Items* (PDI) moet leveren. Voorwaarde daarbij is wel dat het mogelijk moet zijn een dergelijke innovatie gedurende de levering of later te retrofitten in de trein.
1G. Onbekend is of deze manier contracteren succesvol is. Hier moet goed over nagedacht worden omdat het echt anders is dan eerdere contracten, je contracteert immers ook een deel van de ontwikkeling mee. Er is intern het beeld dat dit mogelijk een deel van de oplossing zou kunnen zijn.

C.1.2. Morph Chart

1H. Als je flexibel wil zijn, is het van belang goed de scope aan te geven aan het begin. Deze moet duidelijk zijn maar ruimte bieden, dat ligt bij de aanbestedende partij. Wel is het mogelijk te vragen om varianten. Als een leverancier een goed idee voor innovatie heeft die bijdraagt aan de doelstellingen van de NS, dan mag dit aangedragen worden binnen de aanbesteding, het wordt zelfs gestimuleerd. Het gaat dan wel om een variant op de trein, zoals een internationale variant. De basistrein blijft daarbij in tact.
1I. NS kent een gunningscriterium “Surplus”. Dat houdt in dat we vragen om een basistrein (platform), maar als de platformtrein van de leverancier op bepaalde eisen beter is en NS vraagt daar niet om of stelt lagere eisen, dan wordt dit gewaardeerd binnen het gunningscriterium ‘surplus’.
1J. Dit zorgt ervoor dat de NS steeds meer ‘van de plank’ [catalogus specificaties] gaat kopen. Dat is gewenst, maar ingewikkeld door specifieke [technische] eisen van het Nederlandse spoorwegnet. Grootste deel van de trein moet van de plank zijn, deel moet gewoon aangepast worden aan de Nederlandse infrastructuur en deel mag NS-specifieke eisen zijn, waarbij we steeds meer IT/OT-ontwikkelingen vanuit de markt accepteren.

1M. Eerder is er al eens een Long-Term Service Agreement (LTSA) afgesloten. Er was eerst alleen een support agreement, waarbij de leverancier klaar is zodra de trein door de validaties heen is. Toch hebben we meer hulp nodig, vandaar de LTSA.
1N. De catalogus specificaties lijken me handig: kiezen welke combinatie van dingen van de plank je wilt hebben.
1O. De onderhandelingsprocedure met vooraankondiging is de procedure die gebruikt wordt. Daar binnen zijn er een X aantal plekken voor de volgende ronde. Voldoen alle inschrijvers aan de gestelde eisen en is het aantal inschrijvers gelijk aan het aantal plekken, dan mogen ze allemaal 'door'. Zijn er meer inschrijvers, dan toetsen we ze aan de selectiecriteria om het aantal inschrijvers te limiteren.
1P. Na deze selectie/limitering vindt de verificatiefase plaats, waarin we checken of ons conceptbestek en -contract maakbaar zijn. Daarna sturen we de gunningsleidraad uit voor een eerste bieding. Na die eerste bieding gaan we voor het eerst met de inschrijvers in gesprek, en geeft NS terugkoppeling. Er wordt dan aangegeven waar volgens de NS al dan niet wordt voldaan aan de eisen, dan wel waar dit nog onduidelijk is, waar het beter kan. Leveranciers kunnen daarna vragen stellen over onduidelijkheden. Vervolgens gaat de BAFO-leidraad eruit, met eventueel geüpdatete stukken en het verzoek om een BAFO in te dienen. De beste aanbieder wordt dan gekozen en daarmee wordt onderhandeld, wat leidt tot definitieve selectie en het sluiten van het contract.
1Q. Het limiteren van leveranciers doen we soms in één ronde en soms in meerdere.
1R. Er is gebrainstormd over het gebruik van een (gedeeltelijk) innovation partnership. Dit is er niet gekomen, omdat we, als NS, toch vasthouden aan wat we kennen. Ontwikkelen met een partij samen vinden we een te grote stap.
1S. Het aanbesteden van de trein apart van innovaties zou kunnen werken.
1T. Toch is de houding van de NS voornamelijk dat we graag willen specificeren aan de leverancier hoe NS het graag wil. Daardoor is het lastig om te gaan met als de leverancier bijvoorbeeld zegt: "dit kan niet." We vragen daardoor vaak dingen nogmaals na, om te checken of dat de leverancier toch niet conform onze specificatie kan leveren. Die *mindset* moet veranderen binnen de NS. Het loslaten hiervan gaat extra tijd kosten en er zal veel bijgestuurd moeten worden, maar ik zou het interessant vinden.
1U. Bij een recente aanbesteding is er een Design and Construct contract gebruikt en de gevraagde minimumgeschiktheid-seisen zijn financiële en economische capaciteit, technische geschiktheid en beroepsbekwaamheid.
1V. Het is lastig voor mij om dit overzicht te bezien vanuit een ander perspectief dan het inkopen van treinen.
1W. Het werken in percelen is niet zo handig voor de inkoop van treinen. Je hebt dan een *integrator* nodig en die moet wel met alle partijen willen samenwerken. Dat is lastig. Alle onderdelen moeten met elkaar kunnen communiceren. Als je een 'knip' maakt tussen de trein en innovatie, dan moet er nog communicatie tussen beide delen zijn, dat maakt het ingewikkeld.
1X. In de morph chart moet nog iets opgenomen worden waarmee beschreven wordt dat er aanpassingen gemaakt kunnen worden aan het aanbesteedde product, zolang dit beschreven staat in het contract. Als je dat niet opneemt in je contract wordt het lastig om een basis te hebben waarom je kunt gaan wijzigen. Dat geldt ook voor wijzigingen in wet- en regelgeving. Je moet daarvoor opnemen in het contract wat de modificatieprocedure is bij een dergelijke wijziging, wat je dan moet doen. Dit vormt misschien geen losse categorie, maar kan wel een middel zijn.
1Y. Er zijn geen dingen die nu in de morph chart zitten, die niet kunnen.
1Z. Als je ontwikkeling van innovatie hebt moet je logischerwijs ook testen. Dit hebben we niet altijd geregeld bij NS, maar dat zou je natuurlijk het liefst wel hebben.
1AA. Binnen de NS is het geen optie 'alles' uit handen te geven, zoals het onderhoud bij een DB(F)M contract. NS heeft meerdere onderhoudswerkplaatsen, waar veel NS'ers werken. Dat zullen we nooit aanbesteden, dat hoort bij het bedrijf. Ik ben me ervan bewust dat het voordelen zou kunnen opleveren als we dat wel uitbesteden, als de leverancier verantwoordelijk zou zijn voor de trein, ook voor het onderhoud of als er iets misgaat. Toch kiezen we er heel bewust voor om het onderhoud van de trein zelf te doen.
1BB. Het opnemen van *Innovate* als onderdeel van een DB(F)(M) contract zou een optie kunnen zijn. Toch vraag ik me af wat daar de gevolgen van zijn. Kun je dat blijven vragen en voor wat voor periode doe je dat? Voor de volledige *life cycle* of een periode? Communiceert de trein dan nog wel met deze innovaties? Ik vraag me af of dat blijft werken of dat het heel kostbaar wordt. Dat weet ik echt niet en daar moeten we wel rekening mee houden, dat dat consequenties heeft.
1CC. Je zou een geoormerkt innovatiebudget kunnen gebruiken, waarbij je voorwaarden stelt voor innovaties waar NS of de leverancier mee aankomt. Er moet vastgelegd worden wat er uitgegeven mag worden, aan wat en hoe lang dat potje blijft bestaan. Dat zou je kunnen toepassen als je het, als NS, heel belangrijk vindt te innoveren. Wel vraag ik me af hoe vaak de leverancier dan met een voorstel zou komen en of we dan verplicht zijn dat ook daadwerkelijk af te nemen.
1DD. Het begint dan te neigen naar een periodiek innovatievoorstel. Je vraagt dan de leverancier eens per periode een voorstel te doen en te laten zien wat er gewijzigd is op zijn platform. Als de NS dat dan interessant vindt, dan kunnen we dat misschien afnemen. Dat zou dan niet per se op dat moment zijn, maar wanneer er weer groot onderhoud aan de trein plaatsvindt. Wel vraag ik me dan af wie de innovatie dan gaat uitvoeren, de NS of de leverancier zelf? En hoe zit dat met garantie?
1EE. Persoonlijk vind ik dat we hier wel iets mee moeten, omdat we tegen dit soort problemen aanlopen, maar ik zit vast in het denken over hoe dat moet. We zijn zelf onze grootste vijand. We willen heel graag, maar we weten niet hoe. We kunnen het wel vragen aan de markt, maar straks zeggen ze: "Nee" en wat moet je dan?

C.1.3. Morph Chart as Method

1FF. It is hard to let go of my own perspective when discussing the MC.
1GG. I enjoyed looking at procurement from this point of view. It was challenging as it is hard to let go of your assumptions of how to do it.
1HH. This approach was very out-of-the-box.

C.1.4. Observations

OBS1.1 The respondent remembered something she wanted to add to her story by using the MC.
OBS1.2 The respondent showed the tendency to think along, by suggesting and discussing how categories and means could be adjusted to improve.
OBS1.3 The respondent needed some time to process all information in the MC.
OBS1.4 Asking the respondent for confirmation by referring to categories and means enabled structuring the conversation.
OBS1.5 The respondent's interpretation of definition sometimes differed from the intended meaning, which needed clarification.
OBS1.6 The respondent indicated that this separated approach of factors does not reflect the coherence of institutional aspects.

C.2. Summary Interview II

(Anonymized)

C.2.1. Morph Chart

2A. De flexibiliteit in procedures is beschreven in de wet. Als je een wezenlijke wijziging doorvoert, zoals in de wet omschreven, moet je een nieuwe termijn stellen en opnieuw aankondigen.
2B. De flexibiliteit in contracten is volledig afhankelijk van hoe het contract opgesteld is. Elk contract mag gesloten worden, zolang beschreven wordt wat er gedaan wordt, inclusief eventuele toekomstige wijzigingen of flexibiliteit.
2C. Ik zou flexibiliteit in de aanbesteding bevorderen door voldoende ruimte in het proces in te bouwen om met de markt in gesprek te gaan, kijken hoe deze partijen tegen uitdagingen en oplossingen aankijken. Zorg dat je de ingewonnen info vervolgens meeneemt in het contract, dus geen dichtgetimmerde opdracht afleveren, maar ruimte voor input van leveranciers laten en dat verankeren in het contract. Dit kun je doen door de concurrentiegerichte dialoog te kiezen, waarbij je het probleem omschrijft en de oplossing uit de marktpartijen laat komen. Vraag en aanbod breng je bij elkaar. Dat betreft onder andere het gebruik van functioneel specificeren.
2D. Het vragen van periodieke verbetervoorstellen aan je opdrachtnemer is ook een manier om flexibeler te zijn. Dat geldt ook voor het vooraf testen en laten indienen van varianten; het toevoegen van experimenteerruimte door het gebruik van een perceel. Ook zou de aanbestedende partij een living lab of een proeftuin kunnen faciliteren in een fysieke of digitale omgeving. Dit testen kan gedurende de bouw plaatsvinden, om niet verder uit te lopen.
2E. Een innovatiepartnerschap kan ook uitkomst bieden, dan laat je het onderzoeken en ontwerpen aan de leverancier met de afspraak het in een latere fase af te nemen. Innovatie zit dan niet aan het einde maar aan het begin.
2F. De huidige opzet van de morph chart is goed. Een aantal dingen kloppen niet.
2G. Wat nu selectiecriteria heten zijn subgunningscriteria.
2H. Minimumgeschiktheidseisen en selectiecriteria hebben betrekking op de aanbestedende partij, (sub)gunningscriteria op de aanbieding.
2I. Minimumgeschiktheidseisen zijn eisen die gesteld worden aan de leverancier wat betreft bekwaamheid en financiële geschiktheid. Referenties vallen daar ook onder, onder technische geschiktheid. Je zou dit ook als selectiecriterium kunnen zien: hoe meer referenties aangeleverd om een kerncompetentie aan te tonen, hoe hoger de waardering en dus hoe groter de kans om geselecteerd te worden.
2J. Selectiecriteria worden gebruikt in het geval er een selectie van leveranciers gemaakt gaat worden en niet iedereen de ruimte gegeven wordt om in te schrijven, deze hebben daarom alleen betrekking op de onderneming zelf en niet op de opdracht. Met deze criteria kan dus daadwerkelijk nog een bepaalde ranking aangebracht worden. Selectiecriteria worden dus gebruikt in een procedure waarin je twee of meer stappen hebt voor de limitatie van aanbieders. Is er maar een ronde, dan zijn er alleen de geschiktheidscriteria.
2K. Wat nu de selectiecriteria heten, zou je beter *requirements* kunnen noemen.
2L. Uitsluitingsgronden tot slot, zijn de in de wet beschreven gronden waarop leveranciers bij voorbaat al uitgesloten kunnen worden. Deze gronden vormen een *knock out*: is de onderneming betrokken bij kinderarbeid, fraude, corruptie? Dan is het meteen *knock out* en mag de leverancier niet meer meedoen in het proces.
2M. In de wet worden drie gunningscriteria genoemd: laagste kosten, prijs-kwaliteit en laagste prijs. Best Value Procurement is geen gunningscriterium, maar een methodiek/filosofie over het inrichten van een aanbesteding en moet dus weg uit het rijtje. Bij BVP wordt prijs-kwaliteit als gunningscriterium gebruikt.
2N. Vaak gebruiken mensen 'gunningscriteria' ook voor het Plan van Aanpak, het omgevingsplan etc. terwijl zij gewoon op basis van prijs-kwaliteit gunnen. Deze PvA en het omgevingsplan zijn criteria op basis waarvan besloten wordt wie de beste inschrijving heeft ingediend. Dit wordt vaak door elkaar heen gebruikt. Formeel heten deze subgunningscriteria.
2O. NS valt onder de speciale sector, dat kan andere regels tot gevolg hebben.
2P. Onder type contract staat de concessie, maar hier is een apart kader voor en dit type is in deze context niet relevant en kan dus weg uit dit rijtje, wat ons betreft.
2Q. De raamovereenkomst geeft kans voor innovatie. Je verstrekt een globale omschrijving van de opdracht en deze kun je later vorm geven. DAS is bedoeld om gangbare producten en diensten mee aan te besteden, dat is niet het geval bij innovatie of doorontwikkeling.
2R. 'Procedurele middelen' vind ik een rare term, hier moet een meer generieke term voor komen. Dan zou je onder deze categorie ook de marktconsultatie kunnen laten vallen, dat mag in alle type procedures, zelfs zonder procedure.
2S. Er is geen volledige vrijheid met het maken van combinaties in de morph chart. Het innovatiepartnerschap kan niet gecombineerd worden met het DAS. Het gebruik van percelen en de selectiecriteria hangen af van je opdracht.
2T. Meest onderscheidend vermogen wat betreft flexibiliteit zit in het testen van innovatie en het toepassen van het periodiek innovatievoorstel en de (contractuele) leerruimte. Het inkopen in percelen heeft wel invloed op de ruimte voor flexibiliteit maar is erg afhankelijk van wat je inkoopt, daar heb je zelf weinig invloed op.
2U. Een pilot en een proeftuin zijn voorafgaand aan een aanbesteding en dan maak je gebruik van een uitzonderingssituatie; kleinschalig testen en bij succes inkopen via een aanbesteding. Ik zou focussen op de periodieke innovatie en de contractuele leerruimte en de proeftuin en de pilot daar los van trekken in de morph chart. De eerste twee zijn het implementeren van flexibiliteit tijdens de samenwerking, de laatste twee is testen vóór je inkoopt.
2V. Wat betreft procedure geeft het innovatiepartnerschap ruimte, net als de concurrentiegerichte dialoog en de mededingingsprocedure; het betrekken van de markt heeft zin. Er is veel minder ruimte bij de (niet-)openbare procedure, daar schrijf je voor wat je wil en hoe je het gedaan wil hebben.

2W. Wat betreft de mate van samenwerking weet ik niet wat de meeste ruimte biedt. Het verdelen van de verantwoordelijkheid is belangrijk, daar staat vast iets in de literatuur over.
2X. 'Vastgelegde modificaties' valt onder je gunningssystematiek. Dat biedt heel veel ruimte voor innovatie.
2Y. Het gunningssurplus begrijpen we niet. Dat neem je op in je procedure, hoe je je prijs-kwaliteit inricht bijvoorbeeld. Dat is geen zelfstandige categorie.
2Z. Wat ik nog niet zie is de risicoverdeling over de partijen, maar ik weet niet zeker of dit een eigen categorie moet worden, kan verweven zitten in andere categorieën. Mijn eigen ervaringen, in onderhandelingen met betrekking tot IT, leren dat des te meer risico je bij een marktpartij legt, van aansprakelijkheid tot andere onderwerpen opgenomen in het contract, des te minder snel zal een partij gaan innoveren. Als risico's en boetes bij de marktpartij worden neergelegd, dan denkt een marktpartij: "Ik ga doen wat ik altijd doe en niet experimenteren, straks doe ik het fout en krijg ik gedoe." Dat valt niet onder de mate van samenwerking; je kunt een klassiek contract hebben waarin je de risico's en verantwoordelijkheden gelijkmatig verdeeld en alle varianten daarop. Hier is vast literatuur over, de verdeling van risico's en verschillende profielen hierbinnen.
2AA. Een gedeelte van het benodigde aanbesteden (volume) levert het risico dat er bij een tweede aanbesteding een andere leverancier uitkomt. Je zou dit kunnen ondervangen met een raamovereenkomst.
2BB. Ik zou buiten 'proces' en 'contract' ook een deel 'marktbenadering' toevoegen: hoe ga je met de markt om? Je kunt 'contract' wat inkorten en dan een deel 'marktbenadering' maken met daaronder de categorieën 'risicoverdeling', 'duur van de overeenkomst' – meer risico bij de leverancier of een kwart van de overeenkomst, doet iets met de prijs – en 'type samenwerking'. Marktconsultatie kan er ook onder vallen. Het hangt samen met hoeveel kennis en kunde je als bedrijf al bezit en hoeveel expertise je van de marktpartij nodig hebt. Je moet nagaan wat allemaal een rol speelt bij de omgang met de marktpartij(en).
2CC. Volgordelijkheid kan het diagram verbeteren. Zet het diagram op volgorde van keuzes die gemaakt worden bij het opzetten van een aanbesteding. Het één komt na het ander, zet het op die volgorde, dan wordt het makkelijker te gebruiken. Eerst analyseer je de behoefte, hoe de markt er inzit en kan bieden, dat is je marktbenadering. Daarna kijk je wat voor contract, denk aan duur en voorwaarden. Als laatst bepaal je welke procedure je gebruikt.

C.2.2. Morph Chart as Method

2DD. Short repetition of 2CC: The sequence of the diagram is influential. As a system is studied in which a certain order of 'design choices' are made, the MC should show alignment hereto. It makes it easier to understand and use.
2EE. I like the morph chart, it is well thought-out.
2FF. The morph chart has a good structure and provides overview.
2GG. This is food for thought, but I am not sure if I can provide immediate response to the MC.
2HH. Not all combinations are possible, you are not completely free to choose what you would like, some things cannot or must be combined.
2II. External factors influence the options in the MC too.
2JJ. Some factors are 'hidden' and only appear when certain choices or combinations are made in the MC, but these cannot be added to the diagram. It could be a nice experiment to brainstorm on how to relate those factors to the MC.

C.2.3. Observations

OBS2.1 Both respondents ask for confirmation on the definition of some topics and the scope of the MC, to ensure similar understanding.
OBS2.2 When the interview started, the respondents immediately wanted to start asking questions and discussing the diagram.
OBS2.3 One respondent was more dominant in answering the questions than the other.
OBS2.4 The principles of mutually exclusiveness and collectively exhaustiveness were not immediately understood by both the respondents.
OBS2.5 Asking the respondents for confirmation by referring to categories and means enabled structuring the conversation.
OBS2.6 The respondent showed the tendency to think along, by suggesting and discussing how categories and means could be adjusted to improve.
OBS2.7 Respondents ask questions to each other, criticize each other's opinion and engage in a collective discussion.

C.3. Summary Interview III

(Anonymized)

C.3.1. Case

3A. Eerder heb ik een grote aanbesteding gedaan in Project A waarbij bij de inkoop het de vraag was hoe we de markt moesten gaan benaderen.

3B. De reguliere manier was een Design & Construct opdracht geweest, maar we hadden twijfels over wat dat zou betekenen voor de kosten voor de marktpartijen, de tenderkosten en de investeringen van onze kant.

3C. We ontdekten toen dat marktpartijen goed zelf in staat waren in te schatten wat er nodig was en wat voor risico's daarbij speelden. Ze konden eigenlijk al meteen een overzicht geven van wat er gedaan moest worden en de kosten, maar aangezien er verantwoording afgelegd moet worden, moesten er toch ramingen gemaakt worden, sonderingen en berekeningen gedaan worden. We zagen dat het inschatten van risico's en de verantwoording aan het management de grootste rol speelden.

3D. Daarom hebben we besloten het met de vijf betrokken marktpartijen anders te doen. We hebben dat 'inschrijven met onzekerheden' genoemd, waaruit uiteindelijk de Tweefasenaanpak uit voort is gekomen.

3E. Onze aanpak was als volgt: marktpartijen konden inschrijven op onzekerheden in een concurrentiegerichte dialoog als procedure. We gingen primair trechteren van vijf naar drie partijen op basis van twee criteria: hoe goed ben je in *systems engineering* en hoe goed kun je samenwerken. Met de overgebleven drie partijen zijn we in dialoog gegaan en hebben we gekeken wat de belangrijkste onzekerheden zijn en welke procesafspraken we daar over konden maken. In deze individuele gesprekken kon de marktpartij zijn risicoprofiel laten zien en toch voor zichzelf houden.

3F. Per risico is toen de bandbreedte bepaald van de meest waarschijnlijke, laagste en uiterste waarde. Ons management heeft besloten dat we voor de MU-waarde zouden gaan, de meest waarschijnlijke en dat de bandbreedte niet grote mocht zijn dan +/- 15 procent.

3G. Toen hebben we gecheckt bij de marktpartijen of zij akkoord gingen daarmee, dat was het geval. Er ontstond een spectrum van oplossingsmogelijkheden ontstaan, want het product hoefde niet gebouwd te worden op een specifieke manier, een andere manier met dezelfde functie was ook goed. Daarmee was het heel breed, dat is anders dan bij de huidige Tweefasenaanpak, waarin wij de belangrijkste risico's bepalen. Toen hebben we dat echt aan de marktpartijen gelaten o.b.v. hun beste oplossingsrichting.

3H. Het kost veel tijd en energie om er intern achter te komen welke eisen er daadwerkelijk gesteld moesten worden en welke we los lieten omwille van de oplossingsvrijheid van de marktpartijen. Om dit vast te stellen ben ik met de specialisten in gesprek gegaan om te kijken: Wat is het doel? Wat is de functie van hetgeen we uitvragen? Kunnen we dit functioneel specificeren? Dat is moeilijk, want al snel komen detaileisen boven tafel. Wat belangrijk bleek om met specialisten te bespreken was: "Als we echt alles moeten loslaten, dan wil ik wel…" en "Als ik de berekeningen ga toetsen, dan wil ik weten… dat ze die veiligheidsmarges aanhouden." Er bleven dan uiteindelijk een paar eisen en randvoorwaarden over. Dat wat overbleef schreven we op als technische specificatie.

3I. De risicoprofielen waarborgden we daarmee primair door het gesprek aan te gaan in de dialoog en secundair door risicomanagement aandacht te geven in het procesgedeelte van de specificaties: "Hoe vaak komen we bij elkaar?" "Welke mogelijkheden hebben wij als opdrachtgever om risico's in te brengen?"

3J. Binnen een andere casus was er sprake van een innovatiepartnerschap met als doel het sneller uitrollen van Project B, dan nu gepland stond.

3K. We hebben aan de markt gevraagd, op vijf door ons vastgestelde probleemgebieden projectvoorstellen in te dienen voor een innovatiepartnerschap.

3L. Deze gebieden werden bepaald aan de hand van de missievisie van ons bedrijf, zoals omgevingshinder en duurzaamheid. Per kerngebied is aangegeven wat wij belangrijk vindt, met het doel en de richting waarin gezocht wordt.

3M. In de procedure is getrechterd van selectie naar gunning op basis van die projectvoorstellen, waarbij de uitvraag op nog hoger niveau gespecificeerd was dan functioneel, namelijk op doelstelling.

3N. Het contracteren van meerdere partijen, ook per kerngebied, was het doel.

3O. Bij de marktconsultatie waren meer dan 200 partijen geïnteresseerd. Ongeveer 60 partijen waren uiteindelijk echt geïnteresseerd en hebben gezamenlijk ruim 90 projectvoorstellen ingediend. Dat is veel.

3P. Elk projectvoorstel was per probleemgebied en werd beoordeeld op hoe goed het aansloot bij de doelstelling. De eerste selectie bestond uit het aantonen dat de partijen sterk waren op het gebied van innovatie, wat een binaire beoordeling was. Daarbij zijn maar twee partijen afgevallen, dat is heel weinig, maar als procedure erg transparant.

3Q. Bijna 60 partijen zijn de onderzoeksfase ingegaan, waarin de projecten verder onderzocht werden en gekeken werden hoe lucratief deze zouden zijn voor ons bedrijf. Marktpartijen konden op basis daarvan hun voorstel aanscherpen. Deze fase duurde 3 tot 4 maanden. Dat is kort en dus heel intensief, zeker voor de 5 teams die we hadden opgericht intern per gebied.

3R. Daarna gingen we trechteren voor gunning, daar hebben we twee manieren binnen onze organisatie. Bij Project C hebben we het innovatiepartnerschap gegund na de mededingingsfase, in het partnerschap zitten dan meerdere fasen, zoals onderzoek en ontwikkeling, testen en de commerciële fase. Bij Project D is dat het trechteren verwerkt zit in de meerdere fasen van het partnerschap, tussen het onderzoeken en ontwikkelen, testen en de commerciële fase zitten dan momenten waarin getrechterd wordt in de procedure.

3S. Als tendermanager verandert dan je werk sterk. Vraag en antwoord lopen nog steeds via TenderNed met alle bijbehorende documenten, want je valt nog steeds onder de Aanbestedingswet. Bij Project C is er voor gekozen niet

tussentijds meer te trechteren, daardoor werd de Aanbestedingswet toen minder relevant en was er iets meer vrijheid. We zijn nu aan het evalueren wat beter is.

3T. We zien daarbij sterk dat eigenaarschap van de innovaties belangrijk is en proberen dat eerder in het proces vast te leggen.

3U. We ontvingen primair budget om innovaties te stimuleren. Later is er ander geld nodig, uit een ander potje, om die projecten door te zetten. De vraag is dan van wie dat geld is en hoe er mee omgegaan moet worden. Leg je eerder vast wie de eigenaar is dan voorkom je later veel gedoe en de marktpartij raakt meer betrokken. Dit is makkelijker te waarborgen in het innovatiepartnerschap zonder trechteren tussen de fases.

3V. Binnen Project C hebben we uiteindelijk gegund aan 15 innovaties. Na ontwikkeling en testen zijn er daarvan er nu nog ruim 10 over waarmee we de commerciële fase ingaan, op die vijf probleemgebieden, met als gezamenlijk doel het versneld uitrollen van Project B.

3W. Een voordeel van het innovatiepartnerschap is dat je meteen de commerciële fase in kunt, zonder nieuwe procedure.

3X. Bij een nieuwe aanbesteding zou ik het insteken op de manier van Project C.

3Y. Wat betreft integratie van innovatieve systemen is ooit besloten dat de verantwoordelijkheid bij ons bedrijf ligt. Bij Project B zien we dat er één systeemleverancier benaderd is, dat voor acht eenheden een systeem gaat bouwen. Een nieuw systeem, dat niemand kent maar waarmee gewerkt moet worden. Om een *vendor lock-in* te voorkomen, hebben we gekozen voor kennisallianties, waarbij ingenieursbureaus leren hoe dat systeem gevuld en aangepast kan worden.

3Z. Die kennisalliantie is handig maar beperkt wat betreft flexibiliteit, omdat we niet wisten hoe het systeem eruit zou zien toen we gingen aanbesteden, maar samenwerking was nodig. Daarom staat leren van elkaar centraal in die kennisalliantie, met vijf erkende ingenieursbureaus, die wij hebben geselecteerd. We betalen daarbij op regie, dus uurtje-factuurtje. We zien geen andere mogelijkheid om dat te doen, aangezien niemand nu kan afprijzen hoe het ontwerp eruit gaat zien, laat staan met het leereffect van de alliantie.

3AA. Vanuit inkoopperspectief is betalen op regie niet prettig. Natuurlijk hebben we wel prikkels ingebouwd om toch uiteindelijk te komen tot betalen op product.

3BB. Je hebt dus een systeemleverancier met een contract van 30 jaar voor het bouwen en onderhouden van het systeem. De ingenieursbureaus gaan leren, dat is een kennisalliantie van 8 jaar. Los daarvan zijn er ook nog aannemers betrokken en los natuurlijk de innovaties van Project C.

3CC. Wij zijn verantwoordelijk voor de systeemintegratie, alles loopt via ons. Die keuze is ooit gemaakt. Het laten verlopen van alle integratie via ons, beperkt de flexibiliteit sterk.

3DD. Zelf zou ik liever naar ecosystemisch denken en werken willen gaan. Iedereen bij elkaar zetten, om elkaar te prikkelen en niet af te dwingen. Zo zou ik meer vanuit een *systems engineering* perspectief kijken, meer het volledige probleem plotten dan alle losse stukjes. Dat is nu nog niet mogelijk.

