In search of an Systems Engineering application for Real Estate Procurement.

Appendix Book

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Appendix A – Discussion of research methods

A.1 Case study

The case study is mostly used as an umbrella for a variety of research methods (Leiringer, 2003) and are a rich empirical descriptions of a phenomenon that are typically based on a variety of data sources (Yin, 2003; Eisenhardt & Graebner, 2007). Cases studies can be performed with one single case, but it is also common that several cases are included in the cases – a multiple-case study – that provide the basis of the developed theories, findings and observations. Yin (2003) states that the case study method specifically answers a ‘how’ or ‘why’ question about a set of events over which the investigator has little or no control.

A.2 Survey

The survey is used to explain relationships over a number of variables in a research. The goal of this research method is to derive statements on the population based on a specific group of respondents (Leiringer, 2003). The survey method specifically answers research questions such as ‘who’, ‘what’, ‘where’ and ‘when’.

A.3 Experiment

The experiment is defined by Hicks & Turner (1999) as “a study in which certain independent variables are manipulated, their effect on one or more dependent variables is determined and the levels of these independent variables are assigned at random to the experimental units in the study.” Ideally, an experiment is carried out by analysing the effect of one independent variable on the dependent variables.

A.4 Archival research

Conducting an archival research is, according to Leiringer (2003), not by itself a research method and most research will, in some sort of way, make use of archival documentation as evidence. Archival research can be advantageous as research method when the research goal is to describe the incidence of a phenomenon (Yin, 2003).
Appendix B – Case study research design

B.1 Logic of case study approach

Before assessing the remaining three elements of the research design we aim to increase the perception of the reader on the performed case study by discussing its logic. This relates to the different research steps conducted, and the relation between these research steps. Based on the work of Yin (2003); Eisenhardt (1989) and Leiringer (2006) figure 2 presents the logic of the case study approach. This figure shows the different steps performed in the case study performed for this research project. The first step of this case study is to identify the relevant theoretical concepts/theories/framework and to develop a theoretical framework. As is stated by Eisenhardt (1989) a priori specification of constructs can help the researcher to shape the initial design of the performed research. It is perceived that this action enables the researcher to measure the constructs more accurately. In this project this means that a theoretical framework is designed in which a theoretical (conceptual) model with propositions on the concepts on the selected concepts related to the requirements management process and a normative description of the SE framework are integrated.

Secondly, a case selection procedure is performed based on the unit of analysis and additional selection criteria formulated. In this step the data collection protocol is also formulated. When the cases are selected and the data collection protocol is formulated the third step will consists of the data collection on the selected cases.

The data collection process is followed by the analysis of this data set. The analysis of the data is the heart of each case study but is it perceived to be the most difficult of the process (Eisenhardt, 1989). Miles and Huberman (1984) wrote on this subject that readers cannot follow how a researcher draws his conclusions from a huge data set. However, multiple key features of analysis are identified which are essential for the performance of a case study. One key element is perceived to be the within-case analysis which is performed in this research project before reflecting the findings of the cases to each other (Eisenhardt, 1989). Followed by this within-case analysis is the search for patterns between these cases in the cross-case analysis. These findings of the cross-case analysis are reflected on information derived from other cases. This provided the researcher a tactic to evaluate these findings and it provides and different lens to view the data of the cases.

The final step in this case study is the formulation of the findings and conclusions drawn on these within-case and cross-case analysis. Based on these analyses and the overall impressions, concepts, themes and possible even relations between variables will emerge. In the formulation of findings and conclusions - related to the requirements management process performed by the Rijksgebouwendienst – it is of significant important to reflect these findings on the framework provided by the cases studied to evaluate the level of fit within this framework (Eisenhardt, 1989). In essence, this step means that the two elements – theoretical model on requirements management process & normative model on SE for process – of the theoretical framework formulated are assessed/tested on the empirical data derived in the case study.
Appendix B – Case study research design

B.2 Unit of analysis

As is stated by Leiringer (2003) based on the work of Hamel et al. (1993), case studies are perceived as lacking a precisely defined subject of investigation as their point of departure. To increase the focus of the case study a definition of the unit of analysis is helpful. The unit of analysis refers to the general subject of the cases to be selected and forms a first step in the selection of cases for the research. In this research project the unit of analysis relates to PPP project and specifically the requirements management process performed in the context of DBFMO projects managed by the Rijksgebouwendienst. The objects of study, the cases, are retrieved from the portfolio of projects of the Rijksgebouwendienst.

B.3 Data analysis procedure

After the data collection the data needs to be analysed to provide proper answering of the research questions. Many scholars have addressed these data collection methods, but little attention is given to discussion of data analysis (Eisenhardt, 1989). A key feature is the within-case analysis as discussed by Eisenhardt (1989) and indicated to be performed in the logic of the case study approach. To prevent the situation of “death by data asphyxiation” (Pettigrew, 1988) the researcher has to use an approach which enables the management of the large amount of data that is mostly obtained in case study research. Within-case analysis is one key feature which enables the researcher to become familiar with each case as a stand-alone entity before one investigates generalized patterns across the cases. The cross-case analysis relates to investigation of differences and similarities between the cases. This creates a more in-depth insight in the observed phenomenon because each case is selected because it entails different project and context characteristics. The cross-case analysis forces the researcher to think beyond initial impressions and this improves the likelihood of accurate and valid conclusion based on the case studies (Eisenhardt, 1989). In this research this means that a more reliable assessment on the performance of the requirement management managed by the Rijksgebouwendienst in DBFMO projects can be made due to the use of a multiple case study and the within- and cross-case analysis.

The questions still remains, how do we have to analyse the data obtained during the case study research on DBFMO project of the Rijksgebouwendienst? This question can be answered by using the work of Yin (2003) as he addressed techniques for analysing data which he presents as ‘dominant modes of analyses’. These data analysis techniques are: pattern matching, explanation building, time series analysis and program logic models.

The suitability of the type of data analysis approach is dependent on the object of study; the theoretical framework at hand; and the kind of answers that are required in the research.

These two findings are integrated in the analytical approach by integrating the within-case and cross-case analysis research steps in the case study design. The analytical approach or ‘mode of analysis’ which is perceived to be the most suitable is that of pattern matching since this refers to the comparison of an observed pattern with one that was predicted. In this research project the theoretical framework designed in relation to the requirements management process represents the predicted and this will be compared to the observed
pattern. The latter is derived from the observation of the practical performance of the requirements management process performed by the Rijksgebouwendienst in DBFMO projects.

B.4 Logic of replication

The last requirement which need to be fulfilled by the case study is related to the logic of replication. In this research project a multiple-case study is selected and this is characterized by the fact that it follows replication logic and therefore do not have to be representative of the population as a whole (Leiringer, 2003). The cases for the case study must be selected in such a way that they show strong occurrences of the phenomenon of interest but each has unique contextual characteristics. For this project this is safeguarded by the performed selection process which is used to select unique DBFMO so that a high amount of information is provided. The logic of replication is used to assess the number of cases which are deemed necessary to be used in the case study design. Because a sampling logic should not be used, the typical criteria regarding sample size are irrelevant for this research project (Yin, 2003). More relevant is that it is important for this decision to be a reflection of the number of case replications that are to be preferred in the research. For this research it is expected that the object of study is straightforward and this does not demand an excessive degree of certainty. Yin (2003) stated that this means that the researcher can use two or three cases to obtain the required replication.
Figure 1 - Logic of case study
Appendix C – Overview of Respondents

C.1 Selection of respondents

When choosing the respondents several factors were taken in consideration. A key criterion relate to the fact that the respondent must been in a position in the requirements management process that he/she had an significant position and role in the project organisation in relation to this process. The respondents should have held a key position within their respective organization in the requirements management process of the selected DBFMO project, and preferably the selected respondents of one DBFMO project should act from different hierarchical positions in the (project) organization. The result of this selection of the respondents should increase the diversification of the collected data. This approach – interviewing multiple respondents from different stakeholders and with different perspective – is based on the work of Eisenhardt & Graebner (2007). In their work the authors indicate that one of the main challenges related to obtaining interview data is the bias of interviewees. A key approach to overcome this challenge is using numerous and knowledgeable respondents who perceive the phenomenon for different perspectives. This can include respondents from different hierarchical levels, functional areas as well as actors from other relevant organizations.

The formulated criteria and characteristics framed above are used in the process of contacting respondents. The following table presents the amount interviews that were conducted related to the DBFMO project or subject of interview. This table integrates also the unstructured interviews that are used to expand the knowledge base on the requirements management process of DBFMO projects.

<table>
<thead>
<tr>
<th>Subject of Interview</th>
<th>#</th>
<th>RGD</th>
<th>Non-Rgd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unstructured Interviews</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>A - Defensiemuseum</td>
<td>7</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>B – Hoge Raad</td>
<td>7</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>C – DUO/Belastingdienst</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Other DBFMO projects</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

For a more detailed overview of the respondents, the reader is referred to Appendix C. In this Appendix the reader can get a better understanding of who the respondents were for this research project.
C.2 Information on selected respondents

The table gives insight in the stakeholder they represented and their function in the project organisation. It is observed that for each project a process manager, team coordinator OS and representatives of the end-users are interviewed with the goal to create an complete overview of the process. No members of the Steering Committee were interviewed due to their lack of availability for this research project.