C.3.2. Morph Chart

3EE. Het gunningscriterium 'Best Value Procurement' klopt niet. Het is een benadering waarbij wel gunningscriteria gebruikt worden die zich richten op flexibiliteit. Daarentegen is het wel zo dat bij de interviews die gehouden worden binnen de BVP aanpak er gekeken wordt naar de kwaliteit van de mens die betrokken is in de aanbesteding. Dat is wel echt belangrijk.

3FF. Het Tweefasenmodel zit niet in de morph chart. Die verwacht ik in de lijn van de additionele organisatiestructuur.

3GG. Misschien dat het verstopt zit in het type contract, maar wat ik vind ontbreken is dat, zowel bij Project C als bij Project A, er gefocust is op: Wat is het doel? Het formuleren van een probleemstelling is je begin en dat moet ergens inzitten, bijvoorbeeld in je aanpak of je vraagspecificatie.

3HH. Ik zou een prijsvraag als proceduretype niet combineren met een DBFM(O) of een concessie, omdat die te weinig ruimte geeft voor hetgeen voor die contracten echt nodig is.

3II. Voor Project C geldt dat de innovatie eigenlijk de 'asset' is, het product, wat in percelen verdeeld is voor de aanbesteding.

3JJ. Project C is een geïntegreerde samenwerking. Bij inkoop van de innovatie wordt het zo ingestoken dat het *intellectual property* bij de marktpartij blijft. Beheer, onderhoud en exploitatie liggen dus bij de marktpartij.

3KK. Oplevering doen we in batches. De ontwikkelde batches mogen op maximaal 3 eenheden uitgevoerd worden. De innovatie wordt dus niet in batches gedaan, maar de implementatie ervan wel. *Technology Readiness Level* 9 is bereikt voor de commerciële fase, dus er is geen sprake van doorontwikkeling tussen de badges. Daar mist nu een optie voor bij de ontwikkeling van innovatie in de morph chart. Er moet een optie toegevoegd worden waarbij de innovatie helemaal klaar is en dan geïmplementeerd wordt.

3LL. Het testen is vastgelegd in het contract door de contractuele leerruimte. Innovaties binnen Project C focussen zich op een heel breed spectrum, van interne werkzaamheden tot de constructie van een ontwerp, vandaar dat we hier bij elke innovatie andere afspraken voor maken in die contractuele leerruimte.

3MM. Aansluiting bij de doelstelling is het belangrijkste selectiecriterium. Dat kun je toevoegen aan de morph chart, maar je zou het ook onder kwaliteit kunnen laten vallen. Verder functionele karakteristieken, maar ook geschiktheid voor gebruikers, duurzaamheid (kerngebied), organisatiekwalificatie en ervaring van het personeel, daarbij maken we onderscheid tussen aan de ene kant leveringen en diensten en aan de andere kant werken. Bij de laatste heb je extra certificatie nodig.

3NN. Specificaties zijn het liefst op het niveau van streefcijfers, met zowel resultaat- als inspanningsverplichting en af en toe functioneel.

3OO. Het resultaat hiervan is dat er *spin-offs* van producten ontstaan bij onze innovatiepartners. Deze worden ontwikkeld om onze doelstellingen te behalen, maar worden vervolgens verder in de sector nu ook gebruikt. Het eigendom daarvan ligt bij de innovatiepartners.

3PP. Bij Project C was er sprake van een maatwerkovereenkomst, dit bestond nog niet als contract.

3QQ. Het limiteren van gegadigden is gedaan op basis van de mate van innovativiteit, dat is niet per se de beste aanbieder. We maken gebruik van zowel de directe selectie van de beste aanbieder als van twee rondes graduele inperking.

3RR. Bij het innovatiepartnerschap waarin gedurende de fasen werd getrechterd, is er per fase een ander contract opgesteld, ook maatwerk. In de onderzoeks- en ontwikkelfase was samenwerking het belangrijkst. In de testfase waren afspraken over het hoe, wat en wanneer het belangrijkst. In de commerciële fase krijgen we waarschijnlijk een raamovereenkomst, maar zover zijn we nog niet.

3SS. Voor de financiële structuur is gebruik gemaakt van een geoormerkt innovatiebudget. In de uitvoeringsfase gelden, geoormerkt aan een bepaalde eenheid. Wij geven dan aan dat het sneller, beter of duurzamer kan en dan gaat dat geld dus naar onze innovatiepartner.

3TT. Mogelijke modificaties worden vast gelegd in het contract. Op basis van onze bevindingen worden zelfs normen en richtlijnen aangepast, zodat meer partijen deze innovaties kunnen doorvoeren. Over hoe we dat vastleggen in het contract kan ik je nog veel meer vertellen.

3UU. Het gekozen gunningscriterium was prijs-kwaliteit. Er is geen gunningssurplus.

3VV. Het gehele 'product', de innovatie, is in één keer aanbesteedt. Voor het volume geldt dat de innovatie maar op drie eenheden toegepast wordt. Daarna is het innovatiepartnerschap voorbij en kun je met nieuwe specificaties de markt *triggeren*. Een deel van het geheel wordt dus aanbesteedt.

3WW. Tot slot zijn de geschiktheidscriteria de technische en economische capaciteit, waarbij de technische geschiktheid gefocust is op of een leverancier kan innoveren of niet. Beroepsbekwaamheid en beroepsbevoegdheid gelden alleen voor werken en niet voor diensten of leveringen.

C.3.3. Morph Chart as Method

3XX. I understand the concept, the methodology used.

3YY. Some pairings of means are not possible. Making certain combinations should be avoided in the morph chart.

3ZZ. I thought this was very interesting, also I would like to see the end result.

C.3.4. Observations

OBS3.1 The respondent showed the tendency to ask for reassurance on the interpretation of some means.

OBS3.2 Well-substantiated suggestions for adding and modifying means and measures are made. It must be noted however that the respondent was reluctant in making bold statements. The respondent was careful in the formulation of proposed changes, many times soothing language was used.

OBS3.3 The scope of the research was not immediately clear to the respondent.

OBS3.4 Discussing the MC is done by going through the diagram along the case of the respondent. This way more input of the respondent on the MC was received.

OBS3.5 The multiple choice character of some categories needed to be reminded.

C.4. Summary Interview IV

(Anonymized)

C.4.1. Case

4A. The case I wanted to introduce is the procurement of Project H, a new train series, which we ordered in multiple variants. In total we ordered more than 150 trains, which is a lot.
4B. 4B. In the procurement we focused on aiming for reliability, by enhancing flexibility in terms of technical solutions.
4C. To be flexible, the train was specified with technical requirements, as well as functional ones. Last mentioned offered flexibility to the design. We asked the supplier to deliver the most reliable train for which they found many solutions, which we did not specify directly. The supplier with the best quality and reliability won the procurement, not necessarily the cheapest.
4D. Quality was evaluated by the redundancy level of the solutions, the interface and communication with other systems on the train and certain requirements related to the reliability of single components, used to build up a technical system.
4E. For example, most of the components were put inside the train to avoid challenges related to the climate and they decided to deliver redundancy at the highest possible level. This means we now have three traction packages. If one system goes down, the train is able to fulfil its journey, even if there is a serious issue, e.g. with the engine. Putting these components inside the train minimizes risks as well, as it is not affected by weather conditions.
4F. Technical Specifications for Interoperability (TSI) are international regulations (European standards) that we are following and our national requirements are quite strict too. It has been evaluated if the bid fulfilled these criteria.
4G. In our case some national requirements are more strict than European requirements. For example, in our country advanced electric wheelchairs are quite common. These wheelchairs however, are also heavier. Therefore national regulations require the wheelchair elevator to support higher weight than according to European standards. If a supplier is able to fulfil such a requirement, adding additional value, we have a parameter to evaluate this 'extra quality', the surplus.
4H. The specification method in procurement here is sort of like a sinus. One train program before the current procurement only functional specifications has been used and although they were delivered according to the standards, they did not work. Put those trains another country, but our climate caused them to be inoperative. That is why we now went back to specifying a bit more in a technical way, standardize as much as possible, but with special attention to the national requirements.
4I. In total, technical as well as functional specifications were used. Some were mandatory to be fulfilled. Others had to be fulfilled with a minimum and a surplus was added to the evaluation in case of a better score and on top of that, some requirements could be fulfilled voluntarily and result in an extra score in the evaluation.
4J. Improving the balance of quality and price, we put more emphasis on cost reduction, such as the delivery time, in ongoing projects. The supplier now has to fulfill the national requirements and the right reliability level, but a higher flexibility in choosing their own solutions. We mostly use functional requirements to support this.
4K. This new procurement puts more weight on the functional and less on the technical requirements, compared to the trains of Project H. This supports a more balanced price-quality ratio. We hope it results in high reliability and more innovation. Though, this is dependent on if suppliers fulfill all of our specific national requirements and recommendations. This is why we have to write down specifically what we want to have, because otherwise they might try something they have already developed that fulfills the criteria.
4L. We have used a 'Latest and Greatest Technology' requirement in the procurement, which means the train has to be delivered with the latest and greatest technology at the time of delivery.
4M. E.g. if at the time of delivery of the new train, 6G is the next communication standard, we might start ordering a variation. In case of a significant change, this of course comes with a price on our side. But when the train has to be driven with 5G, which is the current latest and greatest technology, we suppose it being within the scope of the contract.
4N. It also depends on the design process. If we agreed on a certain component and this component can be upgraded without additional costs, it is supposed to be done. But if the system needs to be partially rebuild, we have to pay the extra costs.
4O. It does not imply that there is a development plan included in the procurement contract, which imposes the producer to replace e.g. all IT systems on board every five years.
4P. The responsibility for the initiation of introducing the latest and greatest technology lies with both parties. Sometimes the procured party comes with a solution or update, mostly when they want to test something they have designed. Additionally, we have to pay attention and remind them of the latest and greatest technology available. But we are not always sharp enough about this.
4Q. In case functional specifications lead to a train that does not fulfill the expectations, that is part of the risk. Mitigation of this risk is done by the procedure consisting of three phases, being the conceptual, preliminary and final phase. You try to make adjustments in between these phases on the aspects you disagree about. I expect these changes not to be too big, as the procured party has won the contract based on their proposal. This way of mitigation works most of the time, in my experience.

C.4.2. Morph Chart

4R. The numbers in the top row of the morph chart were initially perceived by the respondent as being six different suppliers for which you can choose one solution per supplier.

4S. The choices made in the morph chart are related to the type of product and its characteristics.
4T. The best options in this morph chart for flexibility starts with procuring the asset in parcels combined with life cycle management. As producers are the best party to enable a certain quality during the life cycle, they should do the maintenance of the train, in my opinion.
4U. Since delivery time is high and development takes place during the construction of the product, batches with increasing innovative development should be chosen, combined with testing this innovation in a pilot. Since you always have to test the final vehicle in the network, you need to test for a long time. We also need circumstantial piloting, to see what happens to the vehicle as well as its innovations in different conditions.
4V. For the selection criteria, the quality, aesthetics, sustainability for users, innovation, social characteristics and delivery terms and conditions are important. For a train also accessibility needs to be included.
4W. The most flexible in specifications is a combination of both technical and functional specifications. Most of it must be specified by functional requirements, but European and national requirements have to be specified technically.
4X. For the procedure, I would go for the public procedure, partially because I do not know much about the other procedures. Also, I think buying a train by procedures such as an innovation partnership, is risky for us because of multiple reasons. We cannot be the first one testing new innovations. I prefer other railway companies to do it first.
4Y. Although, I think the competitive dialogue is part of the public procedure. We contact all the suppliers in the world, even in China, to discuss our national requirements. This dialogue should be performed before the tender process, in my opinion.
4Z. Our strategy is to be innovative but within the safety framework. Not only because of our climate, but also because of our specific infrastructure. We should therefore not be the first to test e.g. a new breaking system. We do want to test innovations on IT, communication, diagnostic systems or condition based maintenance, but no big, new physical systems.
4AA. It is unclear what is meant with 'procedural instruments' as a category. First it was perceived as being an alternative for purchasing.
4BB. The framework agreement is seen as adding the most flexibility to the process.
4CC. For the aim of flexibility, two rounds of gradual reduction of applicants is performed.
4DD. We do not operate the trains, but only are the owner. We buy the trains and lease them out to the operators. Therefore we are a ROSCO (Rolling Stock Company, or Rolling Stock Leasing Company).
4EE. It is an option to have a life cycle management contract, in which the producer delivers contracted availability instead of delivering a train of a certain quality. A producer within such a contract would then operate and maintain the trains and as a result deliver a certain amount of trains on a certain amount of lines matching the need of public transportation.
4FF. I would prefer to do it this way as it will bring a competitive pressure on the producer to keep the train in operation. Replacing the incentives on the producer delivers the best reliability, availability, maintainability and safety, from my point of view. It would be their advantage to innovate and maintain in the best way possible, as it saves cost. However, I do know that not many railway companies prefer to think about it this way.
4GG. As a company we need cooperation.
4HH. Co-financing and alliances should be on the same line or even merged. When the alliances are perceived as being knowledge alliances, a financial or purchasing alliance should be added.
4II. I believe that buying a train together with other railway operators would work well. Both parties need to adapt a bit in the product line, but developing and purchasing in (international) collaboration is a good option.
4JJ. This could even be executed on a European level for just components. If train designs are very different, it could still be useful to procure, develop and purchase the same component. This would decrease procurement and development costs. The product could be adjusted to the different train designs after this, but the procuring parties do not have to pay the supplier twice for the same thing. This has been done before but not with trains.
4KK. If you know about a specific technical alteration which may come, you must include this in the contract in the modifications. However, mostly you do not know about these changes upfront.
4LL. Price-quality ratio is the best awarding criteria for flexibility.
4MM. Taking surplus into account is useful. It should be described upfront in the evaluation model. You should define clearly what surplus is added to the evaluation if more value is given than required. I do not know how to solve this in a contract, from a legal perspective.
4NN. For the duration and volume of the contract I would choose to procure the full necessity in a long-term contract, but including options to call of the contract or expand it, when certain circumstances arise.
4OO. In our country the parameters, such as the passenger capacity vary a lot. In case of Project H., we used all options in the contract, which was initially not planned. Being able to use an option within an existing contract including variations, possible innovations and batches, it is tried to reduce the necessary time and high costs of procurement and the restart of a production line.
4PP. Therefore the combination of a full term contract with batches including increasing iterative development is a successful combination in my opinion.
4QQ. Concerning the eligibility criteria, I would choose all options, as these are all required for building a train.
4RR. Testing innovation should not be skipped. Buying a train means there are many risks, interfaces, different technical systems and thousands of components, so not testing an innovation would be ridiculous. You even need to test in case there is no innovation, in case of procuring a train.
4SS. Co-financing could be related solely to the innovation and not only to the procurement as a whole. There are more options possible in co-financing. It could be used to receive funding, subsidies in a European context. There could be multiple parties involved in the collaboration, or even only two railway operators.

C.4.3. Morph Chart as Method

4TT. The choices made within the morph chart are related to external factors as well.
4UU. Using this diagram enables the dialogue on alternatives and puts things into perspective.
4VV. You could draw on this diagram and each buyer could then be represented by a different line.
4WW. Has this never been created before?
4XX. It was interesting to look at it this way. Receiving the results of this would be helpful.

C.4.4. Observations

OBS4.1 Questions on definitions made clear that the respondent was not familiar with all means.
OBS4.2 The respondent went through the morph chart based on what choice should be made for maximal flexibility. Along the way, the respondent elaborated on the other means as well, but choosing means was used as structure of comments.
OBS4.3 The respondent thought that the numbers above the mean columns referred to a similar amount of suppliers for each of whom a solution was designed, being the column below.
OBS4.4 The respondent was unaware of the existence of some means.
OBS4.5 Unless for the numbers above the columns, this respondent quickly familiarized with the use of the MC. Apart from its general use, the multiple choice option was immediately understood and applied after the introduction of the interviewer.
OBS4.6 It showed to be important to the respondent that the means were written in a (more) logical order.

C.5. Summary Interview V

(Anonymized)

C.5.1. Casus

5A. In 2030 moeten wij circulair zijn, daarom zijn we begonnen met circulariteit bij een infrastructuur productgroep. Een categorie waarvan er relatief veel zijn, technische eenvoudig en je kunt er goed op innoveren omdat er vaker aanbestedingen van zijn.
5B. Een paar jaar geleden zijn we daarom gestart met de Small Business Innovation Request (SBIR) en onlangs hebben we een samenwerkingsovereenkomst gesloten op hergebruik. Het ene contract is tot stand gekomen in een prijsvraag/concurrentieachtige setting en het andere hebben we buiten concurrentie ingekocht, wat mag onder bepaalde voorwaarden in de Europese Aanbestedingswet.
5C. De literatuur op flexibiliteit in inkoop begint met het wetboek, daar moeten we aan voldoen, dat is soms handig en soms onhandig. Toch geeft deze wet wel degelijk ruimte voor flexibiliteit. Soms is er binnen het kader meer ruimte dan er buiten, aldus Jules Deelder.
5D. Er is ruimte maar inkopers vinden het spannend om de randen op te zoeken, daar is het niet zwart-wit. Dat vinden we bij inkoop eng, we willen marge behouden.
5E. Mijn perspectief is niet vanuit aanbesteding en inkoop, maar vanuit innovatie. Je hebt grenswerkers nodig, die kunnen optreden om de grenzen op te zoeken om de doelen van een organisatie te behalen. Het is vaak zelfs persoonsafhankelijk of iets kan of niet.
5F. Bij de inkoop van circulariteit in Project E zijn we flexibel geweest door een bijdrage te creëren die partijen ontvingen om hun project inkoopklaar te maken. Daarvoor hebben we deze projectplannen kwalitatief beoordeeld, op impact, haalbaarheid en economisch perspectief. Dat hebben we van tevoren gecommuniceerd, ook dat we daardoor appels met peren gingen vergelijken. Dat meedelen is erg belangrijk, de uitvraag is dan geen verrassing partijen weten waar ze aan beginnen.
5G. De bijdrage diende als stimulans. Je kunt er als inkoper voor kiezen iets te kopen, een bijdrage te doen of een subsidie te verstrekken, daar heb je keuze in met andere verwachtingen.
5H. Er was nog geen viaduct. Partijen mochten zelf kiezen hoe ze het wilden doen, of ze mee wilden investeren in het product, of een product verworven of een prototype maakten, afhankelijk van hoe je inschat dat je een product inkoopklaar maakt.
5I. Stel de bijdrage was ruim één miljoen, daar kun je het product niet voor bouwen, maar het diende om de onrendabele top van het product af te halen.
5J. In het proces zijn we uiteindelijk van meer dan dertig plannen naar tien haalbaarheidsstudies gegaan en daarna mochten drie partijen een prototype bouwen met daarna een *go/no go*. Momenteel is er één prototype af.
5K. De opzet van deze aanpak is anders dan dat bij een aanbesteding de opdrachtgever en opdrachtnemer zich vaak in een vaste verhouding tegenover elkaar gaan staan. Door de bijdrage kregen we aan de andere kant van de tafel een andere houding. Het stimuleerde de gedachten dat een idee volwassen gemaakt kon worden met de bijdrage. Daarna kan zo'n idee vaker verkocht worden, dan ontstaat er een win-win situatie. Zij leren, wij innoveren.
5L. De samenwerking daarin was heel belangrijk. Er werd een samenwerking aangegaan tussen partijen die eerder niet op die manier met elkaar hadden samengewerkt. Want ook daarin zijn bedrijven niet *open source*, niet alle informatie wordt gedeeld. Ze gaan ook normaal niet met elkaar om de tafel, omdat daar in een 'normale aanbesteding' geen ruimte voor is. Dan is de beste prijs leidend.
5M. De samenwerking bestond uit meerdere ketenpartijen.
5N. De hele keten moet aan tafel om de transitie naar circulariteit te maken.
5O. In de Aanbestedingswet is prijs altijd onderdeel van de keuze. Je geeft aan welk product je wil en vraagt aan partijen zich daar op in te schrijven. De beoordeling bevat altijd een prijs- en een kwaliteitscomponent. Die plannen ga je dus kwantitatief beoordelen. Na die aanbiedingen van marktpartijen ga je aangeven met welke partij je wil samenwerken, maar dat werkt dan niet. Je hebt dan een opdrachtgevers-opdrachtnemers basis, wat het systeem al meteen star maakt, terwijl je wil samenwerken.
5P. Ik kan me voorstellen dat je niet voor elke aanbesteding de uitzonderingen in de wet wil opzoeken, maar het is een keuze om een bepaald systeem te gebruiken en daar krijg je bepaald gedrag op. Ik vind ook dat er dingen anders kunnen in de Aanbestedingswet, maar ik kan me er ook niet aan onttrekken dat niet iedereen de ruimte er binnen zoekt.
5Q. Je zou eens kunnen kijken naar CircuLaw, al is het misschien helemaal buiten scope van je onderzoek. Daarbij wordt gekeken hoeveel procent van de wet- en regelgeving in Nederland bijdraagt aan de huidige vorm van de circulaire economie, in opdracht van de Gemeente Amsterdam. Dat bleek heel weinig te zijn, maar iets van zes of acht procent, dus maar zo weinig innovatieruimte is er. Zij kijken nu hoe je dat kunt oprekken.
5R. Verder vind ik het ook een keuze, hoe je omgaat met inkooppartners. Je kunt dat heel verticaal doen, opdrachtgever naar opdrachtnemer, maar wij denken dat dat steeds meer horizontaal moet. We weten niet wat er gaat komen en hoe we daar mee om moeten gaan, dus overheid en markt moeten elkaar opzoeken. Dat horizontale, het samenwerken is al een innovatie opzich. Werkt het of is het alleen maar een soort utopie?
5S. Samenwerken is een middel, geen doel. Je kiest het bewust. Je moet niet altijd maar een samenwerkingsproject doen, maar er zijn werken met een hoog risicoprofiel, een hoge doorloop op geld en waar het maatschappelijk afbreukrisico hoofd is, dan is risicobeheersing belangrijker dan een paar procent goedkoper. Samenwerken is daar het middel voor.
5T. Normen, richtlijnen en contracten zijn een verzameling gestold wantrouwen, zeggen juristen. Het gevoel dat er weinig ruimte in de Aanbestedingswet is, komt omdat mensen een tik op de vingers gehad hebben. Des te meer ervaren een

inkoper is, des te meer hij/zij heeft meegemaakt. Je moet van goeden huize komen om een open houding te houden en het proces elke keer weer te zien voor wat het is.
5U. Zeker bij grote contracten, zoals het inkopen van materiaal, materieel, is de tweede een slechte verliezer. Commerciële partijen gaan snel arbitreren. Inkopers voelen de angst dat als ze geen gedegen inkoop draaien, de rechter het terug draait. Die houding zorgt ervoor dat vaak niet de ruimte opgezocht wordt, door een gedegen marktonderzoek en een open markthouding. Terwijl je misschien wel een medestander vindt bij de markt als je aangeeft wat je van plan bent, wat je gaat doen.
5V. Een gezonde propositie, gezonde marges, van de opdrachtnemer zijn een voorwaarde voor een samenwerking, zeker bij grote risicovolle aanbestedingen. Samenwerken is een relatief nieuw concept wel.
5W. Bij samenwerken is er wel vaak meer tijd aan de 'voorkant' nodig om elkaars taal te leren spreken. Ik ben gewend te werken vanuit ambitie in plaats van het meest goedkope. Dat kost aan het begin meer tijd, wat een nadeel kan zijn. Je moet aan je eigen *board* kunnen verkopen dat het wat langer duurt. Maar het voordeel zit verderop in het proces, omdat je dan goed met elkaar kunt lezen en schrijven.
5X. Je moet de tafel van belangen kennen, weten wat de belangen van de spelers aan tafel zijn en van hun directies. Dat is van invloed op de basis van de samenwerking, hoe je met elkaar omgaat en de beheersing daarvan. Die belangen moet je altijd kennen, ongeacht met welk mechanisme je inkoopt.
5Y. Gewenning is belangrijk. Eerst was de prijs leidend, toen kwam de Milieukostenindicator (MKI) erbij, maar ook toen moest er niet teveel meerwaarde toegevoegd worden om de prijs te beheersen. Met samenwerken gaan we nu over naar een hele andere aanpak, dan is gewenning belangrijk.
5Z. Ik vind dat houding daarbij een belangrijke rol speelt. Er bestaat arrogantie bij aanbestedende diensten, dat het bijna een cadeau is aan een opdrachtnemer als zij werk mogen uitvoeren. Terwijl je iets aanbesteedt omdat je het zelf niet kunt doen. Je hebt de expertise van de markt nodig.
5AA. Het hoort er aan de andere kant ook bij dat je niet naïef moet zijn, mensen kunnen hebberig of machtsgedreven zijn, dat moet je doorzien. Aan de voorkant van het proces moet je de goede dingen doen, communiceren, dan heb je daarna met een samenwerking betere middelen om te kunnen sturen op onvoorziene omstandigheden.
5BB. Het begint al met taal. In de samenwerkingsovereenkomst spreken we niet van opdrachtgever/-nemer, maar heten dat partners.
5CC. Dat hebben we met de SBIR ook zo gedaan. We zijn partnerschappen aangegaan, met partneroverleggen en innovatiegerichte dialogen, de keuze voor deze termen, taalkundig, was bewust. We hebben ook geen TenderNed gebruikt, maar hadden een mailadres en werkten ook veel via TEAMS. Steeds als partijen door gerichte vragen probeerden de opgave te vernauwen, hebben wij vaak gezegd, als we het antwoord niet wisten: "wij weten het antwoord ook niet." Zo hebben we de opdracht niet nodeloos verengd.
5DD. Nog een leuk voorbeeld, misschien buiten *scope*, is *conscious contracting*. Daarbij gaat niet de aanbestedende partij allemaal contracten aan met opdrachtnemers. Positief contracteren gaat er vanuit dat er één contract komt, in simpele taal, met al deze partijen. Een jurist begeleidt dat proces en is tegelijkertijd een soort *team coach*. Deze persoon zoekt naar gezamenlijke belangen en doelen. Uitgangspunt is dat niet alle risico's voor alle partijen volledig afgedekt worden, maar iedereen bijdraagt vanuit de gedachte dat de doelstelling behaald wordt. Het is wel tijdrovend.
5EE. De inkoopstrategie is belangrijk. Deze pel je af met de opdrachtgever en de asset manager die het over gaat nemen. Dan kan het zijn dat je op een hele andere aanpak uitkomt, of juist dat 80 procent van je werk nog steeds op de geijkte manier aanbesteed wordt, omdat het risicoloos is en het soms nodig is ergens daadwerkelijk een prijs op te plakken. Maar dat 'strategiedenken' is belangrijk.

C.5.2. Morph Chart

5FF. Voor in de Uniforme Administratieve Voorwaarden voor Geïntegreerde Contractvormen (UAV-GC) staan allerlei fases. Naarmate je er meer bij elkaar neemt in een contract, krijg je verschillende contractvormen. Een geïntegreerd contract betekent het bij elkaar pakken van een aantal van deze fases. Ik snap daarom niet waarom 'klassiek' en 'geïntegreerd' bij mate van samenwerking staan. Misschien is contract type al genoeg en hoeft mate van samenwerking niet genoemd te worden, het is verbonden.
5GG. Opvallend is dat bij het testen van innovaties, de pilots en proeftuinen de boventoon voeren terwijl je ook opschaling hebt. Dan heb je een innovatie die al eens succesvol is geweest en die ga je opschalen en er een volwassen markt van maken. Dat zie ik hier niet. Het zou een middel kunnen zijn bij het testen van innovatie, ontwikkeling voorafgaand aan aanbesteding, of een eigen categorie zelfs.
5HH. Twee contractvormen die goed werken bij innovatieontwikkeling is de SBIR en het innovatiepartnerschap. Die laatste kan overal ook een soort 'doorheen gevlochten worden'. Het zijn beide misschien meer contractvormen dan procedures, of in ieder geval kunnen ze in meer gevallen betrokken worden dan alleen als type procedure.
5II. Verder mis ik bij de categorie financiële structuur nog de bijdrage.
5JJ. Ook mis ik bij gunningscriteria nog de MVI, BPKV en Best Value.
5KK. Het uiteindelijke doel van aanbesteden is het maken van een goede keuze zonder een voorkeur voor een partij te hebben vooraf. Als je kunt concluderen dat je niemand bevoorrecht hebt, het uit kunt leggen en het openbaar durft te delen, dan is het goed. Dat is de ondergrens, daar buiten kun je ruimte zoeken. Dat is namelijk ook het doel van de aanbestedingswet, zonder voorkeur een partij kiezen.
5LL. Ik zeg altijd dat de matige middenmanager ook moet begrijpen hoe je circulariteit aanbesteedt, niet iedereen is een top inkoper of contractmanager. Deze tool kan voor een gemiddelde inkoper bij een gemeente of provincie handig zijn, er bij pakken bij het maken van een afweging. Daar is het een krachtig gereedschap voor.

5MM. Ik vind dat hier het verwerven van werk buiten concurrentie opgenomen moet worden. In de wet staat dat bij bepaalde innovaties of leveringen, of bij het ontbreken van concurrentie om technische redenen, buiten concurrentie gegund mag worden. Daarom moet het bij gunningscriteria worden opgenomen, daar zit namelijk meer ruimte dan je nu laat zien. Dit moet dus opgenomen worden met een sterretje erbij, omdat het een uitzondering op de Aanbestedingswet is. Een aanbestedende partij moet de keuze hiervoor wel goed toelichtten. Dit geldt ook voor 'omvang' want onder de 5 miljoen hoef je niet Europees aan te besteden.
5NN. Je brengt dan een 'loopje' van werk op de markt en geeft aan een aannemer een herhaalopdracht. Daar zit een langjarig verband in en is niet helemaal hetzelfde als percelen, daarom vind ik het een belangrijke optie. Ook zit er flexibiliteit in omdat het risico's mitigeert. Van de eerste ontwerpen leer je de risico's en hoe je die beheerst. Op basis daarvan rol je de volgende opdrachten uit met dezelfde partij.
5OO. De Tweefasenaanpak moet toegevoegd worden aan de contracttypes. Met de tweefasenaanpak blijf je weg bij wezenlijke wijzigingen omdat je afspreekt wat er buiten concurrentie tot stand komt. Iedereen heeft dan van tevoren ook de kans gehad op dat werk in te schrijven.
5PP. Verder moeten de portfoliocontracten toegevoegd worden aan contractvormen, net als RAW-contracten (Rationalisatie en Automatisering Grond-, Water- en Wegenbouw) en STABU (Standaardbestek Burger- en Utiliteitsbouw) voor de bouw.
5QQ. Binnen ons bedrijf zeggen we dat alle contractvormen gekozen mogen worden, maar dit zijn onze standaardcontracten. Dan moet ik indirect een inkoopafweging maken, zodat ik erop uitkom dat ik geen alarmen laat afgaan omdat ik iets heel anders ga doen.
5RR. Soms is het ook een bewuste keuze om alle opties en uitzonderingen in je aanbesteding toe te voegen.
5SS. Ik ga me niet branden aan het diagram. Dat is zo specifiek, daar heb ik niet genoeg kennis over.
5TT. Ik vind ook dat bij het initiatief tot innovatie het nemen van een optie als middel opgenomen moet worden. Zorg dat je zoveel mogelijk opties vastlegt in het contract, zodat je ruimte hebt en het niet wezenlijk wijzigen wordt. Die optie hoeft niet eens afgeprijsd te zijn, als het maar bepaalbaar is. Dat wordt nog te weinig gedaan.
5UU. Je draait eigenlijk met de morph chart draaischijven over elkaar heen. Er zitten dingen bij die elkaar bijten, maar het is vooral zo dat flexibiliteit in contracten betekent dat ook je kaders flexibel moeten zijn. Anders levert de keuze voor flexibiliteit in het contract alleen maar werk voor de contractmanager en inkoopadviseurs om het passend te maken. Is dat het dan wel waard? Dit is ook afhankelijk van het type product dat aanbesteed wordt. Verder betekent het dat je dekking moet hebben vanuit de directie. De tool heeft dan draagvlak nodig.
5VV. Wat je met dit diagram doet, doen wij al een beetje. We kiezen verschillende middelen om samen één proces te vormen. Dat mixen doen we.
5WW. De horizontale benadering in samenwerking zie ik nog niet terug. Ik wil daarom het *mixed team* toevoegen bij de additionele organisatiestructuur. Ik ben soms nog wat in verwarring, want het zou ook bij mate van samenwerking kunnen horen.
5XX. Het doel van een *mixed team* is dat er goed horizontaal samengewerkt wordt. Eén groot team om het hogere doel te behalen.
5YY. Ik ben ook in verwarring bij de type contracten en de mate van samenwerking, die hangen samen. De contracten zijn gemaakt om de samenwerking te faciliteren.
5ZZ. Ook zou ik certificering willen toevoegen aan het diagram, bij geschiktheidseisen. Voor sommige aanbestedingen heb je gecertificeerde mensen nodig.

C.5.3. Morph Chart as Method

5AAA. I thought you had to choose one of each column instead of each row.
5BBB. This chart works like a menu.
5CCC. I am surprised an overview like this has not been created before.
5DDD. This tool could be used by the more average people in the field, to help weighing their choices.
5EEE. Some means could be placed in multiple categories.
5FFF. It is important to create support in the organization for this tool, the board must provide backing too.
5GGG. The morph chart functions like disks that can be rotated to combine different options.
5HHH. Some means cannot coexist.

C.5.4. Observations

OBS5.1 Both respondents familiarized with the methodology quickly.
OBS5.2 The respondents were eager to help and suggested many changes, mostly additions.
OBS5.3 One of the respondents wanted to add as much means and categories as possible. This proceeded so quickly that some already included factors were missed initially.
OBS5.4 The respondents suggested a significant amount of new means and categories. There reasoning went fast, which meant that part of the modifications was out of the scope of this research.
OBS5.5 One respondent answered a significantly larger portion of the questions than the other respondent.

C.6. Summary Interview VI

(Anonymized)

C.6.1. Casus

6B. Binnen de spoorsector is men wat terughoudend met innovatief aanbesteding, alles gaat zoals het altijd al ging.

6C. Ik heb met veel van de in de morph chart genoemde procedures ervaring.

6D. Flexibiliteit in aanbestedingen is afhankelijk van de procedure.

6E. Ik pas vaak de uitzonderingsgrond voor onderzoek en ontwikkeling toe waarbij we de aanbestedingswet gemotiveerd niet hoeven te volgen. Bij het aanbesteden van Project F hebben we dat ook gedaan. We vroegen aan de markt of er innovatieve oplossingen zijn om ons probleem op te lossen. De uitzonderingsgrond bood daarbij veel flexibiliteit.

6F. Voor de aanbesteding hebben we gekeken wat het probleem is en wat de mogelijke oplossingen zijn. We vroegen ons af of we dat wel Europees wilden aanbesteden of op een andere manier. Toen hebben we met de juridische afdeling gekeken en gezien dat de inkoop van de oplossing zou liggen bij aannemers, want dat valt niet onder onze werkzaamheden. Daarom hebben we ervoor gekozen een brede innovatieoproep in de markt te zetten en te vragen wat voor oplossingen de markt kon aandragen. In die oproep zat geen verplichting om de uiteindelijke oplossingen ook in te kopen. Wel gingen wij breed kennis delen met de markt.

6G. Die procedure bood partijen vrijheid om creatief te zijn. We hebben de innovatieaanbesteding uitgewerkt in 10 kantjes, heel weinig. We wilden specifieke dingen zien, maar vroegen om met ons mee te denken.

6H. Er zijn bij een aanbesteding kaders, maar dat betekent niet dat je daar niet gemotiveerd vanaf kunt wijken. Dat is niet naar de markt gecommuniceerd, maar is een interne stelling. Het geeft je ruimte, maar je moet wel de basis aanhouden. Ik zit best wel op het juridisch kader, want we hebben best wel vaak bezwaren aan onze broek gehad, dus ik ga heel systematisch te werk.

6I. Er zijn projecten geweest waarin ik discussie moest voeren omdat ze daarin nog meer los wilden laten en alleen nog hoog over wilden communiceren met marktpartijen.

6J. We hebben op bepaalde punten onze vrijheid gezocht, maar wel gekeken naar hoe ver je wil gaan. Je moet in ieder geval transparant blijven en het gelijkheidsbeginsel behouden.

6K. Uit de innovatieoproep zijn er drie innovaties uitgekomen die zijn gecontracteerd en verder mochten de onderzoeksfase in. Daar ben ik vervolgens maar op afstand bij betrokken.

6L. Wat ik wel merk is dat marktpartijen aangeven dat ze het, door ons beschikbaar gestelde geld, in een eerdere fase harder nodig hebben en in een volgende fase juist minder of niet. Normaal gesproken zouden we daar aan vast gehouden hebben, maar nu bewegen we daar meer in mee. Zolang een partij kan onderbouwen waarom. Nu doen we dat we een totaalbudget hebben maar dat als ze de verdeling daarvan anders in willen delen, dat dat onderbouwd wel kan.

6M. De bouwfraude heeft er voor gezorgd dat men voorzichtig is met wat ze doen. Het is allemaal erg rechtlijnig wat er gebeurt en wordt afgesproken. Dat leidt echter niet tot vooruitgang en innovatie. Als wij als bedrijf onze doelen willen halen in 2023, moeten we dingen anders gaan doen. Binnen de organisatie gaan steeds meer mensen daarin mee.

6N. Voor innovatie heb je drijvende krachten nodig. Het is heel persoonsafhankelijk. Als een team of organisatie mensen mist die de rest op sleeptouw nemen, valt innovatie stil.

6O. Ons bedrijf is risico avers. Het is een hele technische organisatie en je ziet dat in het verleden voornamelijk de *engineers* het heel prettig vinden alles technisch te specificeren. Ze willen exact beschrijven wat ze terug willen krijgen, maar vaak blijkt dat je daarmee juist niet dat terug krijgt.

6P. Eerder heb ik een hele grote aanbesteding binnen de infrastructuur gedaan. Dat ging om een gigantisch contract, met grote belangen. Daar is gekozen om technisch te specificeren. Dat contract blijkt nu niet te lopen en moet opnieuw in de markt gezet worden.

6Q. Als organisatie kun je niet alles exact voor schrijven. Je kan niet tegen een expert zeggen hoe hij/zij het moet doen. Zeker in combinatie met de competitie op prijs, 70 procent van de weging is toch prijs, is dat niet handig. De opdrachtnemer gaat zich precies houden aan wat gevraagd is voor die prijs. Daar komen discussies van in de uitvoering.

6R. Innovatie wordt steeds dominanter, maar het is een traag proces.

6S. We doorlopen ook regelmatig innovatiepartnerschappen met pilots en hebben ook meermaals de concurrentiegerichte dialoog toegepast. Toch vind ik dat die standaard Europese procedures minder geschikt zijn voor flexibiliteit.

6T. Het is belangrijk met de markt in gesprek te gaan en te blijven.

6U. Als opdrachtgever moet je op een hoger abstractieniveau gaan werken, maar dat vraagt van de markt ook dat hij dat aankan. De markt was ook ingesteld op de 'oude' manier van werken. Verandering moet daarom van beide kanten komen. Het verondersteld ook een bepaald onderling vertrouwen.

6V. Ik ben er niet van op de hoogte wat er op directieniveau besproken wordt om de omslag van technisch specificeren naar meer 'hoog over' te stimuleren.

6W. Wel heb ik het idee dat deze veranderingen, innoveren, hoog over specificeren, dat dat serieus dingen oplevert. Wij worden er enthousiast van en de markt ook.

6X. Kanttekening daarbij is wel dat er binnen onze organisatie veel wisselingen van de wacht zijn geweest op managementniveau. Dat zorgt ervoor dat sommige professionals veel bezig zijn met een soort missiewerk, om de nieuwe mensen steeds weer te overtuigen van deze aanpak. Sommigen zijn daarom veel bezig met hieraan trekken, elke keer moet je dat gesprek weer aangaan. Tot nu toe is dat wel een succes, maar het is erg persoonsafhankelijk, zowel op het niveau waar deze wisselingen plaatsvinden, als op dat van de betrokken professional(s). Het kost veel energie en wat je ziet is dat er echt commitment nodig is van een organisatie om in dergelijke lange trajecten te zitten.

6Y. Ditzelfde geldt voor programmamanagers, die je moet overtuigen van het opnemen van dergelijke innovaties binnen hun traject, om buiten de gebaande paden te gaan. Daar moet elke keer ook veel trekwerk verricht worden en ook daar is dus een bepaald type mens voor nodig.

6Z. Al met al blijft het mensenwerk, enthousiastelingen zijn nodig. Een tekort daaraan zorgt ervoor dat het over het algemeen niet van de grond komt.

C.6.2. Morph Chart

6AA. De morph chart wordt lastig gevonden, moeilijk te begrijpen.

6BB. In het innovatiepartnerschap besteden we het product en de innovatie in losse percelen aan.

6CC. In de mate van samenwerking zou ik willen zeggen dat we een partnerschap aangaan, die staat er niet tussen en kan er bij.

6DD. De oplevering vond plaats in delen en tussendoor gingen we deze verder ontwikkelen, dus er was sprake van een incrementeel innovatief karakter.

6EE. Je werkt in de morph chart niet met TRL's. Over het algemeen passen wij bij het innovatiepartnerschap innovaties toe die er wel al liggen. Het hoeft nog niet helemaal uitgewerkt te zijn, maar wel redelijk concreet.

6FF. Ik denk dat wij werken met parallelle ontwikkeling van een innovatie. Bijvoorbeeld bij Project G zijn er al oplossingen die voldoen, maar het resultaat is nog niet snel genoeg. Dan blijven we zoeken op de markt naar andere oplossingen parallel daar aan.

6GG. We testen innovaties fysiek. Verder gebruiken we contractuele leerruimtes in de vorm van innovatieve clausules.

6HH. Beoordeling van projectplannen van opdrachtnemers worden beoordeeld op basis van kwaliteit.

6II. Bij innovatiepartnerschappen doen we het meest door functioneel te specificeren.

6JJ. *Off-the-shelf* inkopen, dus met catalogus specificaties, doen we wel maar daar wordt over het algemeen dan niet mee geïnnoveerd.

6KK. De raamovereenkomst wordt vaak gebruikt, ook in combinatie met het innovatiepartnerschap. Dat werkt goed. Binnen een raamovereenkomst heb je wel een afnameverplichting, daar mag je wel iets van afwijken, maar dat mag geen honderdvoud zijn.

6LL. Het innovatiepartnerschap is heel flexibel, met een raamovereenkomst reduceer je de flexibiliteit iets, maar het is alsnog aan te raden.

6MM. De contractvormen die genoemd worden in de morph chart zijn voornamelijk bouwcontracten, worden voornamelijk toegepast bij werken. Bij ons gaat het vaak ook over leveringen en diensten. Wij hebben een overeenkomst van opdracht, ik weet niet hoe je dat vertaalt in de morph chart, maar het is naar mijn mening niet een van deze contracten.

6NN. We limiteren aanbieders in meerdere rondes en maken geen gebruik van een alliantie of iets dergelijks.

6OO. Bij aanbestedingen anders dan het innovatiepartnerschap hebben we wel eens pre-commerciële inkoop toegepast, bijvoorbeeld bij de innovatieoproep voor Project F. Ook passen we het geoormerkte innovatiebudget toe, bij meerdere proceduretypes.

6PP. Bij de innovatieoproep was er geen verplichting om in te kopen. Wij hebben toen wel een bepaalde financiering toegekend om het product verder te ontwikkelen onder de voorwaarde dat die kennis breed gedeeld wordt met de markt. Dat bedrijf mocht dan wel alleen dat verder afzetten, daar aan verdienen wat ze wilden. Dat vormt een extra prikkel, want het bedrijf krijgt zo een voorsprong.

6QQ. De aannemers die gaan inschrijven hebben onderaannemers, waarbij ze jou kunnen contracteren en dan hebben ze een voorsprong. Dus is het zeker goed om te delen met de markt.

6RR. Co-financiering met EU-subsidies passen we veel toe, vooral voor onderzoeken bij diensten.

6SS. Ook zijn we wel eens een internationale samenwerking aangegaan met een 'gelijkgestemde'. Zo'n samenwerking is wel eens toegepast, met name voor onderzoek en ontwikkeling. Dat zijn geen hele grote aanbestedingen, maar als we onderzoek doen, doen we dat graag samen. We schakelen dan gezamenlijk een TU Delft in bijvoorbeeld. Op die manier heb je een grotere afzetmarkt en kun je kennis delen. Het testen van de innovatie gebeurt dan door de opdrachtnemer en die deelt de uitkomsten daarvan met beide partijen. Dit soort samenwerkingen bevallen goed.

6TT. Je gunt altijd op prijs-kwaliteitverhouding. Laagste prijs en laagste kosten gebeuren maar weinig, dat moet je ook heel goed motiveren wil je dat doen. Laagste prijs heb ik twee keer voorbij zien komen. Het ging om een simpele opdracht waarbij meervoudig onderhands aanbesteed werd. De markt was zo klein dat ik het gemotiveerd op laagste prijs kon doen, er was namelijk geen differentiatie op kwaliteit.

6UU. Binnen ons bedrijf zijn er aanbestedingen geweest waarbij varianten worden toegestaan, maar het toepassen van een gunningssurplus daarbij is me niet bekend. Ik weet wel dat het bij werken wat meer wordt toegepast dan bij leveringen en diensten, meer mijn kant van de aanbesteding.

6VV. Aangezien wij een specialesectorbedrijf zijn, mogen wij raamovereenkomsten sluiten van 8 jaar in plaats van 4 jaar. Dat heeft invloed op de duur en het volume. Ik zie wel dat we de laatste tijd best wel vaak gemotiveerd afwijken, dat we hele grote volumes op de markt zetten.

6WW. Een goed voorbeeld hiervan draait om bepaalde bouwwerken, die allemaal modulair en circulair worden. In mijn *tenderboard* ging het er daarom over dat we dat toch voor een kortere tijd gingen aanbesteden omwille van de bekleding, maar dat materiaal is nog niet veel op de markt. Vandaar dat we voor een korter contract willen gaan, want we verwachten over twee à drie jaar meer spelers op die markt. Dan willen wij niet voor een langere periode vastzitten. Daarom besteden we dat nu kort aan, voor drie jaar, zodat we na die tijd het opnieuw kunnen aanbesteden, met de verwachting dat dan goedkoper en van betere kwaliteit te kunnen krijgen. Je wil de markt niet bij voorbaat op slot zetten. Duur en volume ligt dus helemaal aan het project, het varieert gigantisch.

6XX. Aan de andere kant willen we voor kritieke onderdelen van ons bedrijf geen risico lopen. Daar zijn ook weinig aanbieders voor op de markt, maar als we die geen langer contract bieden vallen ze om. Dan hebben we echt een groot probleem.

6YY. Het onhandige aan het Europese spoor en dat is door het Marshallplan gekomen naar mijn mening, is dat elk spoor anders is. Je kunt elkaar daardoor niet één op één helpen. De markt zet je daarom soms op slot, puur omdat je zekerheid wil hebben over wat er geleverd wordt.

6ZZ. Eigenlijk passen wij alle gunningscriteria toe, maar vooral de technische geschiktheid.

6AAA. In de morph chart mis ik bij het type contract de focus op contracten voor leveringen en diensten, deze zijn vooral op werken gefocust.

C.6.3. Morph Chart as Method

6BBB. Reading and understanding how the morph chart works is difficult. I needed more explanation than initially provided to understand what was meant with this system.

6CCC. The posed questions are on an abstract level. I have to think about how to answer.

6DDD. The concept of going through the diagram from top to bottom was something I started to understand later on.

6EEE. I thought It was interesting and fun to look at things from a more abstract level.

C.6.4. Observations

OBS6.1 Understanding how to use the MC was hard. The MC example of designing a beverage container also did not provide sufficient explanation. After a little while the system started to make more sense to the respondent.

OBS6.2 The respondent was confused by the numbers above the mean columns.

OBS6.3 The columns were perceived as each being a solution design. Also the fact that the choice for a mean in row X does not (theoretically) relate to the choice made in row Y, did not make sense at first.

OBS6.4 To support the respondent sharing the expert view on the content of the MC, the interviewer and respondent have been going through each step jointly.

OBS6.5 The initial lack of understanding of the methodology of the MC resulted in the respondent not having confidence in making statements. Also, asking “Why?” was often used to get more a more extensive explanation from the respondent.

OBS6.6 In some cases the respondent reassured to have similar understanding of definitions.

C.7. Summary Interview VII

(Anonymized)

C.7.1. Case

7A. Currently we are procuring a new fleet of automatic trains. However, the current network is not driverless, which means we are procuring trains and simultaneously we upgrade the network to cope with automatic train operation (ATO). At some point in time these need to come together and form a coherent system.
7B. We are almost certain this will result in changes in the initial projects and as we are talking about a network, a change in one project leads to changes in another project. This causes uncertainties in the procurement, we need to enable changes on the trains later on.
7C. An upfront measure to cope with this, is the variation order, defining in the contract what variations can be produced afterwards. Additionally, we have defined options that we can deploy, but this is only applicable if we are able to describe a change.
7D. Also we included prices, hourly rates, for different types of works, which enables us to use this when additional works are needed. The same we did for a number of different components, parts and so on, by putting price tags on those as well. Being in a contract with a supplier means this party can pull the strings. Therefore we build in elements guaranteeing a reasonable price for a change. These hourly rates and prices avoid having discussions afterwards, because it is always the most expensive option that suppliers will propose in these cases. It is not possible to fully avoid these kind of discussions, but these pre-set prices and rates create some common ground, that we can refer back to in these negotiations, instead of starting from a blank sheet.
7E. In this train procurement we use a competitive dialogue instead of our more traditional negotiated procedure. This leaves room to have a dialogue, allowing us to mature the specifications together with qualified suppliers.
7F. We decided to include a Long-Term Maintenance Agreement, in which we included supplier services. This includes that the design authority will stick with the supplier, so that the delivery of extended engineering services is secured. Also they will be responsible for the obsolescence management, mostly focusing on the IT in the train, by updating and replacing it.
7G. Altogether we have tried to implement as much measures in the contract as possible to secure adjustments in the long run. Even though we don't know exactly what we will need and what it will lead to.
7H. Our procurement law might be a bit more strict than in other European countries. It might even be a bit over interpretated and implemented.
7I. This means we have to put in the contract all we want to do and possibly change, to stay within the scope of contract when making adjustments.
7J. Specified is all that we foresee to be a possible change. In this case we included an option to install a driver cap later on. Automatic trains do not need one, but in case the system does not work, we will have to go back to normal driver operation. We have a defined set of requirements for the possible driver cap and two different prices. One for installing a driver cabinet in a train that has not been built yet and one for the retrofitting of an already built train.
7K. Also, we added very high level descriptions of other possible future changes. Pricing will be decided on later on in the process, in case these changes are required. The hourly rates will then be applicable. We are aware that those rates will not fully cover all aspects needed to be prized, but at least a part of the price can be based hereon. For the unknowns we hold the right, in the contract, to benchmark this in the market or to have a third party look at it.
7L. All in all, these changes might be more expensive than procured in a new contract, but we save the costs and time of a completely new process.
7M. A previous contract we procured before was a frame contract, in which we tried some of these measures to change the design when it matured. Since it was a frame contract it allowed us some more flexibility, as it enables buying more within the scope. The current train procurement is a fixed contract with options instead.
7N. My preference for the contract type depends on the purpose. I would prefer the frame contract, but its duration is shorter than for a fixed contract with options. A longer time frame was necessary, for building but also training and so on. That ruled out the possibility of the frame contract. However, I do believe the fixed contract with options will be a success.
7O. Risks belong to the nature of procurement. I do not believe risks are much related to the way we set up the program, but more to factors external to the procurement. In case of the ATO, the existing infrastructure not being designed for that purpose is a risk. Adjusting the infrastructure needs new rail technology that has to withstand all weather conditions. Such things form risks we are more concerned about than the procurement itself, in our process we will find a way to fix it.
7P. Mitigation of external risks is done by including the options. The option of a driver cabinet as a fall back in case ATO fails. We believe these measures limit the risks.
7Q. We expect the train with ATO to be functioning on the first line in 2030, but presumably later. There are many driverless systems in the world, but mainly closed systems. A few are outdoors, such as in Vancouver, but not in such a big and complex network as we are operating on. So we take one for the team.
7R. There is another case, the supporting systems, equipment, on the stations. We are building up a price catalogue the suppliers have to price and created archetypes of five to ten stations using different components. We know there will be changes when the implementation starts, as the stations have various set ups and therefore need different numbers of certain equipment. Pricing the equipment in a catalogue enables us to cope with these kinds of changes. We will see to what extent this approach is useful in the end, but at least we can use, price wise, some stepping stones.

C.7.2. Morph Chart

7S. In the past, many projects were procured in parcels, separating the product into different parcels to be constructed by different suppliers. But now the characteristics of a train have changed, which makes this system difficult. Unless you would procure it from a consortium, but that way you are basically procuring it as an asset and it is just delivered by two suppliers acting as one.
7T. In the case of the Rhein-Ruhr-Express (RRX) an extreme model was created in which they tendered out also the responsibility of being the vehicle owner. They stated how many trains they needed available for operation each day and defined how this should be developed in the next 30 years. Basically this was an availability procurement, outsourcing to the very extreme, this type of cooperation could be added to the morph chart. The suppliers than offered a billing in which it was stated how many trains the procurer needed to buy in order to guarantee the requested availability, including required supplies and maintenance. The extreme part about this was the fact that the train owner did not want to have anything to do with the trains. In case of vandalism for example, this was the responsibility of the supplier, even if the supplier wanted to go to court with it, as long as the contracted availability was delivered. If not, a penalty must be paid. This structure might be too extreme, as they have no chance to influence anything about the trains e.g., but it is interesting.
7U. Another system is also optional, it is more traditional than the previous one and used in several places. In this case the trains are procured by the company, who makes them available for an operator to operate them. It differs who is responsible for maintenance and so on, but it is a quite common system.
7V. The delivery of trains is dependent on how you use them. If you use the different sub fleets for different purposes, delivery of different versions in batches is good. Contrary, if you want all trains to be completely identical, also in terms of software and so on, so all trains can trade places in the network without issues, you need them to be delivered all together.
7W. In case of the ATO train we are now procuring, they all need to be exactly identical as they have this strong network function. We have them delivered in a flow, but we take them in use in batches. Since we need a certain fleet to take another, additional line in the operation, we need full conversion of that line.
7X. The base order of the current procurement contains more than 200 trains. A lot will happen during its production and delivery. As it is important that these trains are compatible, they all need to be upgraded to the same configuration. Knowing that once this has been done, a new configuration will already be on its way.
7Y. Apart from the software also electronic components will need to be replaced or repaired probably, so it is a continuous process. This is why we included in the contract that the design authority and obsolescence management to be in collaboration with the supplier for the lifetime of the trains. This way we mitigate the risk of the fleet, or a part of it, to be standing still, e.g. because of components that are no longer available.
7Z. In this diagram I would translate that to the complete delivery with ex-post adaptations but in combination with the batches with increasing iterative development. There might be functionalities not required in the first batch, which has to be implemented later on, e.g. when the trains have to drive on a different line. It will depend on the capacity, the amount of required trains, the delivery and the possibility to wait with upgrading until other new functionalities will be introduced too.
7AA. The company that won the procurement decided to build an additional train for themselves. It was running in the fleet together with the procured trains, but used to test innovations and modifications for Siemens, to see how it worked before they applied it to the full fleet. This does require a procurement design in which there is room for this. In this case availability was procured which allowed this structure and as a result this company could put in a train on their own expenses.
7BB. In the past, almost each procurement project had their own software versions with specific functionalities. But if suppliers provide several versions and they need to be maintained and updated, also for the approvals, that is difficult. Now we only want one software configuration for all trains, updated in a flow, regardless of project or customer. The disadvantage is that everyone needs to wait when a fault is found in the software until the next cycle of updates is ready. But the advantages are that you always have the newest version, which is completely maintained and controlled.
7CC. In the case of this ATO train we will probably end up with more software versions, as they come in batches. They will then have to be upgraded along the process. It is not an option to have them all delivered at once. We would receive all trains and they would possibly still be different.
7DD. In the past we had the procurement a different train series, in which we procured more than 80 trains and these were all different, not two trains were the same. It is a nightmare to keep maintain these trains, as everything, from electronic parts and wiring to the mechanical parts, were handmade. That should always be avoided.
7EE. Testing innovations on the train is done in real life, but we also have some test tracks in the depot and a test lab. For another intercity train, we ordered the trains as well as an IT train, a setup of the train with all components and even some hardware to simulate all software and innovations. I think that is great development, to avoid having to test with passengers in the beginning. To assure a certain maturity level of innovations before you test those in real life. This way of procuring an IT-model or lab, could be added to the diagram.
7FF. The initiative for innovation is, in my opinion, not only done by determined modifications in the contract in case of changes of legislation, but also for specific technical alterations. So I would say that you need to be able to choose more options from this category. Also because one change could trigger other changes.
7GG. I would say price is a selection criterion too. I would say quality and price are the most important for us.
7HH. We use functional specifications mostly and sometimes technical specifications too. Technical ones are used mostly for all that is related to the infrastructure, e.g. track widths, track profile and so on. These things will always be technically specified. Also, legislation is mostly translated into technical specifications. However, TSI's are mostly technical but also leave room for choices, which could result in a functional specification.
7II. The exception ground as a procedure comes in different forms, so I would put a more general version in the morph chart, without mentioning 'research and development'.

7JJ. I want to note that it is not always possible to really choose what procedure to do. It is almost always dependent of the nature of the product you are buying.
7KK. In my opinion, the public procedure is more of an overarching procedure. I think having a public tender is a public procedure. I don't know how you define this in Dutch.
7LL. Limitation of suppliers is first done by a pre-qualification, we set out criteria that have to be fulfilled. On top of that we have selection criteria that rank the suppliers in case we have more bids than we find suitable for the next round. In a next round the suppliers are then asked to submit their definitive bids.
7MM. The contract we use is engineer and construct, as this also beholds the design phase. In this contract the functional requirements are matured into a solution.
7NN. In our company we finance our procurement ourselves. We go to financial markets to get a loan, some of this could be from the European Bank, but it is al financed by our own company. I do know other projects in which co-financing from the European Commission was used to start the program.
7OO. I do think that joining forces with other railway operators, such as the NS, would be an interesting opportunity. We could join financing development for example.
7PP. Describing and or pricing possible changes in the contract is better than including a surplus. If you use a surplus, you must be very clear on how you include and value this in the procurement.
7QQ. I believe you get the best deal when you procure the full fleet at once. If you split it up, you will end up with different fleets from potentially different suppliers. You miss out on the synergy and scaling advantages. At the moment, the market is completely overheated, which means suppliers are not necessarily hungry for such a big contract.
7RR. You have to think carefully about what risk you want to transfer to the supplier and what is yours.
7SS. We prefer long-term contracts, even including maintenance for the lifetime of the trains. A contract of 30 years, which could even be extended to 40 if wanted. This is done because we want to assure that the responsibility for the performance of the trains stays at the supplier. Avoid that a supplier constructs a train and walks away after that. If we contract on the long term, we are sure a train of high quality will be designed, as this benefits the supplier in the maintenance.
7TT. Our pre-qualification criteria are a mixture of economic and financial capacity and technical competence and capacity. This way we want to assure the possible suppliers are financially robust, which is even more important in long-term contracts.
7UU. Technical competence and capacity is something to be proven with references. If we have more suppliers than we need, we can also score these references on their strength. If the reference shows much similarity to what we procure it is considered strong.