<table>
<thead>
<tr>
<th>DBFMO project A - Defensiemuseum</th>
<th>Organisation</th>
<th>Function in project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondent C</td>
<td>Rijksgebouwendienst</td>
<td>Teamcoordinator OS</td>
</tr>
<tr>
<td>Respondent D</td>
<td>Rijksgebouwendienst</td>
<td>Teamcoordinator OS</td>
</tr>
<tr>
<td>Respondent L</td>
<td>Rijksgebouwendienst</td>
<td>Expert Building physica</td>
</tr>
<tr>
<td>Respondent U</td>
<td>Ministry of Defence</td>
<td>Team coordinator Collection Museums</td>
</tr>
<tr>
<td>Respondent V</td>
<td>Legermuseum Delft</td>
<td>Team coordinator Services and Facilities</td>
</tr>
<tr>
<td>Respondent AB</td>
<td>Rijksgebouwendienst</td>
<td>Process manager</td>
</tr>
<tr>
<td>Respondent Z</td>
<td>Rijksgebouwendienst</td>
<td>Process manager</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DBFMO project B - Hoge Raad</th>
<th>Organisation</th>
<th>Function in project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondent B</td>
<td>Rijksgebouwendienst</td>
<td>Responsible for OS</td>
</tr>
<tr>
<td>Respondent E</td>
<td>Rijksgebouwendienst</td>
<td>Responsible for OS</td>
</tr>
<tr>
<td>Respondent O</td>
<td>PDH - Ministry of Safety &amp; Justice</td>
<td>Process manager / teamcoordinator OS</td>
</tr>
<tr>
<td>Respondent P</td>
<td>PDH - Ministry of Safety &amp; Justice</td>
<td>Process manager / teamcoordinator OS</td>
</tr>
<tr>
<td>Respondent S</td>
<td>Hoge Raad</td>
<td>Provider information Services</td>
</tr>
<tr>
<td>Respondent W</td>
<td>Hoge Raad</td>
<td>Building committee + Delegate end-user</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DBFMO project C - DUO/Belastingdienst</th>
<th>Organisation</th>
<th>Function in project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondent I</td>
<td>DUO</td>
<td>Representative DUO for Services &amp; Facilities</td>
</tr>
<tr>
<td>Respondent J</td>
<td>Rijksgebouwendienst</td>
<td>Advisor Housing</td>
</tr>
<tr>
<td>Respondent T</td>
<td>Belastingdienst</td>
<td>member Technical team</td>
</tr>
<tr>
<td>Respondent Z</td>
<td>Rijksgebouwendienst</td>
<td>Proces Manager</td>
</tr>
<tr>
<td>Respondent AA</td>
<td>Rijksgebouwendienst / OPPS</td>
<td>Proces Manager / teamcoordinator OS</td>
</tr>
</tbody>
</table>
Appendix D – Information mail for interview request

Beste heer/mevrouw,

Om te beginnen wil ik u bedanken dat u de tijd en moeite heeft genomen om dit interview/gesprek te houden. In dit informatiemailtje wil ik kort het doel van dit gesprek en mijn afstudeerstage binnen de Rgd uiteenzetten. Dit document verteld kort voor welke studie dit onderzoek wordt uitgevoerd, wat het doel is van dit afstudeeronderzoek binnen de Rgd en wat het doel van het gesprek is.

**Master Technische Bestuurskunde, MSC SEPAM**

Mijn afstudeerstage/onderzoek is de afsluiting van mijn opleiding Technische Bestuurskunde van de TU Delft. Aan deze faculteit in Delft volg ik de master-opleiding SEPAM wat staat voor Systems Engineering, Policy Analysis and Management. Msc. SEPAM studenten leren hoe ze een significante bijdrage kunnen leveren aan het duurzaam oplossen van complexe maatschappelijke problemen door het analyseren van structuur en werking van technische multi-actorsystemen aan de hand van Systems Engineering, Project Management & Process Management tools, en door het ontwikkelen van interventiestrategieën, handelingspraktijken en instrumenten voor het ontwerpen en verbeteren van dit soort systemen. Waar de Bachelor Technische Bestuurskunde zich met name richt op de analyse en beschrijving van dit soort vraagstukken, richt deze Mastervariant zich op het ontwerpen van oplossingen voor diezelfde Multi-Actor System vraagstukken.

**Methode en gebruik van interview**

Bij goedkeuring wordt tijdens het interview gebruik gemaakt van opname. Dit om het gesprek op te nemen (audio) zodat dit later teruggekoppeld kan worden voor de uitwerking van het gesprek. Deze uitwerking wordt dan later teruggekoppeld aan de geïnterviewde zodat die kan aangeven of dit is wat er gezegd was tijdens het gesprek. Ook kan dit nog aangepast worden en eventueel uitgebreid. Dit om te voorkomen dat de data van het onderzoek niet valide is. Verder gebeurt er niks met de opnames maar zorgt dit wel voor een makkelijker verlopend interview.

De geïnterviewde zal anoniem in het verslag verschijnen. Dit wordt gedaan omdat een naam geen toevoegde waarde heeft en het onderzoek alleen als doel heeft om een generiek model te formuleren voor de totstandkoming van de OS.

**Afstudeeronderzoek binnen de Rijksgebouwendienst**

Dit onderzoek heeft als doel om in kaart te brengen hoe, bij verschillende DBFMO projecten van de RGD, de OS tot stand is gekomen. Hiervoor worden interviews afgenomen met mensen die, direct of indirect, betrokken waren bij de OS van een specifiek DBFMO project. Dit wordt gedaan om in kaart te brengen hoe, bij de verschillende projecten, de OS tot stand is gekomen. Op de eerste plaats staat dus de totstandkoming van de OS centraal en op de 2de plaats staat de OS zelf (het model en de structuur). Dit betreft onderwerpen als

- **Totstandkoming van OS**
  - Organisatie OS team
  1. Totstandkoming van OS team
  2. Betrokkenen en functies binnen OS team
     - Functie van betrokkenen binnen Rgd en bij klant/gebruiker
  3. Rolverdeling en verantwoordelijkheden binnen OS team
Appendix D – Information mail for interview request

- Rol klant en rol RGD
  4. Invloed klant
  5. Mandaat van betrokkenen
  6. Wijzigingen OS team tijdens OS proces
  7. Rol betrokkenen OS proces verdere fases in DBFMO project

- Vorm & Inhoud OS - Gebruikte methodiek
  o Plaats en functie OS in gehele toestandkoming van DBFMO project
  o Nodige input voor OS proces
    1. Welke informatie vormt input voor maken OS
    2. Compleetheid en beschikbaarheid input start OS proces
    3. Methode verkrijgen van informatie van klant gebruiker
    4. Wijzigingen fundamentele beslissingen tijdens OS proces
  o Beschrijving/ervaringen proces van ambitiedocument – prestatie-eisen
    1. Voor start OS proces bekend met aanpak
    2. Gebruikte methodiek in specifiek DBFMO project
    3. Betrokkenen
    4. Rol klant
    5. Toegevoegde waarde Nordic Five Level structure
    6. Positieve en negatieve ervaringen
    7. Review en evalutie van OS
    8. Moment van compleetheid van OS
    9. Invloed consortia in dialoogfase op OS

- Resultaat OS proces
  o Doorlooptijd OS proces
  o Mogelijkheden monitoren kwaliteit tijdens OS proces
  o Robuustheid OS verdere fases DBFMO project (dialoog etc)

Met vriendelijke groet,

Ronald den Hoed
Appendix E – Requirements Management variables

E.1 Experience of team with process

Multiple studies have indicated that the level of experience of the team has a significant relation to the quality of the performed process (Tang et al., 2013; Ahmad et al., 2011; Yu, 2006) and its relevance cannot be overemphasized (Ahmad, Adnan, Bari, & Adb Rashid, 2011). An adequate level of experience of the experts results in the fact that they are able to guide the stakeholders in the process, helping them understand their project objective, and helping to safeguard the teamwork within the project organization for better requirements management process (Ahmad, Adnan, Bari, & Adb Rashid, 2011). In retrospect, an inexperienced client/end-user may find it difficult to describe their organization to the delegates of the Rijksgebouwendienst and they are not always sure of the requirements (Yu, 2006; Barret & Stanley, 1999). It is stated that problems can occur when inexperienced stakeholders are not adequately guided through the process.

E.2 Commitment & Resistance towards the process

The process is a complex and iterative process which requires a shared understanding and commitment in a group of stakeholders (Shen et al., 2004). The commitment of the stakeholders is characterized by the level of support from top management of the stakeholder’s organisation, promptness of decision-making and the providence of full time representative (Ahmad et al., 2011). Multiple studies have been performed to prove that stakeholders’ commitment to the requirements management process indisputably yields a positive result on the performance of integrated contract projects as D&B (Chan et al, 2001, Aricy et al, 2006). However, end-users, project owners and other stakeholders can have little incentives to participate or want to be involved in the requirements management process of the project (Yu, Chan, Chan, Lam, & Tang, 2010). It is the task of the project organisation to manage a process which creates incentives for the stakeholders.

E.3 Roles of Stakeholders

Multiple studies refer to the properly management of stakeholder involvement as one of the most important factors which determine the success of the requirements management process. The provided role and responsibility of the stakeholders is therefore used as input and defined in this variable. This is perceived in the literature which states that the brief development is largely influenced by the clients and it is of significant importance that the roles of stakeholders in the process are adequately managed. This entails the clear definition of both the roles and responsibilities of each stakeholder in the process to encourage the active participation of these stakeholders (Yu, Chan, Chan, Lam, & Tang, 2010). The literature study revealed that stakeholders’ knowledge on their responsibility and their position in the process is determined as a success.

1 (Kamara, Anumba, & Evbuomwan, 2000; Yu, Chan, Chan, Lam, & Tang, 2010; Ang, Wyatt, & Hermans, 2001; Tang L., Shen, Skitmore, & Cheng, 2013)
2 Yu et al. (2010); Zeegers & Ang (2003); Kamara, Anumba & Evbuomwan (2000); Kamara & Anumba (2000)
factor for the briefing process. When these delegates of the end-users and/or project owners are given the possibility to obtain a more leading and central position in the process it could affect the quality of its outcome because their limited knowledge.

### E.4 Consideration of multiple perspectives

When performing the process it is of importance to consider the multiple perspectives as a result of multiple stakeholders (Ferreira, Lima, Formoso, & Leite, 2007). Robertson (2001) stated that “when you try to discover the requirements for any kind of product the difficulties are even more complex because the source of the requirements is not just one person, it is all of the people who are stakeholders in the projects.” One problem of current requirements management practices relates to the fact that proper end-user involvement in the process is lacking³. It is perceived that only a limited number of stakeholders are integrated in the process who all share similar interests, objectives and agenda and thereby a discussion on the requirements is avoided. Without engaging the end-users in the process an important input for the process is lost and they are likely to be left with long-term dissatisfaction towards the project (Barrett, Stanley, & Sexton, 1999).

Next to the fact that it is important to incorporate the multiple perspectives an important aspect related to this variable is the fact whether or not multiple internal stakeholders (employees of the end-user organisations) are used to obtain the information which is needed to create an “complete” perspective on the requirements of the organisation. Literature study showed that to increase the quality of input for the user requirements input of multiple information sources must be considered in order to discover the requirements of the stakeholders (Robertson, 2001). Cheong et al. (2003) stated on this subject that it is important in this process that it captures the requirements of all of the employees who make up this “stakeholder”, by means of for example user groups.

### E.5 Methods used for collection of information

Literature on requirements management indicates that to discover, identify and specificy requirements from different sources there is a need for various techniques (Robertson, 2001). These techniques, requirements “trawling” techniques, are used ideally in a structured framework which is used as an basis to discover the different types of requirements of the stakeholders. This is acknowledged in the work of Chan et al. (2002) who stated that “in order to achieve a satisfactory result of the real estate project, full acquisition of knowledge on client’s aspirations in both tangible and intangible form would be a critical step in construction projects.” A variety of methods are available – workshops; discussion; field trips etc. – and can be used by the experts in order to create a comprehensive perspective on the user requirements (Kamara, Anumba, & Evbuomwan, 2000). Yu (2006) stated that the amount of time it takes to create a clear perspective on the requirements of the stakeholders is frequently underestimated. The structured use of multiple techniques as workshops and brainstorm with qualified and key stakeholders may save time and improve communication in the process on the requirements for the project.. It is presumed that a minimal use of these techniques decreases the

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³ (Yu, Chan, Chan, Lam, & Tang, 2010; Kamara, Anumba, & Evbuomwan, 2001)
qualitative performance of the requirements management process and this will influence the overall quality of the project.\(^4\)

**E.6 Knowledge on formal procedures of process**

Chapter Three did discuss the methodologies which are used in the organisation of the Rijksgebouwendienst. This integrated to use of Nordic Five-layer model, performance specifications and the PPP concepts. Tang *et al.* (2013) stated that a framework should be developed preceding the performance of the requirements management process which is accepted by the relevant stakeholders. This framework entails the procedure which is used as a basis for the formulation of the performance specifications. The application of a formal procedure would guide the experts in the process and can be used to enable a learning process on its effectiveness. This therefore is perceived to have a relevant influence on the performance of the process but the literature is not conclusive on how this process is preferably been performed. The lack of a ‘best practice’ and the statements that the development of an applicable framework is still not available provides a basis for this variable which assesses the level of knowledge of the participants on the used procedures. In addition, this provides insight in the way participants use developed frameworks which can be useful for the possible implementation of the Systems Engineering framework in the process.

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\(^4\) It can occur that an badly performed requirements management process can lead to an successful project but it is assumed that the frequency of this happening is lower than when an good requirements management process is performed.
F.1 Problem Analysis in an SE process

In theory, an SE process starts with an initial analysis of the system and process input. This process is framed in this work as the Problem Analysis and it’s the iterative analysis of the process input formed by the initial stakeholder’s requirements, initial system definitions, related technology base, input from prior development efforts and requirements by specifications and standards. The formulation of the problem related to the system is subject to the perspectives provided by the stakeholders who influence the project. Therefore, at the start of a Problem Analysis the Systems Engineer must create an overview of the relevant stakeholders and gain insight in their perceptions on the problem. These stakeholders can have different viewpoint about this definition of the problem and the scope of the future project and by means of analysis of these viewpoint the problem definition is likely to match the stakeholder’s expectations. This activity can be perceived as insignificant but its performance is crucial as “Writing code isn’t the problem, understanding the problem is the problem” (Curtis, Krasner & Iscoe, 1988). It is observed in the SE literature that the hardest part is identifying the problem correctly (Sage & Armstrong, 2000). Proper Problem Definition needs to occur at the start of any SE phase since “a problem resolution effort that is well-begun, in terms of being well-defined, is a problem half-solved.” This initial problem definition should be defined in such a way that it creates an basic understanding of the current undesired situation as well as the most appropriate way to think about it. By means of for example a situation assessment the System Engineer creates a clear perspective on the problem which is subject to the SE project.

With the definition of the problem at hand and the initial stakeholder analysis the determination of the initial scope of the SE project is required. The output of the initial two activities is used as “to scope a project means to understand why the project is necessary, what the stakeholders intend to accomplish with the project and how to measure project success.” In essence this means that in the project the needs, objectives, criteria and related external constraints are to be identified and documented. At this point this is still perceived as a limited analysis and is based on process input but will be expanded by means of the stakeholder analysis and objective analysis in the subsequent step in the SE project. This activity should give a thorough picture of the “basic ingredients” of a proposed system which needs to be the product of the SE project.
F.2 Requirements Analysis phase in an SE process

The output of the Problem Definition is used in an SE project to perform the next step, the Requirements Analysis. A Systems Engineer must not only realize the importance of the information input but during the process these statements of activities must always be verified with the original input from preceding activities (iterative and interrelated nature of an SE project). This is because every performed activity provides understanding that may cause the need to revisit previous activity outputs (Department of Defense, 2001). This continuous iteration with the Problem Definition safeguards the fact that a process shall be performed which matches with the user expectations and objectives towards the project. This also means that the activities which are performed need to be done in a holistic manner which means that they are means to the end and are not to be perceived as independent activities.

A significant activity in the Requirements Analysis is the performance of a Stakeholder Analysis to identify the actors, groups of people and organisations relevant to system and is used to create insight in their initial needs and wants for the system. The stakeholder analysis is available in many forms and contexts. It is not relevant for this phase to precisely define these steps and substance but the analysis must create insight in the desires of the stakeholders and indicate their position towards the project.

Closely related to this stakeholder analysis is the identification of the objectives of the stakeholders towards the projects in the Objective Analysis. This is perceived to be one of the most controversial but also crucial steps in the entire definition of an SE system because several important product result from this activity (Sage & Armstrong, 2000). An objective analysis must be performed to define the objectives of stakeholders towards the project on the initial system and functional levels and to make them aware of the influence of their objectives on the design of the system. One may wonder how an objective analysis is to be performed on a functional level when no system or functional decomposition is available at this point. This illustrates the iterative character of an SE process since the process is needed to be perform in parallel sequence and knowledge derived from activities – for example the system decomposition or functional analysis – is to be used to update output of activities. During the objective analysis, selecting the proper objectives is crucial because they determine whether or not an “correct” system it to be designed (Sage & Armstrong, 2000). This is mostly performed by using an objective tree which is used primarily as a means of communication and documentation. This objective tree structures the goals on different levels and indicates the relation of high-level goals with low-level goals. This process requires the decision-makers and stakeholders in the project organisation – with different viewpoints on what objectives to pursue and which are most important for the real estate and services – to come to a supported set of objectives. This process means that these stakeholders will find some common ground on which the project can be performed. By managing the conflicts between

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9 For example formulated requirements for a specific system decomposition.
10 Communication is key in an SE project. More attention is on the choices in the definition phase and the related documentation. Many activities that are formally performed implicitly are in the Systems Engineering framework perceived to be essential and are to be done more explicitly. It is the primary means for maintaining traceability in the decision-making process and provides an mean for communication. This enables to System Engineer to create commitment of stakeholders to the project. It is even stated by the Department of Defense (2001) that all objectives and requirements need to be recorded and “if it is not recorder, it cannot be an approved requirements!”
stakeholders in this early stage of the project it is expected that remainder of the project will benefit from this effort (Sage & Armstrong, 2000).

At this point in the process there is a significant amount of knowledge on the problem definition, the stakeholders, and the requirements towards the real estate and its services. The next step is to decompose the system in the System Decomposition to create knowledge on the required functional view of the system which focuses on what the system must do to provide the required objectives and requirements. Due to the increasing complexity of the project it is preferred to decompose the system in subsystems (for example functional, constructive, services, facilities, architecture) on which the identified requirements can be reflected. This enables the coupling between the decomposition of the system and the requirements on the functions and systems. In addition, the formulation of the objective tree can be used in this process to determine objective of stakeholder on lower level decomposition elements before formulating the requirements towards these elements. This relation between the objectives, functions and the requirements is presented in figure 19. In this figure it is indicated that the activities performed in the requirements analysis are strongly related and together need to be used to create a view on the requirements of the stakeholders.

Underlying all these elements is the continuous process of Requirements Engineering (RE) which is perceived as the process which the Systems Engineer is required to perform to create insight in the actual requirements towards the system and its decomposition in sub-systems and functions. The requirements derived from the stakeholders provide the basis for the formulation of the performance specifications in the functional analysis. It is the tasks of the System Engineer to acknowledge the importance of this element and use these techniques discussed in the literature to create a clear understanding of the conscious, unconscious & undreamed\(^\text{11}\) requirements of the stakeholders in the project organisation.

Yu (2006) stated on this subject that the amount of time it takes to create a clear perspective on the requirements of the stakeholders is frequently underestimated because some of the stakeholders are anxious in finding an immediate solution instead of formulating their requirements. However, the author indicates that the use of multiple techniques as workshops and brainstorm with qualified and key stakeholders may save time and – maybe more important – improve communication in the process on the requirements for the project. Derived from the IT sector, RE is the process of “discovering that purpose, by identifying stakeholders and their requirements, and documenting these in a form that is amenable to analysis, communication, and subsequent implementation.” (Nuseibeh & Easterbrook, 2000). The main elements which are related to the SE process are the RE activities which are to be performed. This are eliciting, modelling & analysing, communicating, agreeing and evolving of requirements. Requirements of an SE project evolve continually and therefore the System Engineer must perform these activities in an incremental and highly iterative manner during the process to cope with the dynamics of the process. In an ideal context these requirements are

\(^{11}\) Categorized derived from the work of Robertson (2001).
ultimately frozen by means of decision-making and formalization before these requirements are coupled to the system to its sub-systems and functional decomposition.

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\[^{12}\text{Mostly functional due to the interaction with the stakeholders}\]
Appendix G – Findings of within-case analysis

G.1 Case study 1 - Defensiemuseum

G.1.1 Project organization Defensiemuseum

Different stakeholders can be identified in the DBFMO project Defensiemuseum which each have their own means, interest and power\textsuperscript{13}. The following stakeholders are identified in combination with their overall position in the DBFMO project:

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Stake project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ministry of Defence</td>
<td>Commissioning party - Principal</td>
</tr>
<tr>
<td>DVD Dienst Vastgoed Defensie</td>
<td>Real estate department Ministry of Defence – Advising organ</td>
</tr>
<tr>
<td>Legermuseum Delft</td>
<td>End-user</td>
</tr>
<tr>
<td>Luchtvaartmuseum Soesterberg</td>
<td>End-user</td>
</tr>
<tr>
<td>Rijksgebouwendienst</td>
<td>Manager tendering process</td>
</tr>
</tbody>
</table>

Another organizational character can be identified as unique and this relates to the fact that the project is part of a collection of projects which is managed top-down by one steering committee. The project Defensiemuseum is part of a collection of projects which relates to the restructuring of the museum concept of the Ministry of Defence. This project is referred to as the Nationaal Militair Museum project and not only entails the construction of a new army museum which is performed by PPP Defensiemuseum project. This project also integrates multiple other projects related to the restructuring of the museum concept of the Ministry of Defence.