C.7.3. Morph Chart as Method

7VV. I am not familiar with all means.
7WW. The chart provides guidance pending a discussion.
7XX. It was super interesting.

C.7.4. Observations

OBS7.1 Both respondents ask for verification of their definition of some topics.
OBS7.2 Both respondents understand the methodology right after the introduction.
OBS7.3 One respondents answers a larger portion of the questions.
OBS7.4 One respondents asks for a short recap of how the multiple choice works.
OBS7.5 Both respondents have a similar definition of a mean, which differs from the one in assumed in the research. It leads to the suggestion to make a category of this mean.
OBS7.6 The respondents showed the tendency to think along, by suggesting and discussing how categories and means could be adjusted to improve.

C.8. Summary Interview VIII

(Anonymized)

C.8.1. Casus

8A. De casus die ik graag wil bespreken is die van Project G. Aan onze zijde is er de afgelopen jaren een tender geweest voor de implementatie van een bepaald systeem bij een aanbestedende partij. Die tender hebben wij gewonnen, waarbij ik eindverantwoordelijk was voor onze deelname in dat aanbestedingsproces. In dat contract zat een innovatieparagraaf, wat mij interessant leek voor dit onderzoek.
8B. Voor de aanbestedende was deze manier van werken een totaal andere aanpak dan zij gewend waren. Dit gaat hele nieuwe systemen en een groot deel van de organisatie daar zit nog in een wat verouderd stramien. In de infrastructuur is het zo dat je 35 tot 50 jaar ergens vanaf blijft als het werkt en de veiligheid is gegarandeerd. Men beseft nu dat dat niet meer zo werkt.
8C. Deze transformatie behelst de aanbesteding van IT en gaat daarmee over continue innovatie, er zullen constant upgrades, updates en nieuwe releases zijn, dat vraagt om een andere manier van contracteren.
8D. Naar mijn mening moet je daarvoor van een traditionele klant-leverancier relatie met een afgebakend contract naar een *partnership* toe. Binnen zo'n *partnership* moet je gezamenlijk het einddoel van het programma voor ogen blijven houden, in plaats van wat er precies in de specs staat. Ook moet je flexibiliteit inbouwen om om te kunnen gaan met de dingen die je nog niet kunt voorzien nu.
8E. Het is van groot belang om in een dergelijke samenwerkingsovereenkomst te onderstrepen hoe je met elkaar om wil gaan, de manier waarop je wil samenwerken. Als je dan op een knelpunt komt in de uitvoering, kun je elkaar aanspreken op hoe je het met elkaar gaat oplossen in plaats van alleen op wat er gespecificeerd is in het contract.
8F. Innovatie moet ook expliciet in het contract benoemd worden. Dit kan benoemd worden aan de hand van de hoofddoelen van het programma. Daarbij hebben in het contract beide partijen de verplichting om gedurende het contract met initiatieven te komen, om nog beter aan deze hoofddoelen te kunnen komen. Dat houdt in dat er initiatief genomen wordt als er tegen hetzelfde geld een hogere kwaliteit geleverd kan worden of voor minder geld dezelfde kwaliteit. Die kwaliteit wordt omschreven door een score op die hoofddoelen, op een hoger level dus.
8G. Het is hierbij belangrijk dat er substantiële financiële ruimte voor wordt ingebouwd in het contract en dat beide partijen baat hebben, een *incentive*, bij het initiatief nemen tot het introduceren van innovaties of optimalisaties.
8H. Voor ons als leverancier is de *incentive* verschillend voor innovatie en optimalisatie. Innovatie kan leiden tot additionele *business* voor ons. Financiële ruimte in het contract maakt dat mogelijk. Als je dat niet inbouwt moet het los aanbesteedt worden, dan loop je het risico op het bijkomen van andere partijen, er zijn nieuwe offertekosten enzovoort. Voor optimalisaties is het het delen van de voordelen die daaruit voortkomen.
8I. In ons contract zijn innovatie en optimalisatie opgenomen in een gecombineerde paragraaf. Budget is met name nodig voor innovatie. Een optimalisatie wordt meer gedefinieerd. Je poogt hetzelfde resultaat te behalen met minder geld, dus daar is vaak geen extra budget voor nodig, alleen misschien wat opstartkosten, maar de *business case* zou zichzelf terug moeten verdienen.
8J. Dit gecontracteerde initiatief tot innovatie en optimalisatie kan gezien worden als een toepassing van het periodieke innovatievoorstel.
8K. Het contract in deze case zou uiteindelijk meer dan 30 jaar kunnen duren. Een langetermijncontract en zeker in het geval van IT, kunnen we nog niet inschatten hoe zich dat over 10 jaar al heeft ontwikkeld. We moeten daar ruimte voor in gaan bouwen. Voor alle nieuwe inzichten nieuwe aanbestedingen gaan doen is voor zowel leverancier als aanbestedende partij niet prettig.
8L. Ik denk dat de focus op samenwerking de doelen van het programma centraal stelt en niet de technische specificaties. Wat mij betreft stelt dat ons in staat om te gaan met de IT-vooruitgang. Alles specificeren is een wat verouderd concept.
8M. Bepalen of de aanpak, zoals in deze casus, een succes is is lastig. We zitten nog redelijk in de beginfase. Wel merk ik dat voor het deel van de organisatie van de aanbestedende partij waarmee wij te maken hebben geldt, dat zij in gedachtegoed vooruitlopen op de rest van de organisatie.
8N. Het is een zeer intensieve tender geweest, duurde meerdere jaren, waarin veel dialoog heeft plaatsgevonden tussen de partijen. In die periode is de basis gelegd voor dit gedachtegoed. Dat wordt behouden doordat aan beide kanten minstens 80 procent van het tenderteam ook door is gegaan in de uitvoering. Je kunt een deel op papier vastleggen, maar als dat niet daadwerkelijk zo gevoeld wordt door de projectteams, gaat het niet werken.
8O. Je moet blijven investeren in zo'n samenwerkingsrelatie. In ons team hebben we een *collaboration manager* aangesteld. Iemand die de 'Haarlemmerolie' is tussen de verschillende partijen. Niet alleen tussen de aanbestedende partij en ons bedrijf, maar ook tussen de andere in de keten betrokken partijen.
8P. Ik heb nog niet eerder zo'n vergaande samenwerking gezien, wel de ambities. In de praktijk bleek vaak dat een wisseling van personen daar ook geen goede invloed op had. Het is ook erg persoonsafhankelijk.
8Q. Ik was eindverantwoordelijk voor onze deelname aan deze tender en intern heb ik er veel moeite en energie ingestoken om ons team mee te krijgen. Ook aan leverancierszijde speelt dat gedachtegoed een belangrijke rol. Als je weet dat je door een klant afgerekend wordt op het voldoen aan de specificaties, dan is de kans groot dat mensen aan leverancierszijde ook blijven sturen op het contract. Daarom moet die samenwerking ook aan onze kant in het team geadopteerd worden.
8R. Het is een zware en intensieve dialoog geweest, er ook op gericht te toetsen of dat wat de aanbestedende partij wilde in het gewenste tijdsbestek realiseerbaar en haalbaar was. Daarom werd na al die dialogen pas de RfP uitgebracht. Deze zag eruit zoals de *draft*, maar er was wel degelijk ruimte voor aanpassingen en discussie. Dat is ook in het belang van de

opdrachtgever. Het was een soort verificatie, maar ging verder dan dat. Het is een peiling van het badwater, een test met wat voor partijen je aan tafel zit, om te kunnen beoordelen of een eventuele intensieve samenwerking gaat werken. Dat is een informele schatting, dat mag niet meewegen volgens de Europese regels. De beoordeling vindt plaats op papier, maar de dialoog stelt de opdrachtgever nog beter in staat dat wat op papier staat te duiden.

C.8.2. Morph Chart

8S. Optimalisatie kan beter 'aanpassingen' vervangen in de morph chart bij 'initiatief tot innovatie/aanpassingen'.
8T. Het aanbesteden van innovatie in een separaat perceel zou ik niet doen. Je doet tijdens een project ervaring en kennis op omdat je in de uitvoering van een contract zit. Dat leidt tot inspiratie voor de innovatie.
8U. Het enige wat ik daar tegenin zou kunnen brengen is dat als je gedreven wordt door tijdsdruk binnen het hoofdcontract, je misschien niet toekomt aan innovatie. Dat zou pleiten om toch dingen separaat aan te besteden. Toch denk ik dat het andere argument zwaarder weegt.
8V. Bekeken vanuit leverancierspersperspectief zorgt een bepaald volume ook voor de ruimte om er buiten ook eens wat investeringen te doen. Want bij innovaties gaan de kosten altijd voor de baten uit.
8W. Project G is een voorbeeld van het separaat aanbesteden van innovatie, wel met *funding* vanuit opdrachtgevers zijde. Dat is ook een mogelijke structuur, maar mijn advies zou zijn om het bij elkaar te houden, omwille van het einddoel, ten nutte van de opdrachtgever uiteindelijk.
8X. Badge moet geschreven worden als batch.
8Y. De omvang van de besproken aanbesteding is dermate groot en complex dat je altijd oplevering in delen, batches hebt. Sommige dingen kun je alleen niet uit elkaar halen. Op een gegeven moment moet je iets opleveren, wat daadwerkelijk geïmplementeerd kan worden. Maar wat wij hier gaan leveren is niet de eindsituatie, want wat zou anders de rol van die hele innovatieparagraaf nog zijn?
8Z. Concreet moet er na een aantal jaren een eerste *release* opgeleverd worden die uitgerold wordt. Dan zitten we nog in de ontwikkelfase. Parallel daaraan zijn we al in gesprek over de functionaliteit van de volgende *release* en die daarna staat ook op hoofdlijnen al klaar. Dus die ontwikkeling loopt parallel.
8AA. Van het testen van innovatie ken ik overal voorbeelden van. Bij een andere aanbesteding met een opdrachtgever hebben we recentelijk in samenwerking een fysieke pilot gedaan. Een digitale pilot kan natuurlijk ook.
8BB. Periodiek innovatievoorstel passen wij toe, wederzijds wel. Modificaties door wijzigingen in wet- en regelgeving worden zeker vastgelegd. Ook wordt de contractuele leerruimte toegepast.
8CC. Het type specificaties is van groot belang voor de flexibiliteit en innovatie. Als iets puur op prijs besloten wordt, zal een leverancier kosten minimaliseren. Je moet je blijven afvragen of die kosten opwegen tegen de kwaliteitswaarde. Dat zijn afwegingen die je moet maken.
8DD. In ons geval hebben we dit contract gewonnen tegen een hogere prijs dan de concurrent, omdat we een veel hogere kwaliteitswaarde hadden. Dus de selectiecriteria zijn *key*.
8EE. Wij gebruiken functionele specificaties, maar ook specificaties met een resultaat- of inspanningsverplichting.
8FF. Bij een functioneel beschreven specificatie met een mijlpaal, zou ik dat definiëren als een resultaatverplichting, op basis van tijd en functionele specificaties.
8GG. De inspanningsverplichting zie ik op twee manieren terug. Ten eerste dat we in het contract overeengekomen zijn dat er de verwachting is dat vernieuwingen naar voren zullen komen en dat we verplicht zijn te kijken naar hoe we daar invulling aan kunnen geven. Ten tweede is het je inspanningsverplichting om continu te streven naar het bereiken van het overkoepelende programmadoel, in de samenwerking.
8HH. Verder hebben we veel meer functionele specs dan technische.
8II. Deze aanbesteding is vorm gegeven met een concurrentiegerichte dialoog. Als je de meerwaarde van je leverancier wil maximaliseren in de voorbereiding van de aanbieding, dan is deze procedure goed. Je krijgt veel beter begrip, ook van het programmadoel van de opdrachtgever. Het kost wel veel tijd en energie aan de zijde van de opdrachtgever, moet ik zeggen. In dit geval waren er meerdere partijen waarvan na een vrij beperkte dialoog en een eerste inschrijving dat aantal werd terug gebracht naar een heel klein aantal partijen. Daar is een intensieve dialoog mee aangegaan, dat kost veel energie van de opdrachtgever. Aan de andere kant is dat niet gek voor een contract van zo'n lange duur.
8JJ. Ons contract bevat zowel een design, engineer als construct component en is dus een Engineer & Construct contract, maar we hebben ook een vorm van co-engineering erin opgenomen. Zelfs na contractondertekening wordt er nog samen met de opdrachtgever door de specificaties gegaan, voor het wederzijdse begrip en het filteren van eventuele problemen.
8KK. Wij financieren niet mee, de opdrachtgever ook niet. In het contract is het innovatiebudget vastgelegd, dat is het.
8LL. Wat betreft het gunningssurplus, zie ik dat als volgt. Als het gaat over hoeveelheid van wat er geleverd wordt, dan speelt dat geen rol. Het zit hoogstens in de wijze waarop je dingen aanpakt, de methodiek. Dat is daarmee wel meer de aanpak dan de daadwerkelijke levering. Ik vraag me wel af of het aanbestedingsrechtelijk kan om te gunnen aan een partij die meer biedt dan ik gevraagd heb.
8MM. Voor duur en volume is de opgebouwde kennis bij een leverancier van grote waarde. Ga je dit soort samenwerkingen aan, dan moet je het over langetermijncontracten hebben, anders is er commercieel geen zekerheid voor een leverancier.
8NN. In het diagram kan de samenwerking duidelijker naar voren komen, die is echt van belang.
8OO. Verder moet het inbouwen van die contractuele ruimte nog meer naar voren komen. Ik loop er vaak tegenaan dat een opdrachtgever meer wil doen binnen het contract, maar dat het niet kan omdat het niet opgeschreven is. Die contractuele ruimte zit specifiek in de innovatieparagraaf omdat het daar expliciet benoemd wordt. In die paragraaf zit ook de financiële ruimte. Dat zijn voorwaarden voor een dergelijke samenwerking. Deze zitten nog niet genoeg in het type contract, alleen gedeeltelijk in het geoormerkt innovatiebudget. Het is goed dat je die onder het kopje 'contract' hebt staan, want als je de

leverancier daar buiten laat, dan is het heel erg vanuit opdrachtgevers perspectief beredeneert. Dan heb je intern wel een innovatiebudget, maar dan blijft de vraag of je niet opnieuw moet aanbesteden, door wezenlijk wijzigen.
8PP. Misschien kan dit toegevoegd worden bij het initiatief tot innovatie of zelfs bij het type contract iets toevoegen waar die contractuele ruimte meer in zit. Het moet ergens in je scope en het past wel bij product. Als je de definiëring van de scope te beperkt hebt, verlies je ruimte om wat te wijzigen. Je scope moet je daarom binden aan je *overall* doelstellingen, die heel hoog over zijn. Daar creëer je ruimte mee.

C.8.3. Morph Chart as Method

8QQ. I have read the introductory document, only the first page with the example though, but the methodology is clear to me.

C.8.4. Observations

OBS8.1 The respondent shortly checks if the methodology is understood correctly.
OBS8.2 The respondent checks if the scope and intention of what is designed in the MC are similar to what has been understood from the example provided in advance.
OBS8.3 The respondent sometimes checks the intended definition of the means.
OBS8.4 It is seen that the methodological concept is very clear to the respondent, shown by the well-considered argumentation and explanation of the expert's knowledge and experience.

Appendix: Design modifications MC

A detailed overview of the modifications made according to the conducted expert interviews is given in this chapter. For each interview, an explanation can be found for each category or mean modified, with a prior description of what kind of adjustment has been made. The descriptive verbs are presented below.

Table D.1: Descriptive Verbs for Adjustment to Designed MC

Verb	Action
Add	Category or mean has been added to the MC.
Delete	Category or mean has been removed from the MC.
Consider	Category or mean has been considered to be changes/added/deleted and so on, but no changes were made. An explanation is given on the reason to do so.
Change	Category or mean has been given a different name.
Split	Category or mean has been split into two or more categories or means.
Generic	A general comment on the diagram, not specifically for a category or mean.

It is important to notice that all interviewees have given their written consent to the summaries, as being a correct representation of all that has been discussed in the interviews. However, these summaries do not include quotations. The statements used in this analysis of the adjustments made to the morph chart are therefore not literal statements made by the interviewees, but are written by the researcher based on the agreed on summaries. All data referred to in the text in between brackets refers to the interview number and statement, as can be found in the summaries in the Appendix C. Lastly, it must be added that the following color coding is used to give better insight in the diagrams.

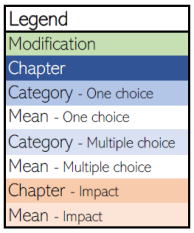


Figure D.1: Legend MC Modifications

D.1. Expert-based modifications

D.1.1. Interview I

Morph Chart - Interview I											
Product											
Scope of product	Total asset	Asset in parcels	Asset and innovation in different parcels								
Degree of co-operation	Classic	Integrated	Life cycle management								
Delivery	Complete delivery	Batches	Batches with increasing, iterative development	Complete delivery with ex-post adaptations per batch							
Innovation development	Incremental innovative nature	Parallel development innovative product	No development								
Testing innovation	Living lab (disclosure to mulitple innovations)	Pilot (testing of one/a few innovations)	Periodical innovation proposal	Contractual learning/ development space	No testing						
Selection criteria	Quality	Esthetics	Functional characteristics	Accessibility	Suitability for users	Social characteristics	Environmental characteristics	Innovation	Organization, qualification and experience of the personnel	Customer service and technical assistance	Delivery terms and conditions
Specifications	Technical specifications	Functional specifications	Catalogus specifications	Targets - Obligation of result	Targets - Obligation of effort						
Contract											
Procedure type	Public procedure	Non-public procedure	Competitive procedure with negotiation	Competitive dialogue	Negotiated procedure with prior publication	Contest	Concession	Innovation partnership			
Procedural instruments	Framework agreement	Dynamic Purchasing System	Electronic Auction	None							
Limitation of applicants	Selection of best candidate	Two rounds of gradual reduction	Multiple rounds of gradual reduction								
Contract type	Classic	Engineer & Construct	Design & Construct	Building management	DB(F)M	DB(F)MO(T)	Concession				
Additional organizational structure	Building Team	Alliance	None								
Financial structure	Co-financing	Pre-commercial purchasing	Dedicated innovation budget	Contracting body pays remuneration to producer							
Contracted future modifications	Changes in legislation	Defined technical alterations	Accidents concerning product	None							
Awarding criteria	Lowest cost (based on cost effectivity)	Price-quality ratio	Lowest price	Best Value Procurement							
Awarding surplus	Surplus taken into account	No surplus									
Duration	Full term	Mid term	Short term								
Volume	Total necessity	Partial necessity									
Eligibility requirements	Financial and economic capacity	Technical competence	Professional competence	Professional qualification							

Figure D.2: MC1: Modifications to Initial MC based on Interview I

Analysis and implementation adjustments

Add: Contracted future modifications

In the interview it was stated that what is currently done to guarantee flexibility as much as possible, is to write all possible modifications in the contract, such as software changes (1D). This way these modifications are within the scope of the procurement and therefore no new procurement process has to be set up. The interviewee mentions three types of these modifications to be included in the review clause: based on changes in legislation (1E) accidents with the product (1N and 1O) and possible technical alterations (1BB). Additionally, it was mentioned that with including modifications in the contract, you must include in the contract what the modification procedure is for such a change, the modification procedure (1BB).

In the morph chart these modifications have been translated in a new category. This adjustment clearly impacts the content of the contract and not the product itself, meaning that the new category is part of the contract aspect in the MC. The category has been named *Contracted future modifications* and its measures, logically, *Changes in legislation*, *Defined technical alterations*, *Accidents concerning product*. As to fulfill the criteria of collectively exhaustiveness of morphological charts, the option of not contracting any possible modification is included in the option *None*.

Add: Surplus

The respondent stated that they use the inclusion of possible variants in their procurement processes. These variants account for the fact that in some cases the supplier's basic product is already better than what is asked in the procurement (1H). To match what is contracted, suppliers might remove this additional value. This costs more money due to more engineering and therefore a less competitive bid. To avoid this, a surplus is added to the contract based on the five main goals of the company. The extra's included in the supplier's bid are valued within this surplus, but may no additional costs may be charged here for (1I).

In the morph chart the *Surplus* has been added as a new contract related category. Based on the interview not much different means of implementing such a surplus in the contract could be identified. Therefore, two options are included in the MC: either *Surplus taken into account* or *No surplus*.

Consider: Service

In the interview it was mentioned that the company has gone from a support agreement to a Long-Term Service Agreement (LTSA). This way, the supplier was held responsible for a longer period of time for providing service concerning the product (1P). As DBFM includes a maintenance component, such as a LTSA, the 'F' from finance has been put between brackets. This way, Design & Build can be combined with a maintenance component, with or without the inclusion of financing by the supplier.

D.1.2. Interview II

Morph Chart - Interview II											
Product											
Scope of product	Total asset	Asset in parcels	Asset and innovation in different parcels								
Delivery	Complete delivery	Batches	Batches with increasing, iterative development	Complete delivery with ex-post adaptations per batch							
Innovation development	Incremental innovative nature	Parallel development innovative product	Upfront development	No development							
Testing innovation	Living lab (disclosure to mulitple innovations)	Pilot (testing of one/a few innovations)	~~Periodical innovation proposal~~	~~Contractual learning/ development space~~	No testing						
Degree of co-operation	Classic	Integrated	Life cycle management								
Sub-awarding criteria	Quality	Esthetics	Functional characteristics	Accessibility	Suitability for users	Social characteristics	Environmental characteristics	Innovation	Organization, qualification and experience of the personnel	Customer service and technical assistance	Delivery terms and conditions
Specifications	Technical specifications	Functional specifications	Catalogus specifications	Targets - Obligation of result	Targets - Obligation of effort						
Contract											
Volume	Total necessity	Partial necessity									
Duration	Full term	Mid term	Short term								
Contract type	Classic	Engineer & Construct	Design & Construct	Building management (EPC(M))	DB(F)M	DB(F)MO(T)	~~Concession (Life Cycle)~~				
Additional organizational structure	Building Team	Alliance	None								
Procurement tools	Framework agreement	Dynamic Purchasing System	Electronic Auction	Market consultation	None						
Financial structure	Co-financing	Pre-commercial purchasing	Dedicated innovation budget	Contracting body pays remuneration to producer							
Eligibility requirements	Financial and economic capacity	Technical competence	Professional competence	Professional qualification							
Selection criteria	Size of company	Amount of references	Type of references	Quality of references	Quality of resumes						
Contracted future modifications	Changes in legislation	Defined technical alterations	Accidents concerning product	None							
Contracted initiative for innovation/changes	Periodical innovation proposal	Contractual learning/ development space	No initiative								
Awarding criteria	Lowest cost (based on cost effectivity)	Price-quality ratio	Lowest price	~~Best Value Procurement~~							
Awarding surplus	Surplus taken into account	No surplus									
Procedure type	Public procedure	Non-public procedure	Competitive procedure with negotiation	Competitive dialogue	Negotiated procedure with prior publication	Contest	~~Concession~~	Innovation partnership			
Limitation of applicants	Selection of best candidate	Two rounds of gradual reduction	Multiple rounds of gradual reduction								

Figure D.3: MC2: Modifications to MC1 based on Interview II

Analysis and implementation adjustments

Add: Scope of contract

In this interview it was stated that flexibility can be included in a contract as all types of contracting may be employed, as long as it is described in the contract including possible future adjustments (2B). As no additional factors were mentioned in the interview about what could possibly be added to the contract to include this in a better way, it is considered to be part of *Contracted future modifications*.

Add: Upfront innovation

It was stated that the innovation partnership makes use of procuring the research and design to the supplier, whilst it being agreed to be purchased in a later phase (2E). This means that the innovation is developed upfront. This option is not yet represented in the diagram. Therefore, the option of *Upfront development* is added to the MC to the category *Innovation development*.

Change: Nomenclature criteria

It is mentioned clearly that the nomenclature used in the morph chart in some cases not correctly transferred from legislation (2F). Some categories have been named incorrectly.

- *Selection criteria* are called *sub-awarding criteria* (2G) and impacts the product to be contracted (2H). In the morph chart *selection criteria* will be replaced by *sub-awarding criteria*. These criteria behold all that is involved in the evaluation of the quality of the bid.
- The actual *Selection criteria* are used in case the amount of suppliers needs to be limited. The *Selection criteria* therefore solely relate to the company itself and not to its bid. The *Selection criteria* are therefore used in procedures with more than one limitation round (2J). Examples of selection criteria are: *size of the company, type, amount* and *quality of references* (2I) and *the quality of the resumes* (PIANOo - Centre of Expertise on Procurement, 2017). This category of *Selection criteria* and the mentioned options are added to the diagram, under *Contract*.
- The existence of *Exclusion grounds* is also discussed. These grounds affect a knock out, if the company is invested in one of the exclusion grounds it is immediately removed from the process (2L). However, these exclusion grounds always apply (European Parliament and the Council, 2014a), for each procurement procedure and do not affect flexibility in anyway. Although the exclusion grounds are a well-known part of each procedure, the lack of influence on flexibility caused this not to have been added to the MC.

Delete: Best Value Procurement

In European procurement legislation (European Parliament and the Council, 2014a) three *Awarding criteria* are mentioned, being: *Lowest cost*, *Price-quality ratio* and *Lowest price*. *Best Value Procurement* is included in the MC but should be deleted. BVP is considered a philosophy, an approach, but not an awarding criteria itself. Instead BVP uses the *Price-quality ratio* as awarding criteria (2M). *Best Value Procurement* is deleted from the MC.

Delete: Concession

The interviewees noted that *Concession* is mentioned in the category of procedure types, but a separate framework exists in legislation for the application of a *Concession*. In the opinion of the interviewees this means that the *Concession* must be skipped from the MC, as it seemed to be out of scope (2P). In the MC this has been followed up by the deletion of the *Concession*, as this research is performed within general procurement legislation and legislation for special sector companies.

Change: Purchasing tools

In the morph chart the overarching category of the *Framework agreement, Dynamic Purchasing System* and the *Electronic Auction* is called the *Procedural instruments*. The interviewees suggest this term to be hard to understand, a more generic term would be desirable. Additionally, a more generic term offers the opportunity to also put the use of a *Market consultation* in this category (2R). To increase readability and understanding of respondents, *Procedural instruments* is changed into *Procurement tools* and the measure of using a *Market consultation* as a 'measure'.

Split: Testing innovation

The interviewees suggested that the *Pilot* and *Living lab* must be separated from the *Periodical innovation proposal* and *Contractual learning/development space*. Their reason was that the first two are performed in advance of the procurement, after which it is decided (not) to purchase the tested innovation and the second are means to implement flexibility in the process. This explanation leads to a logical separation of these two 'couples' of means (2U). Though, the interviewees added that the *Pilot* and *Living lab* make use of an exceptional situation in legislation. In this research, the use of those terms is more widely used and refers to two types of testing innovation of which their distinction is based on either testing disclosure to one innovation (*Pilot*) or to multiple (*Living lab*). This distinction of testing types in this broad sense, as well as the inclusion of *Testing innovation* as a category are considered desirable, as it has an impact on flexibility and is within scope of the procurer (see: 6.2 Characteristics MC).

In the morph chart the category *Testing innovation* is split into two categories, of which *Testing innovation* still is one. The other category is *Contracted initiative for innovation/changes* and covers the measures *Periodical innovation proposal* and *Contractual learning/development space*.

Consider: Surplus

The added category of *Awarding surplus* (see: D.1.1 Interview I) was not easily understood by the respondents in this

interview. According to them, this should not be a separate category as it is included in the procedure (2Y). As this statement did not explain how the addition of the in this case called *Awarding surplus* must then be covered in the morph chart, no adjustments have been made to the MC.

Consider: Risk allocation

The allocation of risks has been mentioned as a potential category in the diagram. Though, the interviewees were unsure on if this should be a actual category, as it is also possible that this allocation is intertwined in other categories and means (2Z). As the conversation did not lead to a conclusion on if and how *Risk allocation* should be a category in the MC, it was decided to not add it.

Consider: Market dialogue

It was stated that, apart from the chapters *Process* and *Contract*, the chapter *Market approach* should be added. Some categories of *Contract* and *Product* could then be moved to this chapter, as well as means from other categories, such as *Market consultation* (2BB). In case of the *Market consultation*, which was added during this interview as well, the interviewees noted that it would be better suited to this new chapter. Although this chapter addition was proposed with the allocation of the category *Duration* and the introduction of the categories *Type of collaboration* and *Risk allocation*. As earlier described, *Risk allocation* is not sufficiently specified in the interview or by brainstorming. The same holds for *Type of collaboration*. For both yet no means have been defined. Therefore, this chapter will be kept in mind during the following interviews, but is not introduced.

Generic: Sequence of diagram

Changing the sequence based on the order in which decisions are made in the public procurement process was also suggested by the interviewees. The MC will improve when the sequence is changed such that the order approaches reality better (2CC). First, you analyze the market and what they have to offer. After that, the contract has to be decided on, e.g. the duration and terms. Lastly, the procedure is decided on (2CC).

D.1.3. Interview III

Morph Chart - Interview III													
Product													
Scope of product	Total asset	Asset in parcels	Asset and innovation in different parcels										
Delivery	Complete delivery	Batches	Batches with increasing, iterative development	Complete delivery with ex-post adaptations per batch									
Innovation development	Incremental innovative nature	Parallel development innovative product	Upfront development	No development									
Testing innovation	Living lab (disclosure to mulitple innovations)	Pilot (testing of one/a few innovations)	No testing										
Contracted initiative for innovation/changes	Periodical innovation proposal	Contractual learning/ development space	No initiative										
Degree of co-operation	Classic	Integrated	Life cycle management										
Sub-awarding criteria	Quality	Esthetics	Functional characteristics	Accessibility	Suitability for users	Social characteristics	Environmental characteristics	Innovation	Organization, qualification and experience of the personnel	Customer service and technical assistance	Delivery terms and conditions	Competence in Systems Engineering	Collaboration capabilities
Specifications	Technical specifications	Functional specifications	Catalogus specifications	Targets - Obligation of result	Targets - Obligation of effort	Targets - Obligation of vision goals							
Contract													
Volume	Total necessity	Partial necessity											
Duration	Full term	Mid term	Short term										
Risk determination	Procurer	Supplier(s)	In collaboration										
Risk mitigation	Focus on process and collaboration	Focus on achieving specified objectives											
Risk profile	Fully covered profile	MU-value of bandwidth											
Ownership innovation	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	No innovation								
Intellectual property	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	No innovation								
Contract type	Classic	Engineer & Construct	Design & Construct	Building management	DB(F)M	DB(F)MO(T)	Custom agreement						
Additional organizational structure	Building Team	Knowledge alliance	Two-phases approach	None									
Procurement tools	Framework agreement	Dynamic Purchasing System	Electronic Auction	Market consultation	None								
Financial structure	Co-financing	Pre-commercial purchasing	Dedicated innovation budget	Contracting body pays remuneration to producer									
Eligibility requirements	Financial and economic capacity	Technical competence	Professional competence	Professional qualification									
Selection criteria	Size of company	Amount of references	Type of references	Quality of references	Quality of resumes								
Contracted future modifications	Changes in legislation	Defined technical alterations	Accidents concerning product	Hourly rates for types of modifications	None								
Contracted initiative for innovation/changes	Periodical innovation proposal	Contractual learning/ development space	No initiative										
Awarding criteria	Lowest cost (based on cost effectivity)	Price-quality ratio	Lowest price										
Awarding surplus	Surplus taken into account	No surplus											
Procedure type	Public procedure	Non-public procedure	Competitive procedure with negotiation	Competitive dialogue	Negotiated procedure with prior publication	Contest	Innovation partnership						
Limitation of applicants	Selection of best candidate	Two rounds of gradual reduction	Multiple rounds of gradual reduction										

Figure D.4: MC3: Modifications to MC2 based on Interview III

Analysis and implementation adjustments

Add: Two-phase approach (Additional organizational structure)

The respondent mentions the absence of the *Two-phases approach* in the MC (3D). This approach logically consists of two phases, in which the design and construction are separated. Also in the early stages of the design, the suppliers are already involved in the process, leading to collaboration and a better utilization of expertise (Rijkswaterstaat [Department of Waterways and Public Works], 2021). This approach is well-known and has an impact on flexibility, by the involvement of the supplier and procurer in the design and is therefore added to the MC, as suggested by the interviewee, in the category *Additional organizational structure*.

Add: Risk profile

It is noted in the interview that they decided to determine a risk bandwidth, instead of determining an exact risk profile. To establish this bandwidth, the most minimum, maximum and most likely (MU) value were determined and the maximum bandwidth was set to +/- 15 percent (3F). In the previous interview, risk allocation was considered, but not included (2Z). However, now this has been mentioned twice as a factor of impact, the MC must be complemented with one or more categories of risk.

As the different means for a risk profile were revealed in this interview, first a category of *Risk profile* will be added to the morph chart. The means of this category are: *Fully covered profile* and *MU-value of bandwidth.* Assumed is that no procurement process will take place without a risk profile, therefore no additional default option is added.

Add: Risk determination

The interviewee mentions that in previous procurement they left the determination of solutions to the supplier, based on their functional specifications. This also meant that the determination of risks was in the hands of the supplier, based on their best solution proposal. In their current application of the *Two-phases approach*, they determine the important risks themselves (3G). Both procurement process were based on the approach being as flexible as possible. This means that the determination of risks is a factor to be taken into account for flexibility. It is added to the morph chart as the category *Risk determination*, with its means being *Procurer, Supplier(s)* and *In collaboration*.

Add: Risk mitigation

Another risk related category to be identified in this interview, is based on how risk is managed and therefore mitigated. The interviewee mentions risk management to be done by focusing on the procedural part of the specifications (3I). Risk mitigation is, especially in relation to the new categories *Risk determination* and *Risk profile*, an important addition. With implementation of flexibility in the process comes risk, specifically because the risk of the use of a new procurement structure, its mitigation must be included in the MC. The category *Risk mitigation* is introduced, with its means being *Focus on process and collaboration* and *Focus on achieving specified objectives.* The first mean relates to the new approach as mentioned by the interviewee. The second mean relates to the more old fashioned approach in which the focus was on mitigating risks by focusing on the strict achievement of all that was specified in the contract (Turley et al., 2014).

Add: Target – Obligation of vision goals

It was mentioned that the company asked for the achievement of specifications on an even higher level than functional specifications. They specified on main purpose, on achieving a certain level of fulfillment on the companies vision, aiming for flexibility in the procurement for the supplier (3M).

Firstly, it was not intended to introduce a new mean in the MC, as it could be argued that *Targets – Obligation of result* already beholds the vision specification. However, the interviewee clearly stated that specifying the vision was on a much higher level than the functional specifications, which gave a signal that this needed to be discussed more extensively.

Since the mean *Targets – obligation of result* was intended to cover specifications of result without prescribing how this should be done, it was not specifically intended to be on a higher level than the other specifications. The inclusion of *Target – Obligation of vision goals* is exclusively focused on specifying the goal, without determining how, but on a much higher level than the other specification means. As this could offer even more flexibility to the supplier, this means is added to the MC.

Add: Competence in systems engineering and Collaboration capabilities

It was mentioned that limiting the suppliers still in the process was done by evaluating their *Competence in systems engineering* and *Collaboration capabilities*. As collaboration and a systems engineering approach both could lead to more flexibility in the procurement process (3E), these means have been included in the MC as part of the *Sub-awarding criteria*.

Add: Competence on innovation

The respondent tells that the limitation of applicants has been executed by doing a binary evaluation of the supplier's competence on innovation (3P). From the perspective of flexibility for the aim of innovation, it is valuable to add *Competence on innovation* to the selection criteria. The reason to add this mean to the selection criteria in the MC instead of the sub-awarding criteria, is the fact that it was mentioned that a first selection to limit the applicants was done by this binary evaluation. This means the *Competence on innovation* was employed as a selection criterion (3P).

Consider: Contracting multiple parties

Contracting multiple parties for the same contract has been mentioned in the interview (3N). This is possible, but this study researches implementing flexibility in the procurement process. It is therefore assumed that for contracting multiple parties,

the MC can be used deployed as many times as necessary. This means no additions are made to the MC based on this notion.

Consider: Timing of awarding contract(s)
It is noted that similar procedures can result in different timing of the awarding of the contract, or even the awarding of more contracts throughout the process. The respondent tells about two different approaches employed within their company. In this case the innovation partnership is performed in two different ways. First, the partnership is awarded after the competitive phase and contains all following phases up until the completion of the process. Second, the partnership consists of intermediate funneling of applicants. This results in decreasing the amount of selected suppliers after each round; research and development, testing and the commercialization (3R). Both offer different advantages and disadvantages to the flexibility in the process, causing this to be a factor to be considered for the MC. Though, the *Multiple round of gradual reduction* does cover this structure, but it is important to notice that these cases do give additional meaning to this means.

Add: Ownership of innovation
Determining and fixing ownership of the innovation is very important to the process (3T). The respondent mentions earlier issues on financial responsibility (3U) and the transaction costs involved in finding a solution here for. To give an insight on how the *Ownership of innovation* can be allocated amongst the stakeholders in the procurement, this is introduced in the MC as a new category. The means are *Procurer*, *Supplier, Supplier – Usus* and *Supplier – Usus fructus*. Differentiation in the last three means is based on what ownership means. *Supplier* reflects the ownership of the supplier of the full innovation, even its physical possession if possible. *Supplier – Usus* refers to the supplier as being the owner of the use of the innovation. *Supplier – Usus fructus* represents the supplier as being the owner of not only the use of the innovation but also the 'fruits of production', its exploitation value belongs to the supplier.

Add: Intellectual property
The respondent mentions the allocation of intellectual property as well (3JJ). From the same line of reasoning as above, for the *Ownership of innovation*, a new category of *Intellectual property* is added to the MC.

Add: Pay on demand
The respondent mentions a solution found in an earlier case to enable some sort of pricing to future changes in the contract, without being able to describe certain changes. To do so, this company employed the system of paying on demand. This meant that an outline of certain modifications was drawn, on a very high level, with a related hourly rate (3Z). As this was agreed on in the contract, it was not out of scope, so there was no need for a new procurement process. Also, it provided some financial grip for the procurer. This option is added as *Hourly rates for types of modifications* to the category *Contracted future modifications*, as it offers a different measure to cope/prepare for future modifications.

Consider: System integrator
It is noted that the responsibility for the integration of innovative systems can be allocated amongst stakeholders (3Y). According to the respondent this limits flexibility (3CC), meaning that there should be other options. As no other examples have been mentioned so far, of various allocations of system integrators, this category is not included in the MC.

Consider: Alignment with program objective
The respondent mentions that the alignment of the bid with the program objective is the most important sub-awarding criterion. He also says that it could be considered to be part of quality (3MM). This is done, as the quality beholds that what is wanted by the procurer, which is considered to be the same as the *Alignment with the program objective*. This means it is not added to the MC.

Add: Custom agreement
The use of a custom agreement is mentioned in the interview. From the perspective of the respondent, this was not employed before, but it did offer flexibility to the process. The company created a contract that included customization to enable an innovation partnership. Such a contract was made by explaining clearly what, why and how everything will be done, leaving no room for discussion afterwards (3PP). This option is added to the category *Contract type*.

Change: Knowledge alliance
The respondent notes employing a knowledge alliance, in which different stakeholders participate to avoid a vendor lock-in, which is crucial for flexibility in the process (3Y). To incorporate this the previous mean *Alliance* is changes into *Knowledge Alliances*, as this describes more accurately what was meant initially with this mean.

Consider: Technology Readiness Level
Technology Readiness Level (TRL) is a system developed by NASA and describes in what phase of development a new technology is (Netherlands Enterprise Agency (RVO), 2022). The TRL is mentioned by this respondent to describe the innovation he is talking about (3KK), but since changing the TRL is not something that can be done by the procurer, it is not included in the MC.

D.1.4. Interview IV

Morph Chart - Interview IV													
Product													
Scope of product	Total asset	Asset in parcels	Asset and innovation in different parcels	Innovation only									
Delivery	Complete delivery	Batches	Batches with increasing, iterative development	Complete delivery with ex-post adaptations per batch									
Innovation development	Incremental innovative nature	Parallel development innovative product	Upfront development	No development									
Testing innovation	Living lab (disclosure to mulitple innovations)	Pilot (testing of one/a few innovations)	No testing										
Degree of co-operation	Classic	Integrated	Life cycle management										
Sub-awarding criteria	Quality	Esthetics	Functional characteristics	Accessibility	Suitability for users	Social characteristics	Environmental characteristics	Innovation	Organization, qualification and experience of the personnel	Customer service and technical assistance	Delivery terms and conditions	Competence in Systems Engineering	Collaboration capabilities
Specifications	Technical specifications	Functional specifications	Catalogus specifications	Targets - Obligation of result	Targets - Obligation of effort	Targets - Obligation of vision goals							
Contract													
Volume	Total necessity	Partial necessity											
Duration	Full term	Mid term	Short term										
Risk determination	Procurer	Supplier(s)	In collaboration										
Risk mitigation	Focus on process and collaboration	Focus on achieving specified objectives											
Risk profile	Fully covered profile	MU-value of bandwidth											
Ownership innovation	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	No innovation								
Intellectual property	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	No innovation								
Contract type	Classic	Engineer & Construct	Design & Construct	Building management	DB(F)M	DB(F)MO(T)	Custom agreement						
Additional organizational structure	Building Team	Knowledge alliance	Two-phases approach	Purchasing alliance	International collaboration	None							
Procurement tools	Framework agreement	Dynamic Purchasing System	Electronic Auction	Market consultation	None								
Financial structure	Co-financing (collaboration parties fulfilling different roles)	Co-financing - EU Subsidies	Pre-commercial purchasing	Dedicated innovation budget	Financial alliance (collaboration similar parties)	Contracting body pays remuneration to producer							
Eligibility requirements	Financial and economic capacity	Technical competence	Professional competence	Professional qualification									
Selection criteria	Size of company	Amount of references	Type of references	Quality of references	Quality of resumes								
Contracted future modifications	Changes in legislation	Defined technical alterations	Accidents concerning product	Hourly rates for types of modifications	None								
Contracted initiative for innovation/changes	Periodical innovation proposal	Contractual learning/ development space	Latest and Greatest Technology requirement	No initiative									
Awarding criteria	Lowest cost (based on cost effectivity)	Price-quality ratio	Lowest price										
Awarding surplus	Surplus taken into account	No surplus											
Procedure type	Public procedure	Non-public procedure	Competitive procedure with negotiation	Competitive dialogue	Negotiated procedure with prior publication	Contest	Innovation partnership						
Limitation of applicants	Selection of best candidate	Two rounds of gradual reduction	Multiple rounds of gradual reduction										

Figure D.5: MC4: Modifications to MC3 based on Interview IV

Analysis and implementation adjustments

Consider: TSIS and national legislation

In the interview, the respondent mentioned the Technical Specifications for Interoperability (TSI) (4F) and national legislation (4H). Both of these legislative criteria are part of a framework that does influence the flexibility in the procurement process. Yet no change in this framework can be directly affected by the procurer, which means it is out of scope, resulting in no changes in the MC.

Add: Latest and Greatest Technology requirement

It was stated that the company makes use of a *Latest and Greatest Technology* criterion. This means the product has to be delivered with the latest and greatest technology at the time of delivery (4M). It avoids receiving an outdated product at the time of delivery, which is desirable, especially in long-term construction projects. Flexibility in the process is greatly enhanced herewith, since it does not require a detailed upfront description of what needs to be implemented, but it allows for innovation along the program. This solution is included in the MC as *Latest and Greatest Technology requirement*.

Add: Financial alliance and Purchasing alliance

The respondent indicated that *Co-financing* and *Alliances* should be on the same line or even merged. It was also pointed out that more alliances should be included, being a knowledge, financial and purchasing alliance (4II). The *Knowledge alliance* already exists within the MC, but additional alliances will be added to the MC as well. The *Financial alliance* can possibly be perceived as being similar to *Co-financing*, but in this mean the alliance is meant to reflect a collaboration between two similar parties, as two procurers. The *Financial alliance* will therefore be added to the category *Financial structure*. Additionally, a short explanation is added to both the *Co-financing* mean, as well as the *Financial alliance*, to support understanding for the reader. The same holds true for the *Purchasing alliance*, which is added to the category *Additional organizational structure*.

Add: International Collaboration

It was noted that *International collaboration* between similar parties procuring a similar product is a good option (4JJ). Although this might seem to overlap with the *Financing* and *Purchasing alliance*, it is perceived to be important to explicitly mention the option to collaborate internationally. This results in *International collaboration* to become a new means in the category *Additional organizational structure*.

Consider: No testing

The respondent stated that *No testing* as a mean in the category of *Testing innovation* should be skipped, since even in case of no innovation a product should be tested (4SS). Still, the consideration has resulted in not skipping the *No testing* mean. As the category is specifically meant to provide measures to test innovation and not the product in full and the option of not testing an innovation could not be ruled out with certainty, it has been decided to not skip *No testing* as a mean.

Add: Innovation only

In the interview it was discussed that another option would be to apply co-financing solely to the innovation and not to the procurement of the product (4TT). Though when this is worked out for the other categories, this can be applied to almost all of them and the remainder does not 'malfunction' in case it would be applied to only the innovation. Therefore, it might be a good option to include *Innovation only* to the *Scope of product*, which enables combination of only the innovation with all those categories. However this was initially not included in the scope of the product as the *Total asset* could also have been perceived as being the Innovation. But since the *Asset and innovation in different parcels* is added, as it is an option for flexibility in the process as well, not including *Innovation only* could not be supported. The result is the inclusion of the new mean *Innovation only* in the category *Scope of product*.

Add: Co-financing – EU subsidies

In the same discussion of the application of *Co-financing*, the possibility of *Co-financing with EU subsidies* arose (4TT). This form of *Co-financing* has been added to the category *Financial structure* as *Co-financing – EU subsidies*.

Consider: Contracted availability

It was mentioned in the interview that contracting availability instead of the construction of a product could be an option (4FF). The producer would than produce, maintain and operate a product and as a result deliver availability matching the product demand. Though, *Contracting availability* as discussed in the interview was similar to a *Concession*, which has been skipped from the MC because it is out of scope. Even though the ownership of the trains in case of *Contracting availability*, this does not influence the mechanism of procurement. The result is that *Contracted availability* is not introduced in the MC.

D.1.5. Interview V

Morph Chart - Interview V													
Product													
Scope of product	Total asset	Asset in parcels	Asset and innovation in different parcels	Innovation only									
Delivery	Complete delivery	Batches	Batches with increasing, iterative development	Complete delivery with ex-post adaptations per batch									
Innovation development	Incremental innovative nature	Parallel development innovative product	Upfront development	No development									
Testing innovation	Living lab (disclosure to mulitple innovations)	Pilot (testing of one/a few innovations)	No testing										
~~Degree of co-operation~~	~~Classic~~	~~Integrated~~	~~Life cycle management~~										
Sub-awarding criteria	Quality	Esthetics	Functional characteristics	Accessibility	Suitability for users	Social characteristics	Environmental characteristics	Innovation	Organization, qualification and experience of the personnel	Customer service and technical assistance	Delivery terms and conditions	Competence in Systems Engineering	Collaboration capabilities
Specifications	Technical specifications	Functional specifications	Catalogus specifications	Targets - Obligation of result	Targets - Obligation of effort	Targets - Obligation of vision goals							
Contract													
Contract type	Classic	Engineer & Construct	Design & Construct	Building management	DB(F)M	DB(F)MO(T)	Custom agreement	Collaboration agreement					
Procurement tools	Framework agreement	Dynamic Purchasing System	Electronic Auction	Market consultation	None								
Financial structure	Co-financing (collaboration parties fulfilling different roles)	Co-financing - EU Subsidies	Pre-commercial purchasing	Dedicated innovation budget	Procurer's contribution (Remove unprofitable peak)	Financial alliance (collaboration similar parties)	Contracting body pays remuneration to producer						
Eligibility requirements	Financial and economic capacity	Technical competence	Professional competence	Professional qualification									
Selection criteria	Size of company	Amount of references	Type of references	Quality of references	Quality of resumes								
Contracted future modifications	Changes in legislation	Defined technical alterations	Accidents concerning product	Hourly rates for types of modifications	None								
Contracted initiative for innovation/changes	Periodical innovation proposal	Contractual learning/ development space	Latest and Greatest Technology requirement	No initiative									
Awarding criteria	Lowest cost (based on cost effectivity)	Price-quality ratio	Lowest price	*Exemption ground (only in case of the exemption ground as procedure)									
Awarding surplus	Surplus taken into account	No surplus											
Procedure type	Public procedure	Non-public procedure	Competitive procedure with negotiation	Competitive dialogue	Negotiated procedure with prior publication	Contest	Innovation partnership	Exemption ground for research and development					
Limitation of applicants	Selection of best candidate	Two rounds of gradual reduction	Multiple rounds of gradual reduction										
Market approach													
Volume	Total necessity	Partial necessity											
Duration	Full term	Mid term	Short term										
Hierarchy of relationship	Horizontal	Vertical											
Risk determination	Procurer	Supplier(s)	In collaboration										
Risk mitigation	Focus on process and collaboration	Focus on achieving specified objectives											
Risk profile	Fully covered profile	MU-value of bandwidth											
Additional organizational structure	Building Team	Knowledge alliance	Two-phases approach	Purchasing alliance	International collaboration	Mixed team	None						
Ownership innovation	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	No innovation								
Intellectual property	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	No innovation								
System integration	Procurer's responsibility	Supplier's responsibility	Independent team coach	No integration									

Figure D.6: MC5: Modifications to MC4 based on Interview V

Analysis and implementation adjustments

Consider: Small Business Innovation Request

The interviewee mentioned the use of the Small Business Innovation Research (SBIR). PIANOo - Centre of Expertise on Procurement (2016d) states that the SBIR procedure is the equivalent of the European *Pre-commercial purchasing*. This mean is not added to the MC as a result.

Consider: Scaling up

One respondent noted that *Scaling up* is a mean to be included in the category *Testing innovation*. Additionally, it was stated that *Scaling up* bringing an already successful innovation in a more matured market. Adding *Scaling* up to the MC could be a measure to test innovation before a procurement process (5CC). All in all, it is decided not to include this mean in the MC, as *Upfront development* is already part of the MC. Also, the level of development of innovations is not yet included, but the use of TRL has been discussed before and should be reconsidered, instead of adding *Scaling up*.

Consider: Portfolio, RAW and STABU contracts

One respondent mentioned *Portfolio contracting*, as well as contract types as *RAW contracts* [Rationalization and Automation Earth, Water and Road Construction] and *STABU* [Standard specifications for civil and commercial construction] (5LL). However, the mentioned types of contracting all consist of a systematic approach consisting of means already mentioned in the MC. All three of these approaches do not reflect options for flexibility of more added value than the current diagram, meaning these will not be included in the MC.

Consider: Certification

A respondent mentions the addition of *Certification* to the MC (5VV), although this is already covered by *Professional qualification* of the *Eligibility requirements*. This suggested mean is therefore not added to the MC.

Add: Procurer's contribution

One respondent adds that to the category *Financial structure* an extra mean must be added, being the *Procurer's contribution* (5EE). In the experience of the respondent this *Financial structure* has been used to remove the unprofitable peak of innovation for suppliers, by providing a contribution (5F; 5G). This mean is added to the *Financial structure* category.

Add: Collaboration agreement

In multiple ways both respondents mention that a collaboration agreement must be included. By contracting collaboration instead of only focusing on a specified product, they state that this enhances risk mitigation, builds trust and enables flexibility in the process (5B; 5L; 5M; 5S). Involved parties are approached as partners in a horizontal approach.

Add: Hierarchy of relationship

Multiple times the respondents point out that the procurer's approach of suppliers is crucial to the success of the process relationship. They mention that using a horizontal approach, as collaboration partners, is more successful for the aim of flexibility than the more old-fashioned vertical approach from procurer to supplier (5R; 5SS). To reflect this, the new category *Hierarchy of relationship* is added, with *Horizontal* and *Vertical* approaches as means and more than one supplier can be involved in the collaboration agreement. All in all, the result is that this mean is included as *Collaboration agreement* in the category *Contract type*.

Delete: Degree of co-operation

The respondents stated that the continued inclusion of *Degree of co-operation* did not make sense. This is reflected in the *Contract type* and *Hierarchy of relationship* and can therefore be left out (5BB). This is applied to the MC.

Consider: Exemption ground for research and development

The respondents mention the possibility to make use of an exemption ground, which is allowed conditionally in EU legislation and provides the option to purchase without competition (5B). Different variants of such an exemption ground exist, but just the *Exemption ground for research and development* is applicable in this case. Both respondents are convinced of the need to include this mean in the MC, as it provides flexibility to the process since the contract is exempted from the obligation to procure. The principles of procurement still apply though (European Parliament and the Council, 2014a).

In the EU Directive 2014/24 (2014a) the exemptions are described. In article 14 of the directive, the exemption for research and development is described. Application of this exemption can only be applied in case of research and development which is not fully financed by the procurer or in case the results do not only benefit the procurer (Van Hulst, 2023). This can therefore be applied in the morph chart, as *Exemption ground for research and development* being part of the category *Procedure type*. Also, the new mean **Exemption ground* is added to the *Sub-awarding criteria* to represent the possibility of making use of the *Exemption ground for research and development* as procedure. The initial awarding criteria are then replaced by the substantiation of the exemption ground (5II).

Add: Mixed team

A *Mixed team* is mentioned during the interview as mean to establish even better collaboration and flexibility in the process (5SS). Specifically including all involved parties in this team is noted (5M; 5N). The *Mixed team* is not represented by another mean and is therefore added to *Additional organizational structure*.

Add: System integrator

In the interview, the respondents mention the possibility to introduce a system integrator in the process. This 'team coach' is the one searching for joint interests and goals and smoothens the process and the integration of all components (5Z).

In interview II the inclusion of a *System integrator* was already considered and it was mentioned that the procurer being the integrator led to limited flexibility (3CC). Adding this up to system integration as mention in this interview, the new category *System integration* can be added to the MC.

Consider: Conscious contracting

A respondent mentions the existence of *Conscious contracting* (5Z). This concept employs the approach of an enduring, relational contract, in which is focused on the collaboration and not on the exclusion of risks for all parties by attempting to build trust amongst involved parties. Even though this concept is new to the MC, it can be represented by certain means in the diagram focusing on collaboration. Therefore this mean is not included in the MC.

Consider: Approaches of procurement

One respondent says the available *Approaches of procurement* should be included in the MC, being the *Best Value Procurement*, *Socially Responsible Purchasing* and *Best Price-Quality Ratio* (5FF). But as these means all present an approach prescribing the choice for certain means in the MC, adding a new category here for is unnecessary.

Generic: Market approach

Earlier, in D.1.2 interview II, the option of adding an extra chapter, the *Market dialogue*, to the MC. At this point of the development of the MC, it was decided not to do so. However, at this point many aspects of a market dialogue have entered the morph chart, such as *Hierarchy of relationship, Intellectual property, Ownership innovation,* all *Risk* related categories, the *system integrator* and the *Parties involved in contract*. To enable optimal readability and understanding, the diagram is split into three instead of two chapters, of which the new chapter will be named *Market approach*.

D.1.6. Interview VI

Morph Chart - Interview VI													
Impacts													
Phases of Technology Readiness	Discovery phase (TRL 1,2 and 3)	Development phase (TRL 4,5 and 6)	Demonstration phase (TRL 7 and 8)	Deployment phase (TRL 9)									
Product													
Scope of product	Total asset	Asset in parcels	Asset and innovation in different parcels	Innovation only	Research and development of innovation								
Delivery	Complete delivery	Batches	Batches with increasing, iterative development	Complete delivery with ex-post adaptations per batch									
Innovation development	Incremental innovative nature	Parallel development innovative product	Upfront development	No development									
Testing innovation	Living lab (disclosure to multiple innovations)	Pilot (testing of one/a few innovations)	No testing										
Sub-awarding criteria	Quality	Esthetics	Functional characteristics	Accessibility	Suitability for users	Social characteristics	Environmental characteristics	Innovation	Organization, qualification and experience of the personnel	Customer service and technical assistance	Delivery terms and conditions	Competence in Systems Engineering	Collaboration capabilities
Specifications	Technical specifications	Functional specifications	Catalogus specifications	Targets - Obligation of result	Targets - Obligation of effort	Targets - Obligation of vision goals							
Contract													
Contract type	Classic	Engineer & Construct	Design & Construct	Building management	DB(F)M	DB(F)MO(T)	Custom agreement	Collaboration agreement					
Procurement tools	Framework agreement	Dynamic Purchasing System	Electronic Auction	Market consultation	None								
Financial structure	Co-financing (collaboration parties fulfilling different roles)	Co-financing - EU Subsidies	Pre-commercial purchasing	Dedicated innovation budget	Procurer's contribution (Remove unprofitable peak)	Financial alliance (collaboration similar parties)	Contracting body pays remuneration to producer						
Financial distribution over time	All financial resources available upfront	Flow of financial resources during the process	All financial resources available at completion	No financial resources to be received									
Eligibility requirements	Financial and economic capacity	Technical competence	Professional competence	Professional qualification									
Selection criteria	Size of company	Amount of references	Type of references	Quality of references	Quality of resumes								
Contracted future modifications	Changes in legislation	Defined technical alterations	Accidents concerning product	Hourly rates for types of modifications	None								
Contracted initiative for innovation/changes	Periodical innovation proposal	Contractual innovative clause	Latest and Greatest Technology requirement	No initiative									
Awarding criteria	Lowest cost (based on cost effectivity)	Price-quality ratio	Lowest price	*Exemption ground (only in case of the exemption ground as procedure)									
Awarding surplus	Surplus taken into account	No surplus											
Procedure type	Public procedure	Non-public procedure	Competitive procedure with negotiation	Competitive dialogue	Negotiated procedure with prior publication	Contest	Innovation partnership	Exemption ground for research and development	Call for innovation				
Limitation of applicants	Selection of best candidate	Two rounds of gradual reduction	Multiple rounds of gradual reduction										
Market approach													
Volume	Total necessity	Partial necessity											
Duration	Full term	Mid term	Short term										
Nature of co-operation	Procurer - Supplier	Partnership (Two partners)	Partnership (Multiple partners)	Partnership (All chain partners)									
Hierarchy of relationship	Horizontal	Vertical											
Risk determination	Procurer	Supplier(s)	In collaboration										
Risk mitigation	Focus on process and collaboration	Focus on achieving specified objectives											
Risk profile	Fully covered profile	MU-value of bandwidth											
Additional organizational structure	Building Team	Knowledge alliance	Two-phases approach	Purchasing alliance	International collaboration	Mixed team	None						
Ownership innovation	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	No innovation								
Intellectual property	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	Shared with market	No innovation							
System integration	Procurer's responsibility	Supplier's responsibility	Independent team coach	No integration									

Figure D.7: MC6: Modifications to MC5 based on Interview VI

Analysis and implementation adjustments

Add: Call for innovation

The interviewee elaborated on a case in which they set out a *Call for innovation*. The goal of doing this was to receive various solutions to the formulated problem system. The *Call for innovation* was not accompanied by a commitment to purchase the resulting solutions, but it aimed to receive as much different solutions as possible (6F). This free form to set out a certain call in the market cannot be found in the MC yet, therefore this *Call for innovation* is added to the category *Procedure type*.