\textsuperscript{13} Information is based on internal documentation of the project and on interviews with respondent on the specific projects.
Within the project Nationaal Militair Museum there are multiple subprojects defined. The decision-making process of all of these projects is performed in the Steering Committee NMM which is seated by the Secretary General of Defence. The project PPP Defensiemuseum (which is subject of the case study) is one of these subprojects. Other projects are for example related to the collection of the museums of the Ministry of Defence and of which the Defensiemuseum is one, the museum concepts and the name of the new museum. The Steering Committee is responsible for the PPP Defensiemuseum and makes all decisions. They convene every 6-8 weeks and their main responsibilities relate to the progress of project, approval of deliverables of projects, cooperation between Rijksgebouwendienst and Defence, and change in scope and goals.

The next organogram, which is presented in figure 3 presents the project structure of PPP Defensiemuseum in which the organisation of the Output-Specification team is expanded.

The **Project team** is seated by delegates of the Ministry of Defence and the Rijksgebouwendienst and the chairman is found in the project manager of the Ministry of Defence. This chairman is held responsible for the management of information required for the Output-Specification process. In this project team, the process
manager of the Rijksgebouwendienst is responsible for the preparation and execution of the procurement process and the integration of all different components produced by the different teams. This process manager is also internally responsible - within the Rijksgebouwendienst – for the performance of the project. Next to these delegates, the project team is seated by the team coordinators of the expert teams: Financial team, Monitoring team, Output-Specification team, and Juridical team. Each of these expert teams is chaired by a delegate of the Rijksgebouwendienst.

The Output-Specification team consists of three sub-teams which are the Building team, Service and Facilities team, and Infrastructure team. The team coordinator of the Output-Specification team is responsible for the formulation of the output-specification but this is formulated in (close) interaction with the end-users – Defensiemuseum Soesterberg & Legermuseum Delft – and delegates of the Ministry of Defence. Initially, the Building Team is coordinated by an delegate of the Rijksgebouwendienst and the other two teams are coordinated by an delegate of the Ministry of Defence or one of the museums. The Service and Facilities team in particular is coordinated by an employee of the Legermuseum Delft (which forms an ministerial organisation). It must be noted that within the Building team there is an delegate of the Ministry of Defence responsible for the museum collection and this forms an significant elements of the project organisation at this point. Each of these teams is responsible for the providence of the required information for the output-specification document but shall be overseen by the AV'ers (Advies-Verantwoordelijke) of the Rijksgebouwendienst.\(^\text{14}\)

\textbf{G.1.2 Timeline of output-specification process}

To create some insight in the output-specification process that is performed for the DBFMO project Defensiemuseum a timeline is reconstructed based on an archival research that is performed\(^\text{15}\). This timeline is presented on the in figure ... and is used to introduce the reader to the performance of this specific process but will also be used in the analysis of the requirements management process in the remainder of this chapter.

\(^{14}\) Chapter Three shall discuss the organisation of the Rijksgebouwendienst which gives an introduction of this delegate

\(^{15}\) For this project, the meetings of the Project Team (PT) and Steering Committee (SC) are used as input for this timeline which presents elements related to the output-specification process.
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Figure 4 - Timeline Defensiemuseum
G.1.2 Findings on evaluative framework of requirements management

Requirements management lies at the heart of the output-specification process. The first findings are related to the proposition of Requirements Management and entail the evaluation of the output-specification process performed in the Defensiemuseum project. Based on the interviews and the archival research on the documentation of the team meetings the most significant elements related to this concept – discussed in Chapter Four – are discussed in this first section.

Variable 1 - Experience of team with process

The use of the DBFMO concept in the realisation of real estate objects cannot perceive to be a new task for the organisation of the Rijksgebouwendienst. However, despite that there are multiple DBFMO projects performed next to other PPP projects it is observed in the interviews for this project that the two responsible delegates of the Rijksgebouwendienst – who manage the output-specification process and who are in the end internally responsible for the quality of the process and document – seem to lack the experience of ever managing this kind of process before. In this project it can be perceived that the two delegates of the Rijksgebouwendienst had no prior experience with the management of the process. The different process managers who were active in the project had some prior knowledge on the management of a DBFMO project but they were active on a higher hierarchical level in the project organisation but they were able to steer in the meeting of the Project Team.

To develop their process approach the two AV’ers followed the DBFMO course and used their common sense, based on their experience from being project leaders of traditional procurement projects. However, even though these efforts they stated that they had trouble understanding the output-specification concept and digital model. This lack of experience is also observed at the side of the delegates of the two museums and the Ministry of Defence who did participate in the project. None of them had any experience with the management of this kind of project of project – none of them had ever participated in this kind of real estate project – and this resulted in the fact that they had no prior knowledge on the concept of performance requirements and the output-specification.

Variable 2 - Roles of stakeholders

The literature study indicated that it is of essence that the client requirements – in this case those of the end-users and the Ministry of Defence – are properly managed in the briefing process by – for example – empowerment of the client. In the output-specification team this is only perceived in a minimal level. One of the respondents indicated that for the provision of requirements on the collection of the museums the end-users were not given a position in the team but this was provided for by the fact that the directors of the two museums were seated in the SC. In addition, when the team needed input from the museums on their collection they were invited by the delegate of the Ministry of Defence. However, the respondent stated that when the members did not give an answer to these invitations then their information would not be integrated in the document and in the performance requirements. This gives a first indication of the observation made by the author that the museums – end-users – were not as “empowered” in this process as the literature states it
is preferred in this process. On this topic it must be noted that one delegate of the Legermuseum Delft was given the role of coordinating the Services and Facilities team which manages the requirements on this subject. This comes forth from the fact that the Rijksgebouwendienst states that they have no knowledge on how to manage services and facilities and this is left – mostly – outside of the scope of their responsibilities. However, a result was that the delegate of the Legermuseum had no experience with performance requirements or PPP projects and was not able to formulate all of the requirements on this topic. At the end, this responsibility was transferred back to the coordinators of the OS team, thus the delegates of the Rijksgebouwendienst.

Another respondent stated that the end-users found it “difficult to write the performance specifications” while they normally have a clear understanding on their requirements towards a project but in the context of a DBFMO project this requires a different approach. This relates to the fact that mostly the clients and end-users have only a limited experience in the performance of a real estate project – whether it is renovation or newly constructed objects. This is also addressed in the literature study which revealed that stakeholders’ knowledge on their responsibility and their position in the process is determined as a success factor for the briefing process (Tang L., Shen, Skitmore, & Cheng, 2013). When these end-users and clients are given the possibility to obtain a more leading and central position in the requirement management process – and this is not observed or reported to the steering committee – it could affect the quality of the process and – in the long term – the project because their limited knowledge on the concept of PPP and performance specifications. The delegates of the Rijksgebouwendienst have the responsibility to create a process environment in which clients realize their role and the function of the Output-Specification in the DBFMO context. However, the archival research indicated that the member from the end-users didn’t had knowledge on their role and what was expected from them in the process.

Another observation on the role and position of the end-users relates to the fact that there input was mainly filtered instead of processed. The AV’er of this process stated that “the delegates mainly thought in solutions. These were left out of the OS.” However, the AV’er could not indicate what else they did with this input despite the fact that these “solutions” represents some form of requirements but formulated differently due to the lack of knowledge of these stakeholders on the concept of DBFMO and performance requirements. In addition, the input from one end-users was filtered by a delegate of the Ministry of Defence which indicates that this end-users was positioned “outside” of this OS process. This form of organization is also perceived in the management of the team and the process. A strict process was managed in which participants needed to oblige to the rules. An example relates to the fact that when someone showed resistance in his posture towards the process and the project, he was removed from the team and the process.

Concluding, the observations indicate that the role of the end-users had two elements. On some elements they were positioned outside of the process – related to information on building and collection requirements – and on other elements they were centralized as coordinator of the Services and Facilities team. This indicates a diffuse approach in the management of the roles of the different stakeholders in this team which is responsible for the formulation of the requirements in the output-spezification document.
Variable 3 - Consideration of multiple perspectives of stakeholders

In this DBFMO project, two end-users and responsible ministry were active in the process. However, as is already made apparent in the preceding paragraphs, the end-users only obtained a limited role in the process. The Legermuseum Delft obtained a more significant role because the team coordinator of the Services and Facilities team was a delegate of this organisation. As regards to this team, “this team only existed on paper. I represented the teams for the two-end users and interacted with the two museums when I needed specific information on these subjects.” So, as is already stated, this delegate of the Legermuseum was given the responsibility to retrieve information from the two museums in order to formulate the requirements, however, this delegate had no experience with this kind of project or with requirements management. Therefore, it can be concluded that the integration of the perspectives of the end-users is partially integrated due to the fact that they had the formal position to provide information on their requirements and collection specification, but they could not influence the process itself due to their position – and resistance towards – in the process. In addition, the end-user Luchtvaartmuseum Soesterberg did not have the capacity – or commitment – to fully participate in the output-specification process. This therefore means that the requirements are mainly based on the perspective of the Ministry of Defence and the end-user Legermuseum Delft.

Another important aspect related to this element is the fact whether or not multiple end-users (employees of the organisations) are used to obtain the information which is needed to create a “complete” perspective on their requirements. Literature study showed that to increase the quality of input for the user requirements input of multiple information sources must be considered in order to discover the requirements of the stakeholders (Robertson, 2001). However, in this project this was only performed on a limited basis because there was only limited input from the museums during the process. The research on the documentation of the meetings of the Project Team learned that it is multiple times acknowledged by the coordinator of the OS team that the lack of participation of the end-users formed the cause for concern. This is integrated in the timeline presented at the start of this chapter. In March 2009 the coordinator of the OS team indicated that there is a lack of participation from the end-users in the process and this is repeated in September 2009 and Oktober 2009. The efforts which are performed in this period didn’t influence this lack of participations of stakeholders in the process.

Variable 4 - Commitment and resistance of stakeholders

The quality of the project is found – however only during the exploitation of the 25/30 year DBFMO contract – in the user satisfaction and this finds its origin in the translation of the user requirements in performance requirements in the output-specification document. Therefore, in order to perform this process properly it is stated in the literature that the end-users and/or clients can relate to the project and feel committed to the process. This shall have a positive effect on the provision of information for the requirements which are formulated in this process. However, this theoretical statement is not fully observed in practiced projects. In this specific project, there was a great deal of resistance and limited commitment to the DBFMO project and the management of this lack of commitment and resistance is not always perceived as suitable.
The interviews indicated that there was a significant resistance towards the process. Firstly, the resistance finds its origin in the fact that the hierarchical decision to use the concept of PPP for the realization of the new museum. It is decided in a high level of the Ministry of Defence that the two museums shall work together and shall be placed in to the Defensiemuseum. This means that the museums are forced to work together—which initially meant that the end-users demanded that the museum should have two front doors—and are obliged to accept the fact that the realization shall be performed by means of an PPP project. Due to their lack of knowledge on the concept of PPP and their role in the requirements management process they felt that they were “kept out of the loop” and had only limited control on the project.

Another source from this resistance towards the project was found in the fact that the museums have “a large amount of knowledge on the exploitation of a museum and for this project someone unknown – with limited knowledge – shall act on our behalf.” The end-users felt that the use of the PPP concept would not use their knowledge related to the management of a museum. However, the goal of the performance requirements is to use this knowledge and provide requirements which the private contractor needs to meet during the exploitation phase. It indicates the fact that the end-users resistance is not properly managed by indicating the added value of the concept.

Despite the various sources of resistance—which are symbiotic to this kind of project—it is the tasks of the delegates of the Rijksgebouwendienst—process managers and AV’ers—in cooperation with those of the Ministry of Defence to manage this resistance and make sure that end-users are willing to cooperate in order to provide information on their requirements. An answers to this resistance is the fact that “a good team and process is created in which team” in which “team members are discarded from the team when they showed resistance towards the use of the PPP concept and this was transposed to his structure in the output-specification process.” The nature of the Ministry of Defence (strictness and hierarchical control) was integrated in this team and delegates of the end-users—or Ministry of Defence—who showed resistance were left outside of the process. This resistance resulted in the fact that the second end-user—Luchtvaartmuseum Soesterberg—did not fully participated in the process. They also lacked to provide the required information and their requirements and this resulted in the fact that the process was delayed by a significant period. However, the strict project organisation being effective or not, the archival research indicated that this lack of support and commitment for the project can be perceived during the output-specification process. The timeline presents these findings and indicated that in March 2009, September 2009, and October 2009 the lack of end-users participation in the OS teams was of significant influence on the progress of this process and only in September 2009 the employees of the two museums were integrated in the OS teams as members to decrease the level of resistance and increase the quality of information input.

**Variable 5 - Knowledge on formal procedures of requirements management process**

As the previous section already indicated, the participants in the process—both project owner; end-users and Rijksgebouwendienst—had a limited knowledge available on the concept of the output-specification and
performance requirements. This also relates to the formal procedures that are available within the Rijksgebouwendienst. Respondent D stated on this subject:

“We – Respondent D and Respondent C which are the two responsible Rijksgebouwendienst delegate for the Output-Specification process – needed to do research on the approach that we should use in the Output-Specification process. Obtaining information on the used methodology within the Rijksgebouwendienst was difficult and we needed to use our experience as project leaders of traditional projects in the formulation of our approach. In addition, we did have some conversations with experienced employees of the Rijksgebouwendienst.”

This statement – form the AV'er of the Output-Specification process – indicates that knowledge on a formal methodology of procedure was not available or only as tacit knowledge of experienced AV'ers within the Rijksgebouwendienst. In addition, it is observed that the AV'ers did not had any guidance in this process despite the fact that it was their first DBFMO project in which they participated. However, this forms the reason why the Rijksgebouwendienst aims to have two AV'ers or IPV'ers on every project so that they can use each other during the process.

The literature study revealed that within the Rijksgebouwendienst the Nordic Five-level structure is perceived as a relevant methodology to use in the output-specification process. The result of this methodology should be to derive at a qualitative model of performance specification that could be verified in relation to initial goals and objectives. However, within the project organisation there was only limited knowledge on this concept and therefore a limited integration in the process. The AV'ers understand the concept of the Nordic-Five level structure but did not fully used the top layers – goals, objective and ambitions – because they didn’t fully understand how this method could be of added value in the formulation of performance specifications. This is only perceived so by one of the AV'ers. In retrospect, Respondent V who was team coordinator of the Services and Facilities team stated that this structure was only used for the building concept and not for the specific elements. Concluding it can be stated that the knowledge and application of formal procedures as the Nordic Five-level structure is questionable and that knowledge on applicability of this procedure is limited within the Rijksgebouwendienst. In addition, there is limited guidance provided internally in the Rijksgebouwendienst to these two AV'ers who were responsible for the Output-Specification process.

Variable 6 - Methods used for collection of information

A first observation is not on the availability of statements that respondents made on the methods they used for the collection of information, but on the lack of statements of the respondent related to this concept. The interviewer tried to make clear how information is extracted from the stakeholders, which information was tried to obtain in the process and which methods are used in this context. All of the respondent together could not provide a clear description on the methodology they used in this process to create a clear view on the client requirements. The process manager during this phase of the project – Respondent Z – stated that on the question that related to this subject:
“The process to fully understand the requirements of the client and end-users varies. It comes down to the process that you take the participants by the hand during the formulation of the output-Specification document. This shall be unknown territory for them because they are mostly inexperienced with real estate projects. The result is that they mostly think in solutions and the main characteristic of an Output-Specification is not to integrate any solutions. It is of importance that an AV’er or process manager explains this process in steps in such a way that you create insight in the real requirements of the client and end-users. The solutions should be removed from the process.”

None of the respondents referred to any methods or tools used to collect the proper information of the clients and end-users. It can be imagined that some sort of brainstorm or advisory group is organized to expand the discussion and to increase the chance of discovery of the requirements of the stakeholders. The literature study revealed that a variety of methods are available – workshops; discussion; field trips etc. – can be used in order to create a comprehensive perspective on the user requirements (Robertson, 2011). However, as discussed multiple times with Respondent A and which is discussed in the literature, to increase the knowledge on the user requirements it is important to use an number of techniques to discover these requirements. In this project it is observed that only a limited amount of stakeholders of the project are integrated in the process. In retrospect, the input provided by the stakeholders mainly were solution-orientated and these “were not integrated in the process or written in the output-specification because this may not comprise of any solutions.” This statement indicates the process of how input of the participants of the employees of the end-users was used. The respondent stated that this information was not used but could because it obtained information but he could not indicate how this was used – if it was used – to create insight in the underlying ambitions and goals of these end-users.

Additional findings – Availability of information

On the availability of information, it is observed that – due to the hierarchical structure of the project organisation – formal decision on the scope, objectives, goals of the museum are performed in the Steering Committee. However, when no formal decision is made on the objectives the AV’ers of the output-specification process are perceived to be limited in their possibilities to integrate this knowledge in to the process. The AV’er indicated that they were obliged to discover the requirements of the stakeholders on these subjects, but if they lack the mandate or if the decision is changed the process cannot proceed or the output-specification document needed to be altered. In addition, it must be noted that the project was not delayed because due to this ambition document, there were also some decision making processes in which the municipality participated which took longer than expected. More important was the fact that there was no decisive decision-making on the objectives, goals, collection and museum concept towards the museum at the start – and during – the process. In the timeline this is also indicated multiple times (May 2009 “Project definition + scope is not complete”; June 2009 “6 weeks delay on OS planning due to discussion on project definition and scope”; November 2009 “Project definition is reconsidered”) and this had a significant influence on the progress of the output-specification team and process. In March 2010 it is acknowledged that the OS planning
Appendix G – Findings of within-case analysis

is not met due to lacking information due to this lack of decisiveness after the fact that the process manager indicated in the Steering Committee that “unavailability of last information for the OS will delay entire project.”

It is observed during the interviews and the archival research that the segregation of responsibilities and mandate results in the fact that the requirements management process is stressed. This is acknowledged by the process manager of the Rgd who multiple times stated in the meeting of the Steering Committee that it is of significant important that a decision is made on topics as museum concept; ambition document and collection. These decisions were lacking and influenced the process of the output-specification team. The latter was forced to make assumptions in the model to be able to continue their process.

“When the end-users or clients delivered new information on the collection or spatial requirements – or when decision where changed by the steering committee for example – it resulted in the fact that we were obliged to take a step back in the hierarchy of the output-specification and this is a very difficult process because every layer in the Output-Specification should be related to each other. It is of fundamental importance that all decisions are made at the start of the process.” (Respondent C)

This resulted in the situation that the process manager stated that as a result of delay of the output-specification process a decrease in quality shall be accepted. So, it can be concluded that the hierarchical organisation – with one Steering Committee for multiple project teams – was of significant influence on the progress and quality of the output-specification performed. The duration of the decision-making process in the top of the hierarchical structure of the project organisation influence the progress of the underlying groups. This was enlarged by the fact that no stakeholders with mandate participated in the process in which the requirements of the stakeholders were identified.

Additional findings - Hierarchy of project organisation and decision-making process

De Bruijn & ten Heuvelhof (2008) indicated in their work that “those who only rely, or rely too much, on the formal structure (of hierarchy in an organisation) will not be able to function effectively. However, a wise director also knows that hierarchical intervention can work, if used intelligently.” During the analysis of the output-specification process of the Defensiemuseum the influence of the project organisation could not have been left out of the scope. Initially, the scope was defined to the output-specification process and the related stakeholders but for this project the project organisation was of significant influence of the progress of this process.