Add: Financial distribution over time

In the interview it was mentioned that suppliers indicated they needed a bigger part of the available financial support in the beginning, than later on in the process when they needed less of the resources (6L). Since this does influence flexibility in the process by the distribution often determining the possibilities to innovate for a supplier, a new category is added to the MC. This category *Financial distribution over time* consists of the following means*: All financial resources available upfront*, *Flow of financial resources during the process*, *All financial resources available at completion* and *No financial resources to be received*.

Add: Research and development of innovation

It was stated that earlier the company has applied collaboration, even internationally, in the procurement of research and development (6SS). It was considered to add this option to the MC. But when analyzing the option to include a mean like *Collaboration on research and development of innovation*, it can easily be seen that this mean actually consists of two merged topics. The first part *Collaboration* is already incorporated in the MC and therefore it enables more design space to the MC to include the second part separately, being *Research and development of innovation*. The mean of *Research and development of innovation* describes the scope of what is procured and is therefore added to the category *Scope of product*.

Add: Nature of co-operation

In earlier interviews, e.g. in D.1.2 interview II, the type of relation between procurer and supplier is discussed as being a possible category. Also in this interview, the respondent mentions the absence of a category describing the *Nature of co-operation* (6CC). This new category is added to the MC as the way in which parties behave towards each other, impacts e.g. trust amongst parties and therefore the success of procurement (Lawther & Martin, 2005). Factors like trust cannot be impacted directly by the procurer, but the *Nature of co-operation* can be impacted and influences factors like trust. The means of this new category are the well-known *Traditional procurer-supplier*, the *Partnership (Two partners), Partnership (Multiple partners)* and the *Partnership (All chain partners)*. A distinction has been made between the last three as in D.1.4 interview IV the respondents also mention a situation in which a partnership between multiple parties, or even the full chain of participating parties has been created.

Add: Mixed team

A *Mixed team* is mentioned during the interview as mean to establish even better collaboration and flexibility in the process (5SS). Specifically including all involved parties in this team is noted (5M; 5N). The *Mixed team* is not represented by another mean and is therefore added to *Additional organizational structure*.

Generic: Technology Readiness Level

In interview III and V, the absence of the *Technology Readiness Level* in the MC was (re)considered. Though, in both cases the Technology Readiness Level has not been included as the procurer cannot influence this factor directly. Indirectly the TRL can be influenced by the choice for multiple means in the MC meant to mature innovation. In this interview however, the TRL again was a topic mentioned to be included in the MC, which sparked the interest to include this category anyway (6EE). As the TRL does influence the choices to be made within the MC, it will be added to the MC but differently. An extra chapter is added to the MC for external but essential aspects influencing the choices made in the morph chart.

The new chapter will be called *Impacts* and is included to show what influences affect the design in the morph chart. This does go against the principle of the morph chart being a design method, as these impacts cannot be chosen but are given. However, as the TRL are considered to be of great important for the design, not including this factor in a way would be a loss of information for the MC. The chapter is included in a contrasting color to clearly show the difference between this chapter and the rest of the MC. The TRL is included in the MC as a new category being *Phases of Technology Readiness* as the separation of phases of technology readiness is detailed enough in the MC, not all TRL's require to be mentioned individually (Netherlands Enterprise Agency (RVO), 2022).

Change: Contractual innovative clause

The respondent mentions the *Contractual learning/development space* as being an innovative clause (6GG). Changing this term into *Contractual innovative clause* does better suit the aim of this mean. Therefore this change is introduced in the MC.

Consider: Extra contract types

The respondent mentions that the contract types in the MC mostly consist of building contracts and that contract types for supplies and services (6AAA). However, when seeking for contract types with a focus on supplies and service nothing can be found which is not in the MC already. Therefore, no extra contract types are added to the MC.

Add: Shared with market

The respondent mentions that the company has procured a *Call for innovation* without the commitment to purchase afterwards, but including the agreement to share all gained knowledge with the market (6PP). This infused competition in the construction and commercialization phase of the innovation, but it also provided a head start for the supplier involved in the research and development phase. As this provides advantages to both the procurer and the supplier and provides more flexibility in the process, the new mean *Shared with market* is included in the MC under the category *Intellectual property*.

D.1.7. Interview VII

Morph Chart - Interview VII													
Impacts													
Phases of Technology Readiness	Discovery phase (TRL 1,2 and 3)	Development phase (TRL 4,5 and 6)	Demonstration phase (TRL 7 and 8)	Deployment phase (TRL 9)									
Product													
Scope of product	Total asset	Asset in parcels	Asset and innovation in different parcels	Innovation only	Research and development of innovation								
Delivery	Complete delivery	Batches	Batches with increasing, iterative development	Complete delivery with ex-post adaptations per batch									
Start usage	All at once	In batches	One by one										
Innovation development	Incremental innovative nature	Parallel development innovative product	Upfront development	No development									
Testing innovation	Living lab (disclosure to multiple innovations)	Pilot - Real life (testing of one/a few innovations)	Pilot - Digital (testing of one/a few innovations)	No testing									
Sub-awarding criteria	Quality	Esthetics	Functional characteristics	Accessibility	Suitability for users	Social characteristics	Environmental characteristics	Innovation	Organization, qualification and experience of the personnel	Customer service and technical assistance	Delivery terms and conditions	Competence in Systems Engineering	Collaboration capabilities
Specifications	Technical specifications	Functional specifications	Catalogus specifications	Targets - Obligation of result	Targets - Obligation of effort	Targets - Obligation of vision goals							
Contract													
Contract type	Classic	Engineer & Construct	Design & Construct	Building management	DB(F)M	DB(F)MO(T)	Custom agreement	Collaboration agreement					
Procurement tools	Framework agreement	Dynamic Purchasing System	Electronic Auction	Market consultation	None								
Financial structure	Co-financing (collaboration parties fulfilling different roles)	Co-financing - EU Subsidies	Pre-commercial purchasing	Dedicated innovation budget	Procurer's contribution (Remove unprofitable peak)	Financial alliance (collaboration similar parties)	Contracting body pays remuneration to producer						
Financial distribution over time	All financial resources available upfront	Flow of financial resources during the process	All financial resources available at completion	No financial resources to be received									
Eligibility requirements	Financial and economic capacity	Technical competence	Professional competence	Professional qualification									
Selection criteria	Size of company	Amount of references	Type of references	Quality of references	Quality of resumes								
Contracted future modifications	Changes in legislation	Defined technical alterations	Accidents concerning product	Hourly rates for types of modifications	Price tag catalogus for components	Right to benchmark modification plan in the market	Right to have a third party check modification plan	None					
Contracted initiative for innovation/changes	Periodical innovation proposal	Contractual innovative clause	Latest and Greatest Technology requirement	No initiative									
Awarding criteria	Lowest cost (based on cost effectivity)	Price-quality ratio	Lowest price	*Exemption ground (only in case of the exemption ground as procedure)									
Awarding surplus	Surplus taken into account	No surplus											
Procedure type	Public procedure	Non-public procedure	Competitive procedure with negotiation	Competitive dialogue	Negotiated procedure with prior publication	Contest	Innovation partnership	Exemption ground for research and development	Call for innovation				
Limitation of applicants	Selection of best candidate	Two rounds of gradual reduction	Multiple rounds of gradual reduction										
Market approach													
Volume	Total necessity	Partial necessity											
Duration	Full term	Mid term	Short term										
Nature of co-operation	Procurer - Supplier	Partnership (Two partners)	Partnership (Multiple partners)	Partnership (All chain partners)									
Hierarchy of relationship	Horizontal	Vertical											
Risk determination	Procurer	Supplier(s)	In collaboration										
Risk mitigation	Focus on process and collaboration	Focus on achieving specified objectives											
Risk profile	Fully covered profile	MU-value of bandwidth											
Additional organizational structure	Building Team	Knowledge alliance	Two-phases approach	Purchasing alliance	International collaboration	Mixed team	None						
Ownership innovation	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	No innovation								
Intellectual property	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	Shared with market	No innovation							
System integration	Procurer's responsibility	Supplier's responsibility	Independent team coach	No integration									

Figure D.8: MC7: Modifications to MC6 based on Interview VII

Analysis and implementation adjustments

Add: Price tag catalogus for components

One respondent mentions the earlier executed strategy to *Contract future modifications* by putting price tags on different components, to enable additional works within a structured pricing scheme. This aims to avoid discussions later on by creating common ground between procurer and supplier (7D; 7R). This option is not yet included in the MC, so the new mean *Price tag catalogus for components* is added to the category *Contracted future modifications*.

Add: Right to benchmark modification bid in the market and Right to have third party check modification bid

A respondent mentions they have included in the contract that as the procurer they hold the right to benchmark the modification bid in the market and to have a third party check the modification bid (7K). This way they have attempted to guarantee some sort of check to not receive an extreme modification bid as a result of a lack of competition. These options have not been included in the MC and are also not covered by other means and are therefore introduced as *Right to benchmark modification bid in the market* and *Right to have third party check modification bid* in the category *Contracted future modifications*.

Consider: Maintenance in Agreement and Ownership in agreement

The respondents noted that the inclusion of maintenance on the long-term could strengthen the incentives for the supplier to produce a high-quality product (7F). Also, they mentioned that cases exist in which the responsibility of procuring the ownership of the product as well also has been applied for the aim of flexibility and innovation (7T). The same was mentioned later on in the interview in relation to a supplier who decided to build an additional train to test innovations and modifications on (7AA). However, these three options can be approached by choosing respectively a *DBFM contract* and the *Supplier* in the *Ownership innovation* category. This results in these means not being added to the MC.

Add: Start usage

One respondent mentions they made use of batches when taking the procured product into use (7W). The new category *Start usage* is created with the means being *All at once, In batches* and *One by one*. Since the nature of a product could require a certain structure of commissioning, e.g. products that are part of a network, it is important to specifically consider how the usage of the product is started.

Add: Pilot – Digital

The respondents mention specifically the application of a pilot in reality as well as digital (7EE). As this separation makes a difference within the contract, finances, responsibilities, ownership, finance and more, this distinction has been added to the MC. The initial mean *Pilot* has been split up into *Pilot – Real life* and *Pilot – Digital*.

Consider: Exemption ground

It was noted by one of the respondents that the *Exemption ground for research and development* must be generalized by deleting the 'research and development' part. It was added that there are more exemption grounds than just this one (7II). Though, when diving deeper into the legislation on exemption grounds, the only 'version' that is within the scope of this research is the *Exemption ground for research and development*, causing the MC not to change based on this comment.

Change: Multiple choice

One respondent stated that in case of the *Contracted future modifications* multiple choices can be combined. In their case e.g. they have applied the *Changes of legislation* as well as *Specific technical alterations*, which means it is possible to combine more than one option in this category (7FF). Therefore, this category will be changed color in such a way that it represents more than one option might be chosen there.

D.1.8. Interview VIII

Morph Chart - Interview VIII													
Impacts													
Phases of Technology Readiness	Discovery phase (TRL 1,2 and 3)	Development phase (TRL 4,5 and 6)	Demonstration phase (TRL 7 and 8)	Deployment phase (TRL 9)									
Product													
Scope of product	Total asset	Asset in parcels	Asset and innovation in different parcels	Innovation only	Research and development of innovation								
Delivery	Complete delivery	Batches	Batches with increasing, iterative development	Complete delivery with ex-post adaptations per batch									
Start usage	All at once	In batches	One by one										
Innovation development	Incremental innovative nature	Parallel development Innovative product	Upfront development	No development									
Testing innovation	Living lab (disclosure to multiple innovations)	Pilot - Real life (testing of one/a few innovations)	Pilot - Digital (testing of one/a few innovations)	No testing									
Sub-awarding criteria	Quality	Esthetics	Functional characteristics	Accessibility	Suitability for users	Social characteristics	Environmental characteristics	Innovation	Organization, qualification and experience of the personnel	Customer service and technical assistance	Delivery terms and conditions	Competence in Systems Engineering	Collaboration capabilities
Specifications	Technical specifications	Functional specifications	Catalogus specifications	Targets - Obligation of result	Targets - Obligation of effort	Targets - Obligation of vision goals							
Contract													
Contract type	Classic	Engineer & Construct	Design & Construct	Building management	DB(F)M	DB(F)MO(T)	Custom agreement	Collaboration agreement					
Procurement tools	Framework agreement	Dynamic Purchasing System	Electronic Auction	Market consultation	None								
Financial structure	Co-financing (collaboration parties fulfilling different roles)	Co-financing - EU Subsidies	Pre-commercial purchasing	Dedicated innovation budget	Procurer's contribution (Remove unprofitable peak)	Financial alliance (collaboration similar parties)	Contracting body pays remuneration to producer						
Financial distribution over time	All financial resources available upfront	Flow of financial resources during the process	All financial resources available at completion	No financial resources to be received									
Eligibility requirements	Financial and economic capacity	Technical competence	Professional competence	Professional qualification									
Selection criteria	Size of company	Amount of references	Type of references	Quality of references	Quality of resumes								
Contracted future modifications	Changes in legislation	Defined technical alterations	Accidents concerning product	~~Hourly rates for types of modifications~~	~~Price tag catalogus for components~~	~~Right to benchmark modification plan in the market~~	~~Right to have a third party check modification plan~~	None					
Innovation clause	Hourly rates for types of modifications	Price tag catalogus for components	Right to benchmark modification plan in the market	Right to have a third party check modification plan	None								
Contracted initiative for innovation and optimalisation	Periodical innovation proposal	Contractual innovative clause	Latest and Greatest Technology requirement	No initiative									
Awarding criteria	Lowest cost (based on cost effectivity)	Price-quality ratio	Lowest price	*Exemption ground (only in case of the exemption ground as procedure)									
Awarding surplus	Surplus taken into account	No surplus											
Procedure type	Public procedure	Non-public procedure	Competitive procedure with negotiation	Competitive dialogue	Negotiated procedure with prior publication	Contest	Innovation partnership	Exemption ground for research and development	Call for innovation				
Limitation of applicants	Selection of best candidate	Two rounds of gradual reduction	Multiple rounds of gradual reduction										
Market approach													
Volume	Total necessity	Partial necessity											
Duration	Full term	Mid term	Short term										
Nature of co-operation	Procurer - Supplier	Partnership (Two partners)	Partnership (Multiple partners)	Partnership (All chain partners)									
Hierarchy of relationship	Horizontal	Vertical											
Management relationship	Collaboration manager	Specifying interaction	Dialogue on mutual understanding of contract										
Risk determination	Procurer	Supplier(s)	In collaboration										
Risk mitigation	Focus on process and collaboration	Focus on achieving specified objectives											
Risk profile	Fully covered profile	MU-value of bandwidth											
Additional organizational structure	Building Team	Knowledge alliance	Two-phases approach	Purchasing alliance	International collaboration	Mixed team	None						
Ownership innovation	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	No innovation								
Intellectual property	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	Shared with market	No innovation							
System integration	Procurer's responsibility	Supplier's responsibility	Independent team coach	No integration									
Continuity teams involved in procurement - asset management	Totally different teams	Less than 50% overlap teams	More than 50% overlap teams	Same teams									

Figure D.9: MC8: Modifications to MC7 based on Interview VIII

Analysis and implementation adjustments

Change: Spelling Badge
The interviewee pointed out that 'Badge' in this case should be written as 'Batch' (8AA). This has been adjusted to the MC and for the aim of readability it is also imposed retrospectively.

Change: Contracted initiative for innovation/changes
The respondent mentions 'optimisation' instead of 'changes', which better approaches the definition of what is described (8V; 8G). This has been implemented in the MC by changing the category to *Contracted initiative for innovation and optimisation*.

Consider: Incentive supplier and producer
The respondent noted that it is necessary to create a situation where both parties have an incentive to take the lead in initiating innovation or optimisation (8G). However, the creation of an incentive for both parties is done by choosing e.g. a certain allocation of *Ownership innovation*. It illustrates the incentive to be impacted indirectly by choices made in the MC and is therefore not added.

Split: Contracted future modifications
The respondent clearly states that the content of a (possible) innovation clause in the contract is not emphasized enough in the MC. Initially the *Contractual innovative clause* under *Contracted initiative for innovation and optimisation* was the only mean referring here to, but this respondent emphatically mentioned that this should get more attention in the diagram (8RR; 8SS).

To do so, a new category is created, being *Innovation clause*. When reviewing the category *Contracted future modifications* and its means, it becomes clear that these can be divided into two categories. The first are literally the modifications to be included in the contract to avoid significant changes leading to the obligation of a new procurement procedure. The second are constructs created to use in the contract to create more grip on innovations and optimisations to come. This last category better suits the new category of *Content innovation clause* and are therefore transferred.

Add: Management relationship
It was noted that managing the relationship between procurer and supplier is important (8QQ) and the respondent also mentioned three means for this category, being *Dialogue on mutual understanding of contract* (8MM) and *Specifying interaction* (8E) and the *Collaboration manager* (8O).

The respondent stated that the appointment of a *Collaboration manager* can be a profitable investment in the co-operation of parties in the contract. This manager focuses on the contract and the involved parties as a system and aims to smoothen the collaboration. This *Collaboration manager* should not be mistaken to be similar to the *Independent team coach* as a mean of *System integration*. The *Independent team coach* focusses on the system integration specifically and not on the collaboration.

Add: Continuity teams involved in procurement – realization
The respondent said that the (dis)continuation of a team involved in the procurement stage into the realization phase influences the flexibility of the process. Transferring the 'philosophy' of the procurement to the realization takes care of preservation of the build-in flexibility (8N). To represent this, the new category *Continuity teams involved in procurement – realization* is added, with its means being: *Totally different teams*, *Less than 50% overlap teams*, *More than 50% overlap teams* and *Same teams*.

D.2. Result sequential development MC

After the eight interviews conducted, a first result of the morph chart can be shown. In figure D.11 an overview is shown of this version of the MC, with all types of adjustments marked. The legend below shows the highlighting of the different types of adjustments made.

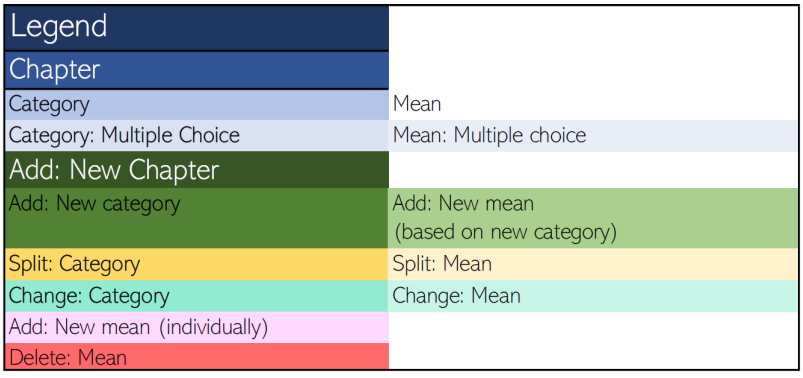


Figure D.10: Legend of Highlighted Adjustments in MC

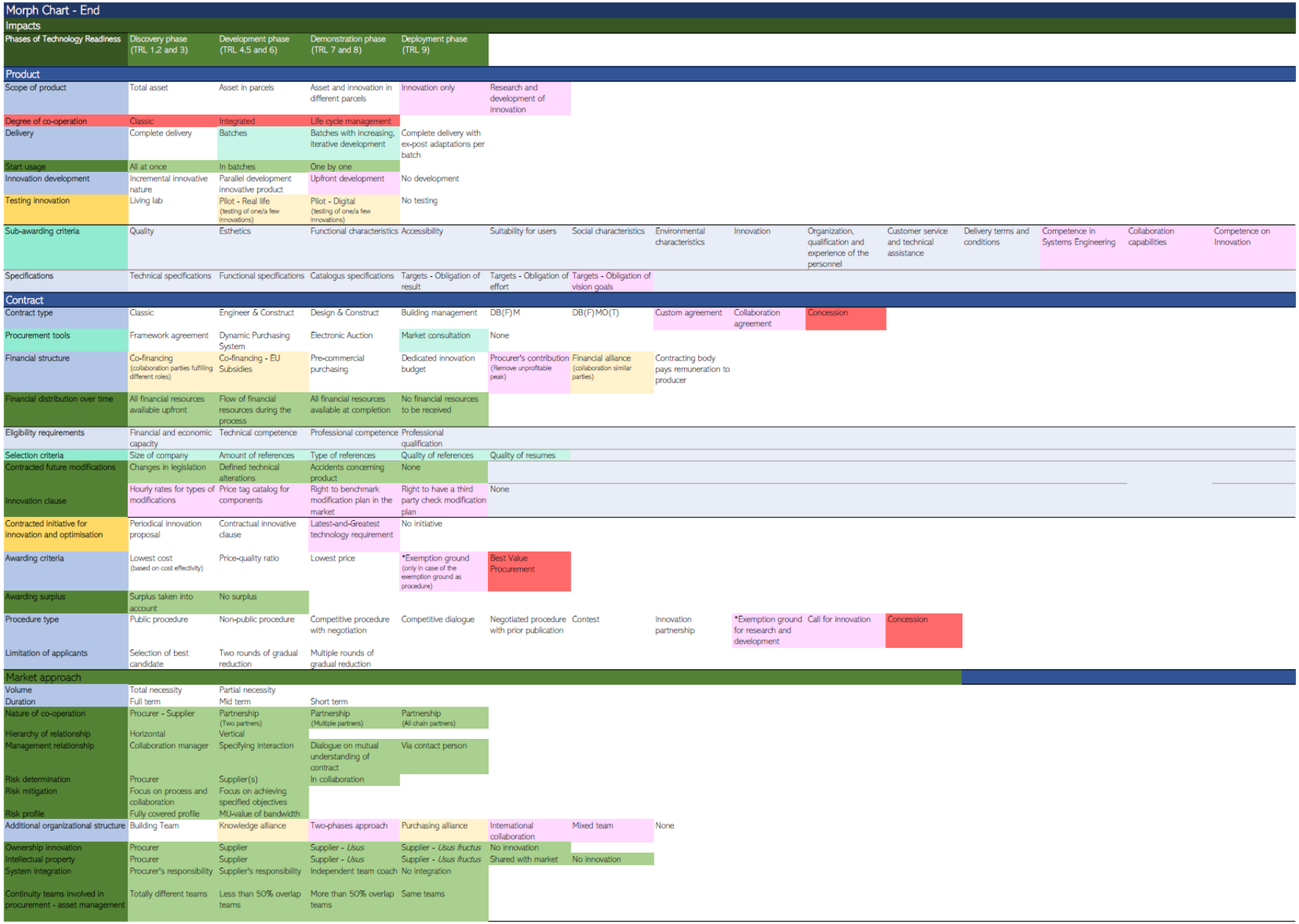


Figure D.11: Developed MC: Overview of Diagram with Highlighted Adjustments

D.3. Rounding modifications

Morph Chart - Final													
Impacts													
Phases of Technology Readiness	Discovery phase (TRL 1,2 and 3)	Development phase (TRL 4,5 and 6)	Demonstration phase (TRL 7 and 8)	Deployment phase (TRL 9)									
Product													
Scope of product	Total asset	Asset in parcels	Asset and innovation in different parcels	Innovation only	Research and development of innovation								
Delivery	Complete delivery	Batches	Batches with increasing, iterative development	Complete delivery with ex-post adaptations per batch									
Start usage	All at once	In batches	One by one										
Innovation development	Incremental innovative nature	Parallel development innovative product	Upfront development	No development									
Testing innovation	Living lab (disclosure to multiple innovations)	Pilot - Real life (testing of one/a few innovations)	Pilot - Digital (testing of one/a few innovations)	No testing									
Contracted initiative for innovation and optimalisation	Periodical innovation proposal	Contractual innovative clause	Latest and Greatest Technology requirement	No initiative									
Sub-awarding criteria	Quality	Esthetics	Functional characteristics	Accessibility	Suitability for users	Social characteristics	Environmental characteristics	Innovation	Organization, qualification and experience of the personnel	Customer service and technical assistance	Delivery terms and conditions	Competence in Systems Engineering	Collaboration capabilities
Specifications	Technical specifications	Functional specifications	Catalogus specifications	Targets - Obligation of result	Targets - Obligation of effort	Targets - Obligation of vision goals							
Contract													
Contract scope	Research	Engineer	Design	Construct	Finance	Maintain	Operate	Terminate	Collaboration				
Procurement tools	Framework agreement	Dynamic Purchasing System	Electronic Auction	Market consultation	None								
Financial structure	Co-financing (collaboration parties fulfilling different roles)	Co-financing - EU Subsidies	Pre-commercial purchasing	Dedicated innovation budget	Procurer's contribution (Remove unprofitable peak)	Financial alliance (collaboration similar parties)	Contracting body pays remuneration to producer						
Financial distribution over time	All financial resources available upfront	Flow of financial resources during the process	All financial resources available at completion	No financial resources to be received									
Eligibility requirements	Financial and economic capacity	Technical competence	Professional competence	Professional qualification									
Selection criteria	Size of company	Amount of references	Type of references	Quality of references	Quality of resumes								
Contracted future modifications	Changes in legislation	Defined technical alterations	Accidents concerning product	None									
Innovation clause	Hourly rates for types of modifications	Price tag catalogus for components	Right to benchmark modification plan in the market	Right to have a third party check modification plan	Surplus taken into account	None							
Contracted initiative for innovation and optimalisation	Periodical innovation proposal	Contractual innovative clause	Latest and Greatest Technology requirement	No initiative									
Awarding criteria	Lowest cost (based on cost effectivity)	Price-quality ratio	Lowest price	*Exemption ground (only in case of the exemption ground as procedure)									
~~Awarding surplus~~	~~Surplus taken into account~~	~~No surplus~~											
Procedure type	Public procedure	Non-public procedure	Competitive procedure with negotiation	Competitive dialogue	Negotiated procedure with prior publication	Contest	Innovation partnership	Exemption ground for research and development	Call for innovation				
Limitation of applicants	Selection of best candidate	Two rounds of gradual reduction	Multiple rounds of gradual reduction										
Market approach													
Volume	Total necessity	Partial necessity											
Duration	Full term	Mid term	Short term										
Nature of co-operation	Procurer - Supplier	Partnership (Two partners)	Partnership (Multiple partners)	Partnership (All chain partners)									
Hierarchy of relationship	Horizontal	Vertical											
Management relationship	Collaboration manager	Specifying interaction	Dialogue on mutual understanding of contract	Language used									
Risk determination	Procurer	Supplier(s)	In collaboration										
Risk mitigation	Focus on process and collaboration	Focus on achieving specified objectives											
Risk profile	Fully covered profile	MU-value of bandwidth											
Additional organizational structure	Building Team	Knowledge alliance	Two-phases approach	Purchasing alliance	International collaboration	Mixed team	None						
Ownership innovation	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	No innovation								
Intellectual property	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	Shared with market	No innovation							
System integration	Procurer's responsibility	Supplier's responsibility	Independent team coach	No integration									
Continuity teams involved in procurement - asset management	Totally different teams	Less than 50% overlap teams	More than 50% overlap teams	Same teams									

Figure D.12: Rounding Adjustments MC: Modifications to MC8 based on General Improvements

Analysis and implementation adjustments

The analysis of all conducted interviews and the modifications to the morph chart this affected are now implemented. As the morph chart is created as a useful tool for the exploration of the design space and subsequently concept generation. To enable the tool to be useful, high readability and easy understanding of the diagram are essential, which is mostly done by simplification without loss of information (Smith et al., 2012). In that context some modifications are made to improve the chart. Below the improved morph chart is presented and reasoning is provided for these final adjustments.

Change: Contract type and means

In the interviews, the contract type used by the respondents were mentioned but none of them mentioned a certain type in which flexibility was more or less enabled. The only notes made on the contract type were (1) each contract can be created as long as a clear description is given of what is done (2B; 5GG; 6F and (2) that often adjustments to existing contract forms were made, mainly by playing around with the scope of contracts (3R; 3D; 1EE; 3PP;4F; 5BB; 7F; 8MM).

One respondent mentions specifically the will to approach the procurement from an ecosystemic way of thinking (3DD). This ecosystemic approach could provide improvement to the *Contract type* category and its means. Combining this perspective with the multiple indications of interviewees 'tinkering' with the contract types in the MC, the approach of this category is changed.

The category *Contract type* is replaced by the category *Contract scope*, which is the only factor of a contract that was mentioned in the interviews. The former means of *Contract type* are deleted as these only represent constructs of contracts, but not the full range of possibilities as stated in the first note (1) on contract type above. To provide this full range of design options, the possible phases to be included in the scope are added and the category is changed to multiple choice. Additionally, *Collaboration* has been added as a mean, even though this is not a scope phase. The inclusion of *Collaboration* in the contract scope has been mentioned by multiple interviewees (Interview IV, V, VI, VIII) and can therefore not be left out of this category.