The hierarchy of the stakeholders’ organisation – Ministry of Defence and Rijksgebouwendienst – was transposed in the project organisation of DBFMO Defensiemuseum. The members of the Steering Committee NMM where given the formal position to provide decision-making on most of the significant – for the output-specification process - subjects as museum collection, museum presentation concept, ambition document, project definition and scope of project. As a result, the OS team was dependent on the progress of this Steering Committee to provide formal decisions on these subjects since these forms a significant part of the subject on

16 Derived from archival research, Project Team meeting
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which requirements need to be formulated. When effectively performed this hierarchal structure can provide a stable and phases decision making process of which the decisions provide information input for the OS team. However, the result – as already indicated in the previous paragraph – for this project was that the lack of decisiveness of the top of the hierarchy negatively influenced the progress of the OS team and its sub-teams.

In theory, in a hierarchy the decision-making is performed in phases and with a regular and sequential character (de Bruijn & ten Heuvelhof, 2008). A top-down and structure approach of the decision-making on the subjects and detail of the subject can be an effective approach for the providence of information input for the OS team when performed adequately. However, the interviews and archival research indicate that the decision-making process in the project organisation lacked decisiveness which led to a delay of formalizing all relevant decisions. The cause of this lack of decisiveness is not subject of this research study but more important is the fact that the conclusion that the establishment of an hierarchical project organisation can be of significant influence on the progress and quality of the performance of the requirements management in an PPP project. This statement is answered by employees17 of the Rijksgebouwendienst that “it is normal that decisiveness on scope or ambition document is performed in multiple rounds.” However, in this case the process manager of the Rijksgebouwendienst indicated that the lack of decisions and therefore the lack of information input forms an significant factor on the progress of the OS team and therefore the whole projects. This forms an indication that the decision-making process in this hierarchical organisation was not as orderly and phases as the theory assumes.

Multiple arenas for decision-making

The theory on decision-making in network identifies the fact that this process tends to take place in several arenas. Various decision-making processes are dependent on each other and this can result in the fact that decision-making in one arena is used as input for decision-making in another arena (de Bruijn & ten Heuvelhof, 2008). This element is also perceived in the project organisation of PPP Defensiemuseum to be of influence of the performance of the requirements management.

The organization description identified the fact that for this specific project multiple project teams or projects are formalized which all relate to the National Militaire Museum (NMM). One of them is the PPP Defensiemuseum in which the PPP project is formalized but the other project teams – which are initially placed outside of the scope of this analysis – are significantly important. This is due to the fact that the other projects need to provide information which is critical for the requirements management process performed in the PPP project. The different projects related to the NMM are perceived to be individual arena’s in which relevant decision-making is performed for the arena of study, the requirements management in PPP Defensiemuseum. This process is dependent on the providence of information these other teams in which the stakeholders participants in a different setting. Other NMM teams must provide information – on collection, museum concept or museum organisation – which needs to be formalized in the Steering Committee before it can be integrated in the OS. However, the analysis of archival data made clear that – in combination with the non-

17 In informal meetings during the graduation internship
decisiveness of the steering committee on these subjects – an significant part of the delay of the OS traject can be related to the lack of information input by these other NMM teams.

The time line – for example April 2009 and July 2009 – indicates that information on the presentation concept of the museum and the description of the future museum organisation is lacking. This information is not delivered – or finalized by formal decision - by the other NMM teams despite the initial goal of these groups of present this information in an early stage of the project. This bottleneck – which relates to the dependency of the OS team – is acknowledged by the SC in the meeting of January 2010.

However, even as important is the fact that this is only acknowledged by the SC ten months after the initial deadline of the museum concept was expired. The reason for this long period cannot be proven in this research but a possibility is the fact that there was only one SC which needed to steer and control multiple project groups. The project team stated – in October 2009 – that the lacking decision-making of the SC was one significant factor which influenced the progress of the output-specification process. This lack of decision-making relates to the NMM project groups which did not provide the information the PPP group needed in the OS project, but the SC did not had any control on this process where it is perceived to be their responsibility to control these sub-projects. This problem is acknowledged by the SC in their meeting of 19 January 2010 in which they stated:

“Despite the fact that multiple NMM project teams are formalized to produce information and statements, the PPP team is forced to work ahead without information input if we want to realize the museum in 2014. In a normal process this information is used as input for the PPP project but due to multiple reason this is not the case in this project.”
G.2 Case Study 2 – Hoge Raad

G.2.1 Findings on project organization Hoge Raad

Different stakeholders can be identified in the DBFMO project Hoge Raad which each have their own means, interest and power\(^{18}\). The following stakeholders are identified in combination with their overall position in the DBFMO project:

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Stake project</th>
</tr>
</thead>
<tbody>
<tr>
<td>DGRR</td>
<td>Project owner</td>
</tr>
<tr>
<td>PDH</td>
<td>Executive commission party for DGRR</td>
</tr>
<tr>
<td>Hoge Raad</td>
<td>End-user</td>
</tr>
<tr>
<td>Rijksgebouwendienst</td>
<td>Manager tendering process – commissioning party to market</td>
</tr>
<tr>
<td>Rijksbouwmeester</td>
<td>Architectural Institution Rgd</td>
</tr>
</tbody>
</table>

For this project an internal project owner is identified in the DGRR. The DGRR is responsible for the housing of the end-user – the Hoge Raad – and is the project owner (principal) for this project. However, the DGRR does not has the knowledge to perform an real estate project and – as stated by Respondent O - “you have to imagine that the DGRR and end-user – Hoge Raad – are not experienced with the performance of an real estate or DBFMO project. For that reason PDH is formalized as the executive commission party for the DGRR and acts as the project owner (principal) on behalf of the DGRR.” The Rijksbouwmeester is mentioned in this list of stakeholders because this organ of the Rijksgebouwendienst has an significant position in the project. The delegates of the Hoge Raad stated that they want to have an certain level of control on the architectural quality of the project, however they perceive that the use of PPP and DBFMO decreases their controle. Therefore, the Rijksbouwmeester is incorporated in the project organisation to safeguard the architectural preferences of the Hoge Raad. The role of the Rijksbouwmeester will be addressed in the remainder of this work.

Figure 5 presents the organisational structure of the project during the preparation phase in which the output-specification document was designed. The organisational structure integrates four hierarchical layers in three levels (strategic, tactic and operational level). The DGRR and PDH are strongly represented in this organisation due to the fact that they provide chairmen of the Steering Committee (SC) and the Project Team (PT). Next to that the team coordinator of the Output-Specification team is also an delegate of the PDH (Respondent O).

The **Steering Committee** is responsible for the end-result of the “PPS Procurement Hoge Raad der Nederlanden” and therefore is responsible for the decision and formalization of products. The SC takes decision which are from strategic nature and they safeguard the process, progress and scope of the project. This SC is seated by the Director-General RR and by delegates of the Rijksgebouwendienst and Hoge Raad of that

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\(^{18}\) Information is based on internal documentation of the project and on interviews with respondent on the specific projects.
hierarchial order. The Project Team is responsible for the integration and safeguarding of the requirements, objectives, wishes and demands of the client in the process. The chairman of the PT is the project-director of DGRR and is complemented by delegates of the Rijksgebouwendienst, PDH and Hoge Raad. In the PT an delegate of the Hoge Raad is provided the mandate to represent the interests and input of the Hoge Raad – the end-user.

The Procurement Team is formalized during the preparation of the DBFMO procurement and is responsible for the process and progress of the DBFMO product which are desired to be completed for this procurement and this team is responsible for the performance of the activities which relate to the procurement of the project. The Rijksgebouwendienst provides an delegate as to be the chairman of this PT and therefore is perceived to be responsible for the procurement of the project. The Output-Specification team is responsible for the formulation of the performance requirements in the output-specification document. This is to be performed based on the input of the DGRR/HR which is integrated in the Design Specification which are to be formulated in advance. The OS team is coordinated by an delegate of the PDH which acts on behalf of the DGRR. The Rijksgebouwendienst is responsible for the facilitation of the process and design of the output-specification model.

G.2.2 Timeline
Ronald den Hoed

In search of a Systems Engineering application for Real Estate procurement

<table>
<thead>
<tr>
<th>Project Organization Level</th>
<th>Output-Specification Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 2007 - September 2008</td>
<td>Identification of potential and estate project Hoge Raad. Initiation of project cooperation between Hoge Raad and Hoge Raad. Performance of studies analysis.</td>
</tr>
<tr>
<td>May 2009</td>
<td>Proposal of possible application for project Hoge Raad. Presentation of architectural possibly technical representation will be formulated.</td>
</tr>
<tr>
<td>October 2009</td>
<td>Conceptual design document; architectural and technical representation of the project Hoge Raad.</td>
</tr>
<tr>
<td>November 2009</td>
<td>Finalization of architectural and technical representation of the project Hoge Raad.</td>
</tr>
<tr>
<td>December 2009</td>
<td>Project Team “Recommendation of Real Estate Procurement” - Final report with recommendations for architectural and technical representation of the project Hoge Raad.</td>
</tr>
</tbody>
</table>

**Figure 6 - Timeline Hoge Raad**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 2010</td>
<td>Opening of the real estate project Hoge Raad.</td>
</tr>
<tr>
<td>March 2010</td>
<td>Planning of OS review completed.</td>
</tr>
<tr>
<td>April 2010</td>
<td>Review of architectural and technical representation of the project Hoge Raad.</td>
</tr>
<tr>
<td>June 2010</td>
<td>Final reviews of OS completed. Second round shall be performed in the next month to complete OS.</td>
</tr>
</tbody>
</table>

In search of a Systems Engineering application for Real Estate procurement.
Appendix G – Findings of within-case analysis

G.2.3 Findings on Requirements Management

Variable 1 - Experience of team with process

In contrast with the two other analysed project, this project is one of the most recent performed by the Rijksgebouwendienst. Therefore it can be expected that the delegates of the Rijksgebouwendienst have more experienced on the performance of this type of project. However, the AV'er of the Rijksgebouwendienst was not experienced with this function in this project:

"I worked in multiple DBFMO projects within the Rgd but this was the first project in which I was the AV'er." Respondent B

In addition it must be stated that this delegate of the Respondent has obtained another function within the Rijksgebouwendienst after the completion of the output-specification.

Variable 3 - Roles of stakeholders

In this DBFMO project – and related to the requirements managements process - it appears that there is an close interaction between three of the stakeholders. These are the delegates of the Rijksgebouwendienst, Hoge Raad and DGRR/PDH. In this project there was a triangular-relationship between the Rijksgebouwendienst, Hoge Raad and PDH. The Rgd is the contractor for this project but the ordering party to the market. The Hoge Raad represents the end-user and PDH acts in service of the DGRR as a project owner of this real estate project.

The first prominent aspect of the project organisation is the fact that the role of team coordinator of the OS team is performed by a delegate of another organisation than the Rijksgebouwendienst. Respondent O acted as team coordinator of the OS team which is a role which is multiple times perceived in DBFMO projects that is performed by a delegate of the Rijksgebouwendienst. In this project this role is “claimed” by the PDH and accepted by the Rijksgebouwendienst that this stakeholders obtained this position in the organisation.

Respondent B – AV'er of the Rijksgebouwendienst – stated on this subject:

“For this project the project leader of PDH (Respondent O) was team coordinator of the OS team. It is the project of their client which we - the Rgd - put on the market so it is there responsibility.”

Respondent B

Despite the fact that Respondent O was team coordinator of the OS team the Rijksgebouwendienst fulfilled a significant role in the formulation of the requirements and performance specification in the output-specification document, as is indicated by the following statement by respondent on this subject:

"We soon found an modus in which I steered the process from an distance and Respondent B was given the daily responsibility for the "construction" of the output-specification document" Respondent O on the cooperation with Respondent B – AV'er of the Rijksgebouwendienst – in the process of formulating the output-specification document.

"I was mainly responsible for the formulation of the documents with an high abstraction level (Design Specification, goals, objectives) and when it became more detailed the responsibility did
In search of a Systems Engineering application for Real Estate procurement

shift to the delegate of the Rijksgebouwendienst (Respondent B) which formulated the functional and performance specification in the OS model. The technical expertise of the Rgd was used to specify the format we - delegates of PDH - designed for the end-users.” Respondent O

These statements indicate that the team coordinator of the OS team (Respondent O) and the AV’er of the Rijksgebouwendienst (Respondent B) each had their own responsibilities in the process. The team coordinator of the OS team worked on an high abstraction level on the goals, objectives and ambition of the end-user – the Hoge Raad – and the delegate of the Rijksgebouwendienst was held responsible for the translation of this input and the formulation of the functional and performance specifications in the OS model. This was acknowledged by Respondent B who stated that “Respondent O was not active in the substantive formulation of performance specifications but was responsible for the providence of information on an high abstraction level and transferred the responsibility of the design of the OS model to me.” Based on these statements it can be concluded that in this project there is an structured organisation on the responsibilities towards the requirements management process performed. The interaction and organisation of roles in the requirements management process is presented in figure ... by using the concept of the Nordic Five-level structure discusses which is used within the Rijksgebouwendienst and discussed in Chapter Three.

This figure illustrates the abstraction level on which these two delegates of the stakeholders participated. This abstraction level also relates to the level of interaction with the end-user in the process. The team coordinator of PDH was responsible for the formulation of goals, objectives and high level requirements and for this he needed to cooperate with delegates of the end-user, the Hoge Raad. In order to safeguard the input the team coordinator participated in the Project Team and the Procurement Team in which the decision-making was performed related to the scope of the project. Respondent O stated on this subject:

“I mainly worked with the process manager of the Rijksgebouwendienst and Respondent W – who was the delegate who represented the Hoge Raad in the Project Team. We formulated the goals, objectives and ambitions for the project – in cooperation with the Rijksbouwmeester – and used
the ambition document and Design Specifications as a basis for this process. When it became more substantive this was transferred to Respondent B who used this input and integrated this in the output-specification model." Respondent O

The role of the Rijksgebouwendienst and PDH/DGRR is introduced but to in order to complete the triangular it is necessary that knowledge is provided on the role of the end-user in this process. On the role of the end-user in the process the respondents stated the following:

"It is the role of the end-user to provide input related to the services and facilities but it is the role of the delegates of the PDH and Rgd to analyse how this information can be used for integration in the OS." Respondent O

"We can give an good estimate of the preferences of the end-users, however the quality of the process will benefit from the fact that the end-users states his own preferences." Respondent P

"The end-user is represented by multiple - high placed - delegates. One of them had an significant level of support within the organisation. These delegates would interact internally with their adherents and this was also identified as their responsibility which they would require to manage properly." Respondent B

It is perceived by the project organisation that the position of the end-user is that of providing information to the Project Team and OS team which processes this in order to be integrated in the output-specification document. However, a delegate of the Hoge Raad – head of Facility Management – cooperated with Respondent B and provided knowledge on the Services & Facilities which needed to be integrated in the output-specification document. This providence of information is performed in multiple layers of the project organisation, namely the Steering Committee, Project Team and OS team, dependent on the hierarchical layer this was discussed. Mostly this was performed in the Project Team and the Steering Committee formalized these decisions.

Next to this decision-making structure there are two factors identified which had a significant influence on the role of the end-user in this process and the providence of information which was needed for the formulation of the output-specification. This relates to the mandate and support of the representative of the Hoge Raad – Respondent W – and the formulation of the user groups (in Dutch: klankbordgroepen). The latter factor – the user groups – shall be discussed in relation to the element of Consideration of multiple perspectives in the remainder of this chapter. The first factor relates to the fact that Respondent W was appointed as representative for the end-user organisation and was given mandate to provide information on the organisational requirements towards the project. The respondents stated on this subject:

"In order to perform the process properly it is important that the delegates of the end-user have a significant level of mandate and support of the organisation." Respondent P
“In the process there was one delegate of the Hoge Raad which was the representative of the organisation. This delegate held an important position in the hierarchical structure of the end-user, was given mandate and had allot of support within the Hoge Raad.” Respondent E

“It is important that the end-user provides delegates which acts as representatives of the organisations and how provide feedback towards their internal organisation.” Respondent P

“The delegates of the Hoge Raad with which we interacted in the output-specification process had an significant influence on their organisation and an high hierarchical position which resulted in the fact that their input was respected and it didn’t happen to often that their input wasn’t supported by the Steering Committee. This resulted in the fact that their input and decisions would stand which increased the efficiency and quality of the OS process.” Respondent O

The input from the client was mainly provided by Respondent W who held an respectable position in the organisation of the Hoge Raad. A positive effect was that the provided input could be used by the OS team and was supported by the Hoge Raad organisation. The latter statement – of Respondent O – identifies the importance of support of the end-user delegates due to this affects the “quality” of the input. In this project this meant that the input provided by the delegates of the end-users in the Project Team and OS team wasn’t very often rejected by the Steering Committee. Respondent O stated on this subject:

“The decisions and input provided by the delegate(s) of the Hoge Raad would stand in time as a result of the hierarchical structure of the end-user. This makes the process very clear and “simple”. The decision and input of the delegates were always discussed but never contested.” Respondent O

Thus it can be concluded that in this project the end-user provided an delegate who was positioned in such a way that he could actually contribute to the process and could provide information and input that would the OS team could directly use instead passing it by the Steering Committee. These findings also indicate that the end-user in this project was empowered in such a way that it was required that they provided information on their requirements towards the real estate object and this was used by the delegates of the Rijksgebouwendienst and PDH to be translated in goals, objectives and performance requirements. This interaction in the requirements management process is illustrated in figure 8.
It is relevant to present some findings that relate to the role of the AV'er of the Rijksgebouwendienst in the process. The role of the AV'er of the Rijksgebouwendienst is perceived to be a different approach when this is related to other projects of the Rijksgebouwendienst. The preceding findings already indicated that the role of team coordinator of the OS team was performed by a delegate of PDH and the AV'er of the Rijksgebouwendienst (Respondent B) was held responsible for the translation of the input provided by the team coordinator and the delegates of the Hoge Raad in suitable performance requirements in the output-specification model. However, when this activity – formulating performance specification and integration in the digital model – is mostly performed by experts of the Rijksgebouwendienst, in this project this is performed differently. The respondents stated on this subject:

“I choose to be the only one who could work in the OS model and formulate the specifications. Experience showed me that consistency would not be safeguarded when multiple experts would work in the document. In addition, I learned that the technical experts of the Rgd and Rijksbouwmeester still work in an traditional manner and think in solution-oriented specification instead of adopting the PPP concept.” Respondent B

“It is decided that one delegate worked in the OS model to safeguard the quality and consistence of the specifications. This task was performed by Respondent B.” Respondent S

This is perceived to be a new approach because it is observed that in most project the formulation of the specifications is mostly performed by experts of the Directie A&A but Respondent B aimed to decrease the number of people who worked o the document. This approach is – according to multiple respondents of this project – an effective approach and provides control on the quality of the work. Respondent O states on this subject that he has knowledge on DBFMO projects in which the delegates of the end-user are provided the opportunity to work in the OS model:

“There are DBFMO project in which the delegates of the end-user are given the opportunity – or even the responsibility – to work in the digital OS model. However, these end-users have no experience with an OS or the formulation of requirements relating to real estate. I think it is important that you give the end-user an position in the process that they can provide input and this must be translated in the OS.”

However, within the Rijksgebouwendienst there is some discussion on the approach selected by Respondent B:

“My aim was to create an output-specification document which was consistent and of high quality. I wanted to reach this aim by excluding the experts in the process of formulating the performance specifications. They could provide input but they weren’t given the opportunity to work in the actual model. However, this approach doesn’t make you popular within the organisation of the Rijksgebouwendienst. A huge amount of the architects of Directie A&A is not able to be flexible and work within the concept of PPP and DBFMO. The result is that they state
that the traditional approach had always worked and they will formulate solution-oriented specification instead of performance based specification.” Respondent B

This indicates that the used approach in the requirements management process is perceived as “new” but is contested within the Rijksgebouwendienst. In addition to this criticism of Respondent B, Respondent E stated that the Rijksgebouwendienst has not spend significantly effort in the process of “management of the role of the end-user”.

“It is possible that an OS team will integrate solutions and work on an high detail level of abstraction because the clients wants this and generates pressure. It can be concluded that this end-user then steps out of his role and responsibility. This can be explained by the fact that the end-user is not experienced with the process while this is perceived to be the core-business of the managers of the Rijksgebouwendienst. However, there is not much attention on the fact that this requires the right delegate of the Rijksgebouwendienst on an specific end-user of client. The management of the position of the client and end-user and let them participate in the process is an field in which the Rijksgebouwendienst must gain knowledge. The stakeholders in the process should be made clear what their role is in the process and how this affects the project.”