Change: Sub-awarding criteria and means

Sub-awarding criteria appear to come in many forms, as can be seen in all interviews, and can be adjusted to the preference of the procurer as long as it is substantiated in the contract. Since the morph chart considers all categories to be collectively exhaustive, it assumes to be inclusive of the full set of possible options. Introducing the full range of all possible *Sub-awarding criteria* would result in a too extensive row in the MC, which is hugely out of proportion compared to the rest of the diagram. Also, adding all optional means to this category will likely not add much informational value to its users. As all procurers formulate these criteria to their preference, it could lead to multiple means with a slightly different meaning.

The MC must be modified in such a way that the category *Sub-awarding criteria* does not go against its principle of collectively exhaustiveness without having to delete this category. The proposed solution is to include a mean being '<>*' in the first mean of this category. The asterisk is repeated underneath the diagram with as follows:

** The full set of possible options is hereby assumed to be included, however the following means present what should be focused on in this context.*

This way, the first mean represents the full range to be 'included' without being presented in total in the MC. The following means of this category will then present the means that have been found to be of importance for the context in which the design is made. In this case it means that the means *Innovation, Competence in Systems Engineering* and *Collaboration capabilities* are added after the '<>*', now called the 'Range inclusion mean'.

Change: Multiple choice

The category *Financial structure* consists of means which in some cases do not exclude each other, e.g. *Co-financing by EU subsidies* can be used whilst the contracting body still pays a remuneration to the producer. Splitting this category in such a way that the means will be mutually exclusive will result in the addition of many extra categories whilst no extra informative value is added to the MC. It has therefore been chosen to make this category multiple choice.

Delete + change: Awarding surplus

Enhancing the simplicity of the diagram, for each category its informative value must be considered. The result is the deletion of the category *Awarding surplus*. This category is binary and solely evolves around the (non)existence of a surplus in the contract. The surplus though, is a mean that can be used in the *Innovation clause* to account for variants. This results in the category *Awarding surplus* to be deleted, but the mean 'Surplus taken into account' is transferred to the category *Innovation clause*.

Add: Language used

The category *Management relationship* was added to the MC in the last interview. In retrospect, it can be included that in Interview V, one of the respondents mentions the use of language to create a better relationship. For example, by avoiding the use of 'procurer' and 'supplier', but calling them 'partners', being in a 'partnership' recorded in a 'collaboration agreement' (5X). This subtle mean is added to the morph chart, as it increases the design space and enables a broader sense of means to improve procurement relationships.

D.4. Matured Morph Chart

The adjustments made along the feedback received in the expert interviews and the final rounding with general improvements resulted in the diagram as shown below.

Morph Chart - Matured									
Impacts									
Phases of Technology Readiness	Discovery phase (TRL 1,2 and 3)	Development phase (TRL 4,5 and 6)	Demonstration phase (TRL 7 and 8)	Deployment phase (TRL 9)					
Product									
Scope of product	Total asset	Asset in parcels	Asset and innovation in different parcels	Innovation only	Research and development of innovation				
Degree of co-operation	Classic	Integrated	Life cycle management						
Delivery	Complete delivery	Batches	Batches with increasing, iterative development	Complete delivery with ex-post adaptations per batch					
Start usage	All at once	In batches	One by one						
Innovation development	Incremental innovative nature	Parallel development innovative product	Upfront development	No development					
Testing innovation	Living lab	Pilot - Real life (testing of one/a few innovations)	Pilot - Digital (testing of one/a few innovations)	No testing					
Sub-awarding criteria	*Other*	Competence in Innovation	Competence in Systems Engineering	Collaboration capabilities					
Specifications	Technical specifications	Functional specifications	Catalogus specifications	Targets - Obligation of result	Targets - Obligation of effort	Targets - Obligation of vision goals			
Contract									
Contract scope	Research	Engineer	Design	Construct	Finance	Maintain	Operate	Terminate	Collaboration
Procurement tools	Framework agreement	Dynamic Purchasing System	Electronic Auction	Market consultation	None				
Financial structure	Co-financing (collaboration parties fulfilling different roles)	Co-financing - EU Subsidies	Pre-commercial purchasing	Dedicated innovation budget	Procurer's contribution (Remove unprofitable peak)	Financial alliance (collaboration similar parties)	Contracting body pays remuneration to producer		
Financial distribution over time	All financial resources available upfront	Flow of financial resources during the process	All financial resources available at completion	No financial resources to be received					
Eligibility requirements	Financial and economic capacity	Technical competence	Professional competence	Professional qualification					
Selection criteria	Size of company	Amount of references	Type of references	Quality of references	Quality of resumes				
Contracted future modifications	Changes in legislation	Defined technical alterations	Accidents concerning product	None					
Innovation clause	Hourly rates for types of modifications	Price tag catalog for components	Right to benchmark modification plan in the market	Right to have a third party check modification plan	Surplus taken into account	None			
Contracted initiative for innovation and optimisation	Periodical innovation proposal	Contractual innovative clause	Latest-and-Greatest technology requirement	No initiative					
Awarding criteria	Lowest cost (based on cost effectivity)	Price-quality ratio	Lowest price	*Exemption ground (only in case of the exemption ground as procedure)					
Procedure type	Public procedure	Non-public procedure	Competitive procedure with negotiation	Competitive dialogue	Negotiated procedure with prior publication	Contest	Innovation partnership	*Exemption ground for research and development	Call for innovation
Limitation of applicants	Selection of best candidate	Two rounds of gradual reduction	Multiple rounds of gradual reduction						
Market approach									
Volume	Total necessity	Partial necessity							
Duration	Full term	Mid term	Short term						
Nature of co-operation	Procurer - Supplier	Partnership (Two partners)	Partnership (Multiple partners)	Partnership (All chain partners)					
Hierarchy of relationship	Horizontal	Vertical							
Management relationship	Collaboration manager	Specifying interaction	Dialogue on mutual understanding of contract	Language used	Via contact person				
Risk determination	Procurer	Supplier(s)	In collaboration						
Risk mitigation	Focus on process and collaboration	Focus on achieving specified objectives							
Risk profile	Fully covered profile	MU-value of bandwidth							
Additional organizational structure	Building Team	Knowledge alliance	Two-phases approach	Purchasing alliance	International collaboration	Mixed team	None		
Ownership innovation	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	No innovation				
Intellectual property	Procurer	Supplier	Supplier - *Usus*	Supplier - *Usus fructus*	Shared with market	No innovation			
System integration	Procurer's responsibility	Supplier's responsibility	Independent team coach	No integration					
Continuity teams involved in procurement - asset management	Totally different teams	Less than 50% overlap teams	More than 50% overlap teams	Same teams					

Figure D.13: Matured MC: Result of Development

E

Appendix: MC as Method

This appendix shows the substantiation of the results as found for the application of the MC as institutional design tool. Based on statements and observations made during the conducted interviews, themes are identified amongst this data set. In the table below, the summarized statements and observations made, based on audio and transcriptions, are clustered into the themes as shown on the leftmost column of the table. Based on these themes, the MC as institutional design tool is adjusted in Chapter 6.

Table E.1: Categorization of All Gathered Interview Data on Using the MC as Design Method

Theme	Noted	Origin
Understanding		
Definition	Need to check interpretation of definition	OBS1.5; OBS2.1; OBS3.1; OBS6.6; OBS7.1; OBS8.3
	Unfamiliarity with definitions	OBS4.1; OBS4.4; 7VV.
	Different interpretation leads to wrong assumption	OBS7.5
	Need to check interpretation of methodology	OBS7.4
Advantage	Introduction of methodology was clear	OBS8.1
	Understood concept of methodology	3XX.; 8TT.; OBS4.5; OBS5.1; OBS7.2; OBS8.4; OBS2.6; OBS1.2
	Easy handling of options in MC	OBS1.2; OBS2.6; OBS3.2; OBS4.5; OBS5.1; OBS7.6; OBS5.2; OBS8.4
Design		
Construction	Column perceived as design	6DDD.; 5WW.; OBS4.3; OBS6.3;
	Distracted by numbers above columns	OBS4.3; OBS6.2
	Order of means in row is important	2DD.; OBS4.6
	Need extra explanation on methodology	6BBB.; OBS6.1
	Well-structured and interesting	2FF.; 3ZZ.; 4YY.; 7XX.
	Unclear principles of MC and multiple choice	OBS2.4; OBS3.5
Combinations	Some means cannot coexist	2HH.; 3YY.; 5EEE.
	Coherence of means not shown	OBS1.6; 5BBB.
	Emergent factors in certain combinations not shown	2JJ.
Scope		
	Need to confirm of research scope	OBS3.3; OBS8.2; OBS2.1
	Made suggestions are out of scope	OBS5.4; OBS7.5
Personal experience		
	Enjoyed new perspective	1NN.; 4YY.; 6EEE.; 7XX.; 2GG.
	Novelty of method	1OO.; 3ZZ. ; 4XX.; 5ZZ.
External impacts		
	MC is impacted by external factors	2II.; 4UU.
Dynamics		
Duo	Questions mostly answered by one respondent	OBS2.3; OBS5.5; OBS7.3
	Collective discussion	OBS2.7 OBS2.2
Conversational support	MC offered structure to dialogue	OBS1.4; OBS2.5; OBS6.4
	Case supported dialogue on MC	OBS3.4; OBS4.2
Expert	Difficult to let go of own perspective	1MM.
	Need time to process	2GG.; OBS1.3; 6CCC.
	Noticed reluctance	OBS3.2; OBS6.5
Recommendations		
	Drawing on the MC will help	4WW.
	Create support in board	5CCC.
	Use as guidance in dialogue	7WW.; 4VV.
	Support decision-making for less experienced	5AAA.

F

Appendix: Visualization means in MC

In this Appendix an elaboration is provided on how to visually include different types of variables in the MC, to enable a broad range of variables to be included to enhance the use of the MC for institutional design.

F.1. Input variables

When designing institutional concepts, a variety of variable types must be able to be included in the diagram. In current use, the morph chart is filled with independent design concepts of sub functions of an equal abstraction level (see: 6.2). This is done by either drawings or short text in the cells. Deploying this diagram in an institutional context though leads to the necessity of including different types of variables as well. For variables of a nominal character this appeared to be quite straight forward. However, difficulties arose during this research when trying to include variables with a non-nominal character, being ordinal, interval or ratio (Stevens, 1946). A solution to introduce these variables in the MC as well, is required. The visualization used to do so can be found in Appendix F.

Moultrie (2016) describes the morphological as to be a "visual way to capture necessary product functionality" and also emphasizes sub-solutions should be made visual wherever possible. Although most institutional sub-functions can not be illustrated in the MC without losing its informational value, visual representation could be the solution for the variables of a non-nominal character.

Ordinal

Some institutions are categorical, but differ from nominal variables as these do appear in a fixed order (Stevens, 1946). Representation of means of an ordinal nature can easily be done by including the ordinal categories in the morph chart. Logically, these must be presented in the right order to not cause confusion to the user of diagram.

Interval and Ratio

Means can also be categorical, sequential and also have a similar 'interval' between each option, which is described as being a interval variable (Stevens, 1946). This variable either has no meaningful zero point, making it an interval variable or it does have a meaningful zero point and in this case this is a ratio variable (Stevens, 1946). In the morph chart, the existence of a meaningful zero point does not influence the issue of including these factors in the MC, so the problem solved simultaneously for these variable types. The issue with both variables is that these are described to be categorical, but their values are mostly numerical and therefore result in a wide range of options to be included in the MC.

In figure F.1 an example is shown of the interval variable temperature in degrees Celsius. In this example a range from 10 to 40 degrees Celsius has to be represented in the MC. At first glance, it might feel logical to include as many means as existing categories. In this example, this will cause the category *Temperature* to consist of sixteen means.

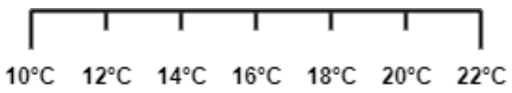


Figure F.1: Example Interval Variable: Degrees Celsius

The inclusion of such extensive amounts of means in the MC lowers its readability and therefore usability (see: 6.2 Characteristics MC). Also, relatively low informational value is added to the MC by including more means with values of the same interval or ratio variable, solely the range of options is enlarged. Together it can be stated that interval and ratio variables must be included, but this should not lead to these categories existing of many means with low marginal

informational value. The solution however must include the presentation of the full range of these variables as to be complete to the user of the totality of the design space as explored.

Three possible solutions are found to solve this issue. Firstly, when the count of variables over the full range to be included is less or equal to the mean width of the MC, these values are directly listed as such in MC-means, as shown in figure F.2.

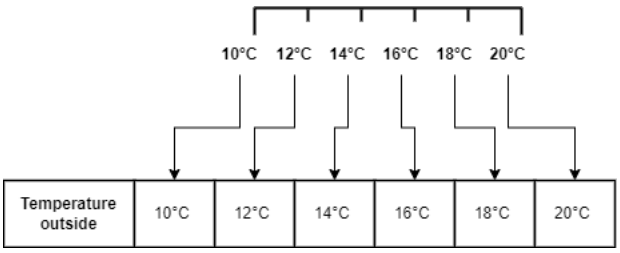


Figure F.2: Visualisation Interval Variable: Direct listing

Secondly, in case the values of the variable matter to the design to be made, but a certain generalisation of this value does not lower the value of the design, the second solution is used. This will mostly be done when the amount of variables to include is bigger than the mean width of the MC and generalisation does not lower the informational value.

In this solution categories are created based by merging variables within a range into one mean. When considering the earlier mentioned example, there could be a design process in which it is of importance to know if the outside temperature is between 10 and 20 degrees Celsius, or between 20 and 30 degrees Celsius and so on. In such cases, categories are created merging the values into joint means. Underneath, in figure F.3, it is shown what this looks like.

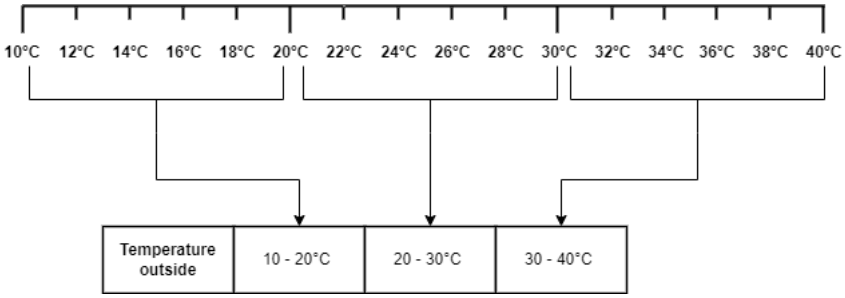


Figure F.3: Visualisation Interval Variable: Merged Categories

Thirdly, when even the value range to be included results in a bigger amount of value ranges than the mean width of the MC, a different type of visualisation for this category is used. Also this can be applied to variables in which no generalisation is desired. An illustration of a slider on a scale running from minimal to maximal value of the category is implemented in the MC and replaces the 'boxes' in which the means are usually presented. On the right side of the box created, the unit of the variable is mentioned. In case the category is an interval variable, the step size is mentioned here as well. The visualisation captures the interval and ratio variable in a concise and accurate way, as shown in figure F.4.

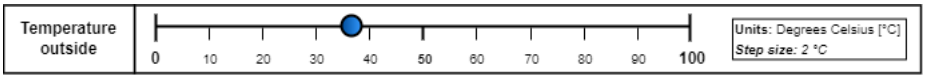


Figure F.4: Visualisation Interval Variable: Slider on Scale

G

Appendix: Focus Group

G.1. Preparations of focus group

In this meeting the final version of the MC (see: Chapter 6), the created design lines (see: Chapter 7) are presented and a group of NS-employees is asked for their perspective hereon. After validation, the participants are asked to vote for the most promising design lines for the NS, in their opinion. These lines are then used for exploration of a conceptual design for the NS.

G.1.1. Goal

Validation of the developed morph chart and subsequently creating a conceptual *MC design line* is the aim of the focus group. Reaching this goal requires a certain 'order' of goals to be followed. To start it must be checked if the understanding of all participants of the MC, its contents and usage is aligned. After, the (non-)validation of the morph chart can be discussed. Then a joint understanding must be created amongst all participants of the design of the current NS-process in the MC. As soon as this is established, a new design can be discussed, reaching all intermediate and end goals of the focus group.

G.1.2. Participants

According to Greenbaum (1998) the number of participants is dependent on the goal of the focus group. In this case it was chosen to organize a so-called *mini group*, consisting of four to six participants. The advantages of a mini group are stated to be the easier retrieval of in-depth information from a smaller group and more time per individual. As the focus group covers the validation of the MC as well as the creation of a design for the NS, sufficient time and attention for each expert is preferred, thus a mini group is created. To do so, eight NS-employees are initially invited, to account for possible absence of participants. Eventually five participants attended.

Greenbaum (1998) describes the participants of a focus group to be a "reasonably homogeneous group based on specific criteria" and also mentions they should be "capable of providing the highest-quality discussion about the topic being researched". The homogeneous group is created as solely NS-employees are selected with substantial experience in the field of public procurement processes. Though the focus group is not only used for application for the NS, but also for validation of the MC, too much homogeneity should be avoided. The participants fulfilling a diverse set of functions in the process is desired, whilst guaranteeing their capability to provide quality discussions. In consultation with research supervisors of the NS, eight participants complying with these requirements have been selected. All participants are involved in the procurement process from a diverse set of roles and have sufficient insight on the strategy of this process, as determined by the NS supervisors.

Consent

After participants accepting the invitation to take part in the focus group, a consent form was sent to inform on the recording of the meeting and the management of the data retrieved. All participants have signed the consent form before the start of the data collection during the meeting. The consent form can be found in Appendix I. More information on how the data was managed can be found in Chapter 2.

G.1.3. Approach

Apart from the more 'tangible' factors in the preparation of the focus group, the aspects influencing the atmosphere of the meeting must not be overlooked. Underneath a short description is given of the aspects identified by the researcher to be of influence.

Language

The focus group will be held in Dutch. Providing an open conversation is best done by communicating in the language that is predominantly used in the working environment. Within the company Dutch is the main language and although there is a significant European component to the field of public procurement, Dutch remains the main language within the department and the entire company. This applies for the entire company, not only amongst colleagues, but also in its internal and external communication, when possible. The upfront information, the morph chart and presentation are therefore translated to Dutch, as has been done in the interviews (see: Appendix C). Translation of Dutch data output to English has been used to process the results.

Environment

The focus group is organized as a physical meeting at the NS-office. When planning this meeting, the planned presence of participants in the office is taken into account, aiming to avoid barriers to attend. Additionally the meeting was held in a separate room, not visible or audible to others, eliminating barriers to speak freely.

Moderation

During the meeting, the researcher is the moderator. Guidance is given not only during but also in advance, by providing the participants with an explanation of the use of the MC and an overview of the final MC. This is done to support quick understanding of all participants as time is limited.

During the focus group it is important to guide participants with appropriate questions, to enable the extraction of valuable insights (Greenbaum, 1998). The questions are kept as simple as possible, to clearly indicate what specifically is asked for in each step of the meeting and avoid off-topic conversations.

As mentioned, moderation of the focus group is done by the researcher. Since the aim of this focus group is to gather as much expert input as possible on the application for the NS, it is important that all participants feel they are free to give all types of input. As this could possibly mean sensitive, internal information is exposed to all who are present, it is important this happens in a confidential environment. This means that apart from the researcher, no second moderator is involved.

G.1.4. Alignment of understanding

The meeting takes 90 minutes, in which the meeting goals must be met. Therefore focus must lie on validation and convergent ideation and all else must be merged as much as possible without violating an informative introduction of the MC, its development and use. To do so, an introduction video was made to inform participants hereon and this was send in advance. A video was preferred over an introductory text, to get the attention and minimize the risk of participants reading just a part or scanning through the text. Additionally, the voice over asks participants to draw the most recent NS procurement process (ICNG) in the MC to check their understanding of the MC-usage and send it to the researcher. This avoids the need to draw the current NS-design during the meeting. To create a new design in the (*convergent ideation* part, the current situation must be clear and aligned amongst participants. Covering this in advance leaves extra time in the meeting for *validation* and *convergent ideation*.

G.2. Introduction video

All participants were send an introduction video in advance. Below the slides of this video are presented, as well as the text of the voice over. The voice over and the slides are in Dutch, as this language was used in the meeting.

G.2.1. Text voice over

Slide 1 - Introductie

Welkom allemaal! Allereerst fijn dat jullie mee willen doen aan de focus groep die ik organiseer in het kader van mijn afstudeeronderzoek naar flexibiliteit in aanbestedingen. Om maandag vlot aan de slag te kunnen met elkaar heb ik dit filmpje gemaakt, waarin ik kort een introductie geef wat ik met jullie graag zou willen bespreken maandag. Dit filmpje duurt een paar minuten en ik zou je willen vragen om het helemaal uit te kijken, alvast bedankt voor je tijd. Laten we beginnen!

Slide 2 - Onderzoek & Doel

Mijn onderzoeksdoel is zoeken, en hopelijk vinden, van een manier om de flexibiliteit in het aanbestedingsproces te vergroten, om zo tussentijdse veranderingen en doorontwikkeling mogelijk te maken. Om dit te doen heb ik mij eerst ingelezen in het aanbestedingsproces in het algemeen. Op basis hiervan heb ik een functionele analyse gemaakt van dit proces. Op basis van deze functionele analyse heb ik een overzicht gemaakt van de factoren waarvan ik verwacht dat deze invloed zouden kunnen hebben op de flexibiliteit van het proces. Dit overzicht heb ik doorontwikkeld, waarover later meer, en het eindresultaat bespreek ik vandaag graag met jullie. Het doel van de focusgroep is om dit eindresultaat te valideren, met name de designs die daarbinnen ontwikkeld zijn, en om dit overzicht toe te passen voor de NS. Die designs zal ik tijdens de meeting aan jullie presenteren, het eindresultaat zelf presenteer ik jullie graag in dit filmpje.

Slide 3 - Morphological Chart

Graag presenteer ik jullie de morphological chart. Een diagram dat normaal gesproken gebruikt wordt voor het ontwerpen van een product. De reden dat ik dat doe, is omdat de morph chart een concreet beeld geeft, een meer “tastbaar” overzicht. Het doel van een morph chart is om de bestaande ontwerpruimte inzichtelijk te maken. Hoe dat gedaan wordt leg ik je graag kort even uit. Onderstaand is een voorbeeld te zien van het ontwerp voor een “drankhouder/drankcontainer”. Te zien is dat in de lichtblauwe kolom de functies van zo’n drankhouder weergegeven worden. Een drankhouder moet de drank kunnen bevatten, het moet toegang geven tot de drank enzovoort. Links, in het wit weergegeven, staan de manieren om deze functies te vervullen. Voor elke subfunctie in het lichtblauw worden, apart van de andere subfuncties, oplossingen bedacht, in het wit. Dit betekent dat de oplossingsgeneratie voor elke subfunctie onafhankelijk is van de andere subfuncties. Vervolgens kan een ontwerp gemaakt worden voor een drankhouder door uit iedere rij tenminste één en ook maar één oplossing in het wit te kiezen. Je ziet in het onderste diagram dat dit gedaan is voor de drankhouder. Het resultaat is een drankhouder te vergelijken met een Caprisun verpakking. In het geval van mijn onderzoek is deze methodiek toegepast voor flexibiliteit in aanbestedingen, met als doel het gesprek over het vormgeven van een aanbestedingsproces te kunnen structureren, om als startpunt te fungeren van de discussie.

Slide 4 - Ontwikkeling

Nu hoor ik je denken: Hoe mag dat er uitzien? Dat ga ik je laten zien! Zoals ik al vertelde heb ik op basis van de analyse van het proces een initieel overzicht, een initiële morph chart, gemaakt van de factoren die invloed hebben op deze flexibiliteit. Vervolgens ben ik in negen interviews met experts in aanbestedingen binnen de spoorsector gekomen tot een steeds verder ontwikkelde versie van deze morph chart. Kort gezegd heb ik hen steeds gevraagd: hoe waarborgen jullie flexibiliteit in het aanbestedingsproces? En vervolgens: Hoe kan dit overzicht verbeterd worden?

Slide 5 - Resultaat

Het resultaat daarvan is het volgende diagram. Ik kan me voorstellen dat het misschien wat groot en veel lijkt zo op het eerste gezicht, maar ik hoop dat mijn uitleg ervoor zorgt dat de morph chart daarna juist logisch lijkt. Het ontwerp is opgesplitst in drie delen: Product, Contract en Markt Benadering. Elk van deze drie onderdelen van het aanbestedingsproces is opgesplitst in categorieën, die te zien zijn in de meest linker kolom. Rechts van deze categorieën zijn de manieren opgenoemd, zoals ook voor het ontwerp van de drankhouder, waarmee deze subfuncties ingevuld kunnen worden. Het is de bedoeling dat er van boven naar beneden door het hele diagram gelopen wordt om een proces te ontwerpen waarin flexibiliteit zoveel mogelijk gewaarborgd wordt. Voor elke rij geldt dat er één manier gekozen mag worden. Alleen voor de lichtblauwe rijen geldt dat er meer dan één oplossing gekozen mag worden om de subfunctie te vervullen. Bovenaan het diagram is tot slot een oranje balk te zien. Hierin wordt een externe factor, Technology Readiness Level, weergegeven. Aangezien deze morph chart ontwikkeld is vanuit het perspectief van de aanbestedende partij, is het Technology Readiness Level van een innovatie niet direct te beïnvloeden, in ieder geval niet in alle gevallen. Vandaar dat deze “externe” factor, die toch een directe en significante invloed op het procesontwerp kan hebben, op deze “oranje” manier is opgenomen in het diagram. Nu je deze introductie van de morph chart gehoord hebt, zou je een ontwerp kunnen maken in het diagram van het proces van de NS voor de ICNG? Ik zou het heel erg waarderen als je zou willen proberen dit ontwerp te tekenen op het document zoals ik dat meegestuurd heb in de mail en deze naar mij terug zou willen sturen.

Slide 6 - Vragen

Ik hoop je op deze manier goed uitgelegd te hebben hoe de morph chart werkt. Luister gerust nog een stukje terug, vanaf ongeveer 01:30 minuut begint de uitleg van het gebruik van de morph chart. Ik wil je bedanken voor het kijken van deze introductie en kijk er erg naar uit volgende week met elkaar in gesprek te gaan. Mocht je op basis van deze video nog vragen hebben, dan hoor ik het heel graag! Via de mail ben ik bereikbaar, maar mocht je meer vragen hebben of sowieso liever bellen, dan ben ik ook altijd bereikbaar via [telefoonnummer]. Als je tijd hebt, dan zie ik heel graag je tekening van de ICNG tegemoet! Dankjewel en tot volgende week!

G.2.2. Slides

Ter voorbereiding op:
27 Nov 2023

Introductie focusgroep
Flexibiliteit in Aanbestedingen

TU Delft

Onderzoeksdoel

- **Vergroten flexibiliteit in aanbestedingsproces**
  - Algemeen aanbestedingsproces in kaart
  - Brede rondgang langs betrokken partijen
  - Ontwikkelen gestructureerde vorm voor discussie
  - Toepassen voor de NS

TU Delft

Doel focus groep

- Valideren morph chart > gecreëerde 'designs'
- Ontwerp voor de NS

Morphological Chart

Reden

- Concreet, meer "tastbaar"
- Ontwerpruimte inzichtelijk
- Structuur discussie

Werking

- Elke rij 1 kiezen
- Genereren van een ontwerp (oranje)

Morph Chart Example

Feature/Function	Means					
Contain beverage	Can	Bottle	Bag	Box	....	....
Material for drink container	Aluminium	Plastic	Glass	Waxed cardboard	Lined cardboard	Mylar films
Mechanism to provide access to juice	Pull tab	Inserted straw	Twist top	Tear corner	Unfold container	....
Display of product information	Shape of container	Lables	Color of material	....	....	....
Sequence manufacture of juice container	Concurrent	Serial	....	....	....	....

Morph Chart Example

Feature/Function	Means					
Contain beverage	Can	Bottle	Bag	Box	....	....
Material for drink container	Aluminium	Plastic	Glass	Waxed cardboard	Lined cardboard	Mylar films
Mechanism to provide access to juice	Pull tab	Inserted straw	Twist top	Tear corner	Unfold container	....
Display of product information	Shape of container	Lables	Color of material	....	....	....
Sequence manufacture of juice container	Concurrent	Serial	....	....	....	....

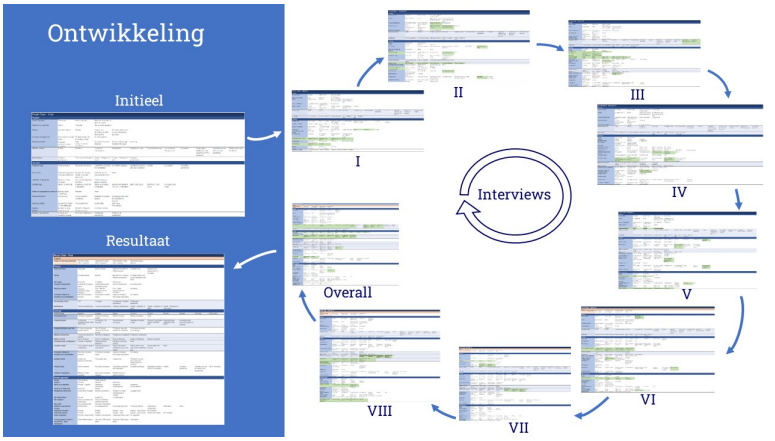


Figure G.1: Slides Introduction Video for Participants of Focus Group

G.3. Meeting

G.3.1. Structure

Creating a structure of the meeting must include all aspects mentioned. As the goals of the meeting are to validate the conceptual design lines and to start the application of the MC for the NS, the structure of the meeting is written around these two aspects, being *validation* and *convergent ideation*. Other aspects required are a short introduction of the researcher, the research itself and reassurance of consent. After this, correct understanding of the MC-usage must be ensured and remaining questions can be answered. After validation and convergent ideation as the focus of the meeting, the meeting will be finished by asking for feedback on the meeting.

All together, a planning has been created to prepare each stage of the meeting. In table G.1 a short description of each stage has been given, including questions and tasks, comments on the approach and a time indication.

Table G.1: Planned Structure Focus Group

Topic	Goal	Task/Question	Comment	Time
General Introduction (5 min)				
Personal	Welcome participants			00:01
Research	Inform on research in general and its goals	Clearly but shortly introduce research	A warm welcome is necessary, but also kept short. Time is limited, focus is on validation and convergent ideation.	00:01
Focus group	Clarify what is done in the meeting	Give short overview of structure of meeting.		00:02
Consent	Check consent and inform on opting out	Remind participants.		00:01
MC Introduction (8 min)				
Recap	Check understanding and alignment of MC use according to upfront introduction video by mail.	Check if questions have been arising since introduction.	Stay concise and use definitions made upfront to stay clear and consequent. Check if all topics are well-understood by all participants, but keep time limitations in mind. Focus is on *validation* and *convergent ideation*.	00:05
Design lines	Present approach to discuss designs	Show what will be done and how.		00:03
Validation (30 min)				
Design Lines	Determine validity of created lines based on interviews	*Do the drawn lines represent a coherent design for procurement? What is (not) suitable in these concepts?*	Leave room for discussion but direct towards (non-)validation of design lines.	00:22
Preferred Design Lines	Retrieve opinion on lines drawn by letting participants individually vote on Mentimeter for two most suitable design lines to apply for the NS.	*Which two conceptual lines do you prefer to explore for application for the NS?*		00:08
Convergent Ideation (40 min)				
Current NS Design	Recap of current NS design as drawn upfront by participants	Shortly touch upon the drawn lines by participants to support structure and understanding of the meeting.	Summarize what has been said to keep focusing on the design instead of letting the conversation wandering off.	00:02
NS application	Design future process for the NS	Support discussion on design for future NS-process based on the two most preferred lines after voting. Ask questions like: *Why and how is this line best applied for future NS-application to incorporate more flexibility?*		00:30
Impact NS	Find underlying reasons for (refraining from) action	*What opportunities and obstacles do you see or perceive in using the proposed line in reality?*	For opportunities: *How to support-/increase?* For obstacles: *Why? When? How to avoid/mitigate?*	00:08
Feedback (7 min)				
Morph Chart as method	Receive feedback on MC as method	*Would you like to use the morph chart as a design tool after this meeting? What for? When?*	Given the personal perspective asked for, it is important to leave sufficient room to all participants to express themselves and to make them feel like they can say anything.	00:04
Design lines	Receive feedback on the use of designed lines	*Did you think introducing the named lines supported the conversation?*		00:01
NS design	Receive feedback on the NS Design and process	*Do you think the morph chart supported designing for the NS? How do you feel about designing this way? Do you feel more or less involved in the design made?*		00:01
Focus group	Receive feedback on the meeting in general	*What did you think of this meeting? What would you recommend if the use of this MC would be combined with such meetings? Possible improvements?*		00:01
Closing				
End	Finish meeting	Thank participants and leave room for questions		00:90
TOTAL (90 min)				

Appendix: Summary Focus Group

In this appendix the summary of the focus group is given. The aim of this meeting was validation of the use of the MC and the design lines and the exploration of a conceptual design for the NS. The meeting was in Dutch, since this is the main language within the NS and therefore the summary is also provided in Dutch. Further, the summary is split into these three aspects, which have been used for validation in chapter 6 and 7 and for exploration in chapter 8. The transcription of the focus group has been summarized in statements, presented by 'FG' followed by an ascending number to enable identification.

H.1. Use MC

FG1 Twee respondenten geven aan niet zeker te zijn van de definitie/interpretatie van sommige categorieën en means.
FG2 Eén respondent geeft aan het ingewikkeld te vinden om te bepalen hoe de MC toegepast moet worden in de context.
FG3 Een aantal maal stellen respondenten vragen waaruit blijkt dat cellen van de MC niet correct gelezen zijn.
FG4 Alle respondenten laten zien de methodiek van de MC te begrijpen. Op basis van de introductievideo hebben ze de MC zich eigen gemaakt, beantwoorden elkaars vragen hierover en voelen zich vrij de MC te gebruiken om te ontwerpen, waarbij de principes in acht genomen worden. Ook het multiple choice karakter van sommige categorieën wordt correct toegepast.
FG5 Opgemerkt wordt dat de keuze voor sommige means afhankelijk is van het perspectief van de procesontwerper.
FG6 Aanvullend wordt gezegd dat dit niet alleen afhankelijk is van welke partij de procesontwerper onderdeel is, maar dat de functie van de ontwerper binnen deze partij ook al sterk van invloed is.
FG7 De respondent die aangeeft de toepassing van de MC in de context ingewikkeld te vinden, laat door formulering van zijn/haar vraagstuk doorschemeren eigenlijk heel goed te begrijpen hoe de MC toegepast moet worden. Na doorvragen blijkt dat twijfel bij de respondent over welke middelen in de morph chart zullen leiden tot verbetering ten grondslag liggen aan het gevoel van onbegrip van de MC.
FG8 De opvatting van het begrip 'innovatie', een van de pijlers van de MC, is bij één respondent afwijkend van de rest van de groep. Innovatie wordt hier gezien als een volledig nieuwe ontwikkeling, totaal buiten het kader van al bestaande oplossingen. De meerderheid ziet innovatie zoals binnen dit onderzoek aangehouden wordt; de ontwikkeling van een voor de sector nieuwe toepassing.
FG9 Soms worden begrippen genoemd, zoals Turn-key, die in het diagram niet gebruikt worden, maar wel gebruikelijk zijn bij de deelnemers. Afstemming van de interpretatie van deze begrippen in relatie tot de MC gebeurt onderling en zorgt voor een gezamenlijke opvatting.
FG10 Om de leesbaarheid te vergroten worden de ontwerplijnen los van de MC gepresenteerd. Het resultaat is dat andere categorieën uitgelicht worden in de verschillende ontwerplijnen. Dit zorgt kort voor verwarring bij sommige respondenten.
FG11 Respondenten geven aan de tijd nodig te hebben de verschillende ontwerplijnen te verwerken en een mening te vormen.
FG12 Sommige means worden sneller begrepen wanneer ze in de context van de andere means binnen de categorie staan. Het contrast tussen de verschillende opties ondersteunt het begrip.
FG13 Bij het behandelen van de ontwerplijnen worden af en toe voorstellen gedaan tot combineren van lijnen of het toevoegen van means aan ontwerpen. De respondenten laten zien te 'spelen' met de onderdelen van de MC.
FG14 Ook wordt er meermaals in een discussie op basis van een ontwerplijn opgegooid dat respondenten zich op basis hiervan afvragen of de huidige aanpak wel goed is. Er wordt met een kritische blik naar het eigen proces gekeken.
FG15 Respondenten geven aan de meeting nuttig te vinden. Ze zeggen dat het hen triggert na te denken. Het was niet saai.
FG16 Eén respondent geeft aan nog steeds vragen te hebben over de toepassing van de MC in de context. Hierbij wordt opgemerkt dat buiten product, contract en markt hier meer factoren een rol spelen die van invloed zijn op het aanbestedingsproces.
FG17 Verder zeggen ze dat de morph chart maakt keuzes explicieter en er ontstaat inzicht in de besluiten en de motivering die hieraan ten grondslag ligt.
FG18 Ook wordt aangegeven dat de ontwerplijnen de discussie scherp maken.
FG19 Er wordt aangegeven dat voortzetting van discussie op basis van de MC graag voortgezet wordt.

FG20 Tot slot wordt gezegd dat er goede interactie was tussen de aanwezigen.

H.2. Design lines

H.2.1. Design line 1 – Traditional

FG21 Het betalen bij oplevering is niet traditioneel, het betalen gedurende het proces is dat FG wel. Eerstgenoemde wordt soms wel toegepast, maar is geen gangbare manier van werken.
FG22 De aanbesteder als verantwoordelijke voor de systeemintegratie klopt ook niet in de traditionele context. Die verantwoordelijkheid ligt bij de leverancier.
FG23 Ook wordt aangegeven dat in een traditionele aanpak de nadruk ligt op technische FG specificaties en dat de shift naar functionele specificaties als vooruitstrevend wordt beschouwd.

H.2.2. Design line 2 – *Innovation Only*

FG24 In eerste instantie worden verschillende definities van innovatie aangehouden door de respondenten. Eén respondent interpreteert innovatie als een volledig nieuwe ontwikkeling, totaal buiten het kader van al bestaande oplossingen. De rest van de groep ziet innovatie zoals binnen dit onderzoek aangehouden wordt; de ontwikkeling van een voor de sector nieuwe toepassing.
FG25 De raamovereenkomst wordt niet geaccepteerd binnen deze ontwerplijn. Aangegeven wordt dat hiermee een hoeveelheid weggezet wordt in de markt en dat onzeker is of dit ook ingekocht gaat worden. Ook legt de raamovereenkomst veel druk op de leverancier en weinig op de aanbesteder, terwijl de respondenten het innovatiepartnerschap zien als een samenwerking.
FG26 Het bouwteam is ontbrekend volgens de respondenten. Dit zou beter representeren dat er samengewerkt moet worden om de innovatie tot stand te brengen. Hierbij gaan eerste de opdrachtgever, ontwerper en bouwer gezamenlijk plannen maken waarna de (ont)koppeling komt richting de constructiefase. Dan gaat de lead naar de bouwer. Dat komt meer overeen met alleen de innovatie aanbesteden.
FG27 Daarentegen zijn er ook respondenten die niet het bouwteam zo zeer vinden passen, als wel het opnemen van aspecten van samenwerking.
FG28 De specificeren van een resultaatverplichting werd niet passend gevonden, aangezien het juist bij innovatie ingewikkeld is het resultaat te beschrijven.
FG29 Vanuit dat perspectief wordt beter begrepen waarom de raamovereenkomst opgenomen is in deze lijn. Het faciliteert een overeenkomst waar binnen uren afgenomen kunnen worden of werkzaamheden op een andere manier, zonder dat detaillering hiervan bij aanbesteding al nodig is.
FG30 De andere specificatie types in deze ontwerplijn worden wel gezien als passend.
FG31 Toegevoegd wordt dat het separaat aanbesteden van innovatie vooraf aan de aanbesteding van het 'volledige' product kan plaatsvinden, maar dat dat ook parallel of met gedeeltelijke overlap zou kunnen.
FG32 De kennisalliantie wordt niet gezien als een goede combinatie in deze lijn. Reden hiervoor is dat partijen niet zoveel geld en energie willen steken in een ontwikkeling die vervolgens met de markt gedeeld wordt. Partijen hebben geen interesse omdat de aanbesteding die hierop volgt vele malen groter is. Daar komt de focus op te liggen.

H.2.3. Design line 3 – *Collaboration Light*

FG33 De concurrentiegerichte dialoog wordt passend gevonden in de ontwerplijn. Het is goed om in dialoog onderbouwing te kunnen krijgen van de leveranciers bij hun aanbod, zeker met betrekking tot het aangaan van een samenwerking.
FG34 Wel wordt opgemerkt dat het lastig is dat de concurrentiegerichte dialoog ervoor zorgt dat de aanbesteder verschillende projectplannen met elkaar moet gaan vergelijken. Het vergelijken van uiteenlopende ontwerpen wordt gezien als obstakel. Toch wordt aangegeven dat deze uiteenlopende ontwerpen wel gebaseerd zijn op dezelfde oplossingsonderwerpen, wat structuur biedt.
FG35 De check van een derde partij opnemen in de innovatieclausule wordt in deze ontwerplijn gezien als incorrect. Een samenwerking is gestoeld op onderling vertrouwen, het betrekken van een derde partij past daar niet in.
FG36 De focus op het bereiken van gespecificeerde doelen betracht het nastreven van de doelen van de aanbesteding in het contract te representeren. Daar wordt bij opgemerkt dat het belangrijk is ook na te gaan wat de achterliggende drijfveren van de betrokken partijen zijn. Dat moet geaccepteerd worden binnen de samenwerking.
FG37 Daaropvolgend wordt opgemerkt dat openheid over drijfveren belangrijk is in een partnerschap. Transparantie is belangrijk. Aangegeven wordt dat het creëren van een win-win situatie daarbij goed is. Toch wordt ook gevonden dan de leverancier wel eens meer zou kunnen winnen dan de aanbesteder, maar ook dan winnen beide partijen.

H.2.4. Design line 4 – *Collaboration Plus*

FG38 De ontwerplijn wordt begrepen en ondanks een wat radicaler karakter gezien als mogelijkheid voor samenwerking.
FG39 Ook hier wordt opgemerkt dat wederzijds vertrouwen de basis is en dat gezamenlijk de waardes van het samenwerkingsteam bepaald moeten worden.
FG40 Een hoge continuïteit binnen teams wordt herkend en het belang hiervan wordt benadrukt. Nieuwe betrokkenen zullen opgevoed moeten worden volgens de heersende samenwerkingswaarden.
FG41 Het opzetten van zo'n partnerschap kan alleen voor de lange termijn.
FG42 Ook hier wordt genoemd dat een win-win situatie gecreëerd moet worden voor alle samenwerkingspartners. De meeste winsten vallen daarbij te behalen op innovaties.
FG43 Het eigenaarschap van de innovaties bij de leverancier (usus fructus) leggen wordt passend gevonden. Wel wordt vermeld dat dit vooral geldt aan het eerste deel van het contract. In de beheerfase moeten minimale marges nagestreefd worden. Verder moet er tussentijds getoetst blijven worden op haalbaarheid van de afspraken over marges, anders moeten deze omhoog in de beheerfase, wat nadelig is voor de aanbestedende organisatie.
FG44 Het gebruiken van een bandbreedte om acceptatie van risico te bepalen wordt passend bevonden in deze ontwerplijn.

H.2.5. Design line 5 – *International*

FG45 De ontwerplijn wordt begrepen en herkent als mogelijkheid.
FG46 Het wordt opgemerkt dat co-financiering door EU subsidies breder gezien kan worden. EU-subsidies is te beperkend, subsidies in de bredere zin zijn een mogelijkheid en worden ook gezien als een bruikbare optie, zeker in deze ontwerplijn.
FG47 De allianties op inkoop, financiën en kennis om transactiekosten te verlagen, door één in plaats van meerdere procedures op te zetten, worden herkend en passend bevonden in deze context.
FG48 Als belangrijk risico hierbij wordt de verplichting van mededinging genoemd. Een alliantie balanceert vaak op het randje van het toegestane binnen de EU. Sectoren zoals die van het spoor en de luchtvaart zijn beperkt wat betreft diversiteit van partijen. Samenwerking in een alliantie wordt door de mededingingsautoriteit snel gezien als dat men een blok in de markt zet. Dat ligt gevoelig en is daarom een risico van deze ontwerplijn.

H.2.6. Design line 6 – *Product in Network*

FG49 'Netwerkproduct' als naam van deze ontwerplijn wordt niet meteen logisch gevonden.
FG50 Een relatie tussen deze ontwerplijn en de introductie van innovatie als los systeem wordt direct herkend.
FG51 De link wordt gelegd tussen de treinaanbesteding als klassieke waterval en deze ontwerplijn als methode om om te gaan met zo'n waterval in een aanbesteding.
FG52 The latest-and-greatest technology requirement wordt gezien als oplossing voor snelle vooruitgang. Echter wordt de kanttekening gemaakt dat het risico bestaat dat op basis hiervan een ander product wordt geleverd dan gewild. Toch wordt dit punt afgezwakt door het argument dat dit wel nodig is om bij te kunnen blijven met toekomstige ontwikkelingen.
FG53 Eerst wordt gesteld dat deze ontwerplijn meer een werkwijze representeert dan een aanbesteding. Later wordt gesteld dat deze lijn toch misschien wel de key zou kunnen zijn in omvangrijke aanbestedingsprocedures. In de huidige situatie wordt veel vastgezet, terwijl deze ontwerplijn aandraagt hoe je daarbinnen toch een stukje latest-and-greatest kunt inpassen.
FG54 Er wordt opgemerkt dat het specificeren van deze netwerk(deel)producten op visie doel een goede oplossing hierbij zou zijn. Dan kun je op een zeer globaal level vastleggen wat hoe het netwerk moet functioneren, de invulling daarvan wordt overgelaten aan de leverancier.
FG55 Het leggen van de verantwoordelijkheid voor systeemintegratie bij de aanbesteder wordt niet per se als logisch binnen deze ontwerplijn ervaren. Wel wordt aangegeven dat het van essentieel belang is die allocatie goed af te wegen. In huidige aanbestedingen van dit netwerkproducten ligt die verantwoordelijkheid meestal bij de leverancier. Het (gedeeltelijk) verleggen hiervan naar de aanbesteder kan kansen bieden.

H.3. Exploration conceptual design NS

H.3.1. Design line 2 - *Alleen innovatie*

FG56 Er is gekozen voor de Ontwerplijn Alleen innovatie omdat hiermee op zichzelf staand getoetst en getest kan worden of een innovatie past bij de NS en de treinen of niet. Nu gebeurt dat grotendeels op gevoel en daar moet vanaf gestapt worden.
FG57 Ook zou dit separaat aanbesteden zorgen dat voor alle innovaties onderzocht kan worden wat ze opleveren en of en wanneer de NS daar gebruik van zou willen maken.
FG58 Momenteel worden innovaties niet grondig genoeg onderzocht op functionaliteit en op welke manier dit ingezet zou kunnen worden om zoveel mogelijk voordeel te kunnen behalen. Dat zou deze ontwerplijn verbeteren.
FG59 Opgemerkt wordt dat innovaties momenteel alleen ingezet worden volgens de wijze waarop dat initieel bedoeld was, terwijl er vele ontwikkelingen zijn die veel breder toepasbaar zijn. Er vindt nu geen exploratie van die inrichtingsmogelijkheden plaats.

FG60 Ook zouden deze procedures tegelijkertijd kunnen plaatsvinden.
FG61 De uitkomst van een dergelijke separate aanbesteding van innovatie zou moeten resulteren in specificaties voor de aanbesteding van de trein.
FG62 Het risico hiervan is dat uit de separate aanbesteding een perfecte oplossing komt en dat er bij het aanbesteden van de trein toch een ander resultaat uitkomt.
FG63 Als oplossing wordt aangedragen om zo te specificeren dat dit niet het geval is. Kanttekening hierbij is dat er niet toegeschreven mag worden naar een leverancier.
FG64 Het goed specificeren van de functionaliteit (niet: functionele specificaties) van de innovatie waarborgt echter dat verkregen wordt waarom gevraagd wordt, ook als dat anders is dan de oplossing uit de separate aanbesteding.
FG65 Opgemerkt wordt dat er eigenlijk continu gezocht moet worden naar wat het doel is van de aanbesteding en alle onderdelen daarvan. Gedurende het proces moet de NS zich constant blijven afvragen welk doel bereikt moet worden.
FG66 Alleen innovatie aanbesteden is niet voor de lange termijn. Het is niet gegeven dat de partij die innoveert, ook betrokken is bij de uitvoering op de trein, dus in de 'totale' aanbesteding.
FG67 Als innovatie los in de markt gezet wordt kan het zijn dat er niet bij een treinbouwer uitgekomen wordt, maar bij een ICT bedrijf gespecialiseerd in een bepaalde techniek. Door dat niet te doen worden er kansen onthouden.
FG68 Het zou wel kunnen zijn dat bij voorafgaande innovatie dit ontwerp al verouderd is wanneer het op de trein komt. Dit heeft tot gevolg dat geaccepteerd moet worden dat niet alles state-of-the-art is, maar dat de NS in het 'midden' van de markt meegaat.
FG69 Een ander aspect dat een invloedrijke rol speelt is de modulariteit van het product, de trein. Als flexibiliteit wordt gezocht om te innoveren en optimaliseren, dan moet het product modulair zijn om dat te kunnen waarborgen. Als dit niet het geval is kunnen die ontwikkelingen niet doorgevoerd worden in het product.
FG70 In het geval dat de NS wil voorkomen hiervoor afhankelijk te zijn van de treinleverancier, is die modulariteit garanderen extra belangrijk. De verantwoordelijkheid voor de systeemintegratie komt dan wel te liggen bij de aanbesteder.
FG71 In dat geval zou echter een partnerschap met meerdere partijen ook een optie zijn.

H.3.2. Design line 4 – *Collaboration Plus*

FG72 Er is gekozen voor Ontwerplijn Samenwerking Plus omdat dit een vrij radicale optie is ten opzichte van de huidige inrichting van het aanbestedingsproces bij de NS. De respondenten geven aan het interessant te vinden om te onderzoeken wat deze ontwerplijn voor mogelijkheden zou bieden.
FG73 Het aangaan van een partnerschap is eerder het plan geweest. Hierbij was uiteindelijk toch de instelling: als er maar betaald wordt en op tijd geleverd wordt is het goed. Daar is uiteindelijk weinig van het partnerschap in terug te vinden.
FG74 De aspecten in deze ontwerplijnen vragen echter wel een hele grote omslag.
FG75 Er wordt opgemerkt dat het voor een partnerschap vereist is dat de NS en partner gelijkwaardig zijn, financieel en qua grootte. Dat is niet met alle mogelijke treinbouwers het geval, wat een partnerschap ingewikkeld maakt.
FG76 Sommige respondenten brengen hier tegenin dat het gedrag van de NS hieraan ten grondslag ligt en dat gelijkwaardigheid niet per se nodig zou moeten zijn.
FG77 De wens van de respondenten om een omslag naar samenwerking te maken wordt duidelijk uitgesproken. Ook wordt aangegeven dat ook de omstandigheden de NS hier toe dwingen, bijvoorbeeld door het gebrek aan onderhoudspersoneel. Verandering is onvermijdelijk, zeker met het oog op de toekomst.
FG78 De spoorsector is een uitdagende sector voor verandering. Er wordt aangegeven dat zelfs binnen partijen verschillende visies bestaan op innovatie. De mechanische trein wordt genoemd als trots van velen binnen de sector. Innovatie op het gebied van IT is in de visie van sommigen maar bijzaak.
FG79 De treinenmarkt is uniek en traditioneel. Sommige respondenten geven aan dat vooral de markt traditioneel is. Het ligt daarom niet aan de NS, maar aan de markt dat (nog) niet mogelijk is meer in samenwerking te gaan aanbesteden.
FG80 Er worden voldoende voorbeelden buiten de sector gezien die bewijzen dat het wel kan. Toch wordt door sommigen aangegeven dat die sectoren anders georganiseerd zijn, dat samenwerken daar meer in het DNA van de branche zit.
FG81 Een respondent brengt een andere visie op: De sector is conservatief en wij hebben als NS behoorlijke knauwen gehad de afgelopen jaren. Dat heeft ook iets met de betrokkenen gedaan. De markt heeft vaak aangegeven nieuwe dingen te willen doen, maar als NS blijven we vasthouden aan wat we doen. We eisen precies te krijgen wat we willen, als het dat niet is vinden we het niet goed.
FG82 Dit werkt ook door in de relatie met marktpartijen. Zelfs de omgang met elkaar is vastgelegd met eisen. We schrijven alles tot in detail voor. Het is de vraag of we dit los durven laten om tot een andere oplossing te komen.
FG83 Er wordt aangegeven dat het wantrouwen binnen de NS richting de leveranciers doorwerkt in hoe het aanbestedingsproces nu vorm gegeven wordt.
FG84 Een respondent geeft aan dat dit mee valt. Er is hard gewerkt de hoeveelheid technische eisen terug te brengen. Dat is gelukt met factor 10 ten opzichte van andere partijen.
FG85 Daarentegen wordt door een andere respondent aangegeven dat er een grote hoeveelheid zeer specialistische mensen per aanbestedingsprogramma zijn binnen de NS. Dat kan tot prachtige resultaten leiden. Het kan aan de andere kant ook de vraag oproepen of het nodig is zoveel expertise in huis te hebben.
FG86 Er moet bepaald worden waar de grens ligt voor de NS wat betreft interne specialistische kennis. Een duidelijke afbakening is nodig van welke expertise bij de NS ligt en waar de expertise van de leverancier gevraagd wordt.
FG87 Binnen de nabije toekomst wordt het reëel geacht dat aanschaf en onderhoud in geheel gecontracteerd zullen worden.

FG88 Voor samenwerking moet er meer wederzijds vertrouwen komen, waarbij de focus ligt op het vertrouwen van de NS in de leverancier.
FG89 Het verschil tussen de verschillende leveranciers in de treinbouw is een remmende factor hierbij. Niet met alle partijen wordt een dergelijk partnerschap haalbaar geacht.
FG90 Het uitblijven van een beweging richting samenwerking in de aanbesteding wordt door sommige respondenten nadrukkelijk gezocht in de cultuur van de NS; het gedrag en ook taalgebruik in de aanbesteding.
FG91 Het aangaan van een Long-Term Service Agreement (LTSA) in een actuele aanbesteding wordt gezien als een tussenstap richting het opbouwen van vertrouwen.
FG92 Het wordt gezien als een uitdaging om binnen de aanbestedingsprocedure uit te komen op een partij met eenzelfde insteek als de NS om een samenwerking mee aan te gaan.
FG93 De continuïteit van teams, betrokken personen binnen de samenwerkingspartijen, is belangrijk. Er moet een samenwerkingsteam met een drive gevormd worden. Mensen uit de dialoog hierbij betrekken is daarvoor belangrijk.
FG94 Inzet van het bouwteam wordt geopperd. Toch focust dat zich vooral op de organisatievorm, terwijl de respondenten het eens zijn dat het gaat om normen en waarden, de cultuur die heerst.

Appendix: Consent Form

This appendix shows the consent forms for the expert interviews and the focus group meeting. All experts interviewed and consulted in the focus group have been asked to sign the consent form in advance of the meetings. The signed consent forms are stored safely on the TU Delft Project Storage. Before each interview and the focus group, all have been reminded that consent has been given, participation is voluntary and withdrawal is possible at any time.

In the consent form it was stated that only the NS-employees would receive a summary of the transcription to check for agreement with the participant. Eventually, all transcriptions were transformed into a summary. All participants have received this summary and signed for the approval of its content to be used in the research.

Informed Consent Form – Research 'Flexibility in Public Procurement'

You are being invited to participate in a research study on flexibility in public procurement processes in the transport sector. This study is being done by Nena Schenk from the TU Delft and is supervised by Sander Renes and Wijnand Veeneman of the TU Delft and Louis Michielsen and Tony Smulders of the Nederlandse Spoorwegen.

The purpose of this research study is to develop an overview of possible interventions and their suitability for public organizations in transport procurement procedures to implement intermediate changes to an initial procured design. The resulting master thesis will be published, except confidential data, on the educational repository of the TU Delft, which is accessible by TU Delft students and employees.

The interview or consultation will take you approximately 60 minutes to complete. The data will be used for the conduction of a TU Delft master thesis, publication hereof and for recommending the NS on a possible intervention. We will be asking you to answer the questions of this interview/consultation about the public procurement process, your point of view and provide insights on the interventions to be designed within this research. This information will be used for argumentation and decision making purposes and for providing examples. The responses, views or other input can be quoted anonymously in research outputs. Also, the obtained data could be used to support scientific publication, in which case the same anonymity will be guaranteed and all other terms as provided in this document will apply. The topic of such a publication will not change, public procurement and intermediate innovation will still be the research focus.

The audio of the interview/consultation will be recorded and later a transcription will be made. The transcript will be used in the research and personal information will be anonymized. The audio recording, transcription and personal data will be saved in a secured TU Delft storage. For verification purposes, data on the professional role will be collected but a generalization will be applied to avoid identification of natural persons.

Figure I.1: Consent Form: Front page

As with any (online) activity the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential. We will minimize any risks by deleting all personal information 2 years after the end of the project (1-1-2026). However, it must be understood that taking part in the study also involves collecting personally identifiable research data with the potential risk of the identity being revealed.

***For NS employees**: The recording and transcription will be saved at TU Delft. A summary will be made from the transcription and send to you to check if you agree. After that, the summary is used for analysis and will as such be added to the appendix of the research. The NS will check the summary again at the end of the project. If the data is sufficiently anonymized in their view, the summary can be made publicly available as part of the thesis.*

Your participation in this study is entirely voluntary **and you can withdraw at any time** without having to give a reason. You are free to omit any questions. Also, if you have any questions, these can be asked at any time.

To get in touch, you can contact ___ or responsible researcher W.W. Veeneman at ___.

Expressing gratitude for taking part in this research forms the conclusion of this consent form. It is of great value to this study to be able to conduct this interview or consult. Thank you.

If you have read and understood the information and you have been able to ask questions about the study and these have been answered to your satisfaction, you can sign here:

Name participant	Signature	Date

As a researcher have read the informed consent form closely to the potential participant and ascertained to the best of my ability that the participant understands what is voluntarily agreed to.

Nena A. Schenk

Name researcher	Signature	Date

Figure I.2: Consent Form: Second page