Variable 4 - Consideration of multiple perspectives

Compared with the other projects that are used in the case study, this project only incorporates one end-user which participates in the process. However, it is perceived that – next to the position of the end-user in the process by its role as discussed in the previous chapter – much effort is performed to gain insight in the multiple perspectives of employees of the Hoge Raad. Respondent W stated on this subject:

“I think the objective of the process has to be that nobody is excluded of "lose sight" of it. This will cost allot of energy but in the end it will increase the user satisfaction because these stakeholders will be the users of the building.” Respondent W

This gives an first impression of how the participants of the project organisation perceived the importance of the input of the members of the organisation. This input is obtained by multiple sources. Archival research indicated that for the formulation of the Design Specification multiple interviews are conducted with a high amount of employees of the Hoge Raad to gain insight in the process and functionalities that they desired in relation to the new real estate. This input is used in the formulation of the Design Specification but the project organisation perceived that the input of the organisation was needed during the whole process. This was performed to increase the knowledge on the preferences of the members of the Hoge Raad organisation. As a result, Respondent W indicated that it would be of added value to create multiple user-groups in which multiple members of the Hoge Raad – from multiple hierarchical levels – could discuss themes and topics that would be relevant for the requirements management.

"Respondent W came up with the idea to form user groups within the organisation with the goal to create support towards the project and to create insight in the preferences of the members of
the Hoge Raad. This was a good action as it increased the quality of the input and thereby the formulated requirements towards the project.” Respondent S

“It was my idea to use user groups in this project. I have no experience with construction projects but I know it is of importance that the organisation will support the project otherwise you will end up with a process that is doomed to fail to produce an qualitative product.” Respondent W

Respondent W created the idea for the user groups and this was granted by the Project Team and the Steering Committee. They perceived these groups to be of added value because they increased the knowledge-base of the organisation which provided input for the process, and it would also decrease the level of resistance towards the project. On the added value of the user groups in relation to the knowledge-base of the organisation is stated by Respondent O:

The user groups are used to increase the knowledge on the requirements of the different groups within the organisation of the Hoge Raad. This process is facilitated by us - process management of the project - but in the end it is up to the end-users to state their preferences on which requirements their new real estate should suffice. This is one reason why the interaction with these user groups is very important, it is a mean to integrate the end-user organisation in the process and to increase the knowledge on the internal perspectives.” Respondent O

Archival research indicated that multiple user groups are formed which integrated the internal departments of the Hoge Raad and in which different topics were discussed. The output of these user groups was used as input for the OS team and it was perceived to work in a very organized and structural manner. In addition, the user group also had influence on the scope of the project and the Steering Committee used the input of the user groups to formalize decisions on scope related discussions.

Variable 2 - Commitment & resistance to process and project

The decision after the PPC analysis to use PPP for the realization of the new housing of the Hoge Raad lead to some resistance within the organisation of the Hoge Raad. Respondent O referred to this phase as difficult and he stated that it was a hard process to come to an agreement to perform a DBFMO procurement for this project.

“It is important to realize that it was difficult for the end-user to accept the method of DBFMO as the right one for this project. The end-user had doubts on the use of PPP because they thought there would be little control on the end-result of the project. The end-user perceives architectural quality as very important in the project.” Respondent O

“The resistance towards the project was caused by the fact that the end-users had doubt in the use of PPP, not in the knowledge and skill of the PDH and Rgd.” Respondent O

As a result of the resistance towards the use of PPP for the project an very narrow scope was defined in the early stages of the project. The reason behind this narrow scope relates to the fact that the Hoge Raad was
“afraid” to procure services and real estate to a private party which would be responsible for the providence of these for over an contract period of 30 years. The narrow scope would create control for the Hoge Raad.

“Initially their was an Design Specification which formed the basis for the PPC analysis. In this analysis the initial scope was determined. The Hoge Raad had trouble with the decision after the PPC to use the concept of DBFMO and PPP and the trust in this decision - and thereby the project - needed to grow. The low level of trust was mainly caused by the fact that the Hoge Raad perceived that they had little control on the architectural quality of the project.” Respondent W

As a result, the project organisation was obliged to deal with this resistance and did this by means of multiple actions. The first action that should decrease the resistance is the integration of the Rijksbouwmeester in the project organisation. Multiple excursions were organized in which the Rijksbouwmeester explained the concept of PPP and DBFMO to the end-user. By explaining the concept and the fact that this doesn’t mean that the public party loses control on the project and the architectural design an first step was made in decreasing the resistance of the Hoge Raad.

Secondly, next to a standard ambition document an ambition document was designed in which the architectural preferences of the Hoge Raad were integrated by means of images, concepts and explanations. Using this concept and the created ‘corporate identity’ would provide the private consortia insight in the preferences of the Hoge Raad in relation to the architectural quality.

An third approach to decrease the distrust in the PPP project was by the organization of an architectural commission:

"Another way to decrease this resistance was by the installation of an architectural commission which safeguarded the architectural quality of the project. In this commission the Hoge Raad was well represented." Respondent P

This architectural commission – in which the Hoge Raad was heavily represented – was formalized to safeguard this aspect of the project and was given the responsibility to assess the designs of the private consortia on the architectural quality. It had also assessed the OS on its quality.

The fourth and final measure which was used to decrease the level of distrust in the project was the establishment of multiple user groups as discussed in the previous section on Consideration of multiple perspectives. By using this user groups and creating the possibility of members of the Hoge Raad to influence the project it will result in a decrease of the resistance and distrust in the concept of PPP.

Based on these statements it can be perceived that commitment to the project was perceived to be an vital element towards the successful performance of the project and the project organisation had made significant effort to increase the support towards the project and process. The respondents from the Hoge Raad indicated that these measures increased the internal commitment towards the project which increased the input of information in – for example – the user groups.
Variable 6 - Knowledge on formal procedures of process

The literature study revealed that within the Rijksgebouwendienst the Nordic Five-level structure is perceived as a relevant methodology to use in the output-specification process. The result of this methodology should be to derive at a qualitative model of performance specification that could be verified in relation to initial goals and objectives. During the interviews it is perceived that the responsible delegates had obtained some knowledge on this methodology. During the interview with Respondent O – who was team coordinator of the OS team and thereby responsible for its process and progress – the respondent stated:

“There is the process that you work from an high level to an low level, from goals; ambitions and objectives to the functional and performance specifications. By using the pyramid you will formulate more in detail during the process.” Respondent O

This indicates that this respondent - which is not active in the organisation of Rijksgebouwendienst – has gained some knowledge on the use of the Nordic Five-layer structure. This methodology is also observed to be used by Respondent B – who was responsible for the formulation of the functional- and performance specifications in the OS model:

“I chose to work from an high to low layer in the pyramid. It is important that you complete every layer in good order – ambitions, objectives, functional requirements and performance requirements – before you work on the next layer. If you start to early with an “ruimteboom” before you know which processes are to be performed than you will miss important information.” Respondent B

“Based on the objectives and functional processes I identified which spaces and rooms were required, and the functions that these spaces and rooms need to fulfil. The experts of the Rijksgebouwendienst would give input on the technical performance specifications but I perceived that they would think in an solution-oriented mindset and I needed to correct them during the process.” Respondent B

Despite the fact that these observations give the impression that the methodology of the Nordic Five layer structure is applied properly, there are some shortcomings perceived. Important is the fact that in the goals, objections but also in the awarding criteria (in Dutch: gunningscriteria) that these represent the preferences of the end-user and project owner. This means that some kind of prioritization is integrated which makes it apparent for the private consortia which is perceived to be important in the project. The end-user indicated that the architectural quality is perceived as important, but an analysis of the OS and award criteria learns that the prioritization within these documents is still lacking. The use of prioritization by the use of for example Critical Success Factor (CSF) or Key Performance Indicators (KPI) is indicated by Respondent N. Respondent N is perceived to be the authority within the Rijksgebouwendienst on the concept of Nordic Five-level structure and she was one of the persons who developed the use of the output-specification and related procurement document. On the use of CSF’s and/or KPI’s she stated:
"The problem with the performance of the OS process by AV'ers of the Rijksgebouwendienst is that they don't “see” the relation between the goals & objectives with the functional and performance specifications in the OS model. In relation to the goals & objectives it is important that CSF's are identified for the project which represent the preferences of the end-user and which determines whether or not the project shall be an success. However, the substance of the Nordic Five-level method is used in different ways and in the most project – for example the Hoge Raad project – I see that the goals and objectives don't present the preferences of the end-user. Instead the goals and objectives give the impression that “everything is important” and it provided no clear prioritization of preferences for the private consortia.” Respondent N

This statement is acknowledged by an internal review of the procurement documents – OS, BOM and awarding criteria – which indicate that no prioritization is indicated and the elements are still too vague in order to steer the design and indicate the preferences of the Hoge Raad. Based on these findings it can be concluded that the delegates of the OS team did had some knowledge on the formal procedure and methodology on the use of the OS and performance specification but the application of the concept was only limited. An statement of the team coordinator – Respondent O – can be related to this conclusion:

"This was the first DBFMO project we (Respondent O and Respondent P) performed. However, the approach in a DBFMO project doesn't differ from the formulation of an Design Specification in an traditional project. In the end it is the goal to identify the client requirements properly and the OS and DBFMO forces you to do this in a way that you have a full understanding of these client requirements." Respondent O

It is observed that the respondent perceive the requirements management process in the concept of an DBFMO project as to be compared to an traditional project. This is the case in some extend, but - as is indicated by multiple respondents and employees of the Rijksgebouwendienst which I spoke during the period at the Rijksgebouwendienst – the use of performance specifications and an DBFMO agreements requires an different approach in the client requirements management in relation to traditional procurement projects. This is a result of the transfer of responsibilities, activities and tasks to the private sector in addition to the long duration of the agreements.

**Variable 5 - Methods used for collection of information**

The previous chapters already indicate that multiple techniques and methods are used to identify to preferences and requirements of the stakeholders – primarily the delegates of the end-user and the DGRR. The delegate of the Hoge Raad – Respondent W – who represented the Hoge Raad in the process indicated in the interview that he provided input which is used as a basis of the output-specification process:

"The actual OS is formulated without any input of the end-users organisation and user groups. These user groups were used to provide input and information which would provide the basis and the delegate of the Rijksgebouwendienst used this to formulate the actual OS." Respondent W
Appendix G – Findings of within-case analysis

“It is dependent on the delegate of the end-user how he/she perceives the concept of specification related to performance instead of solutions. Input is required from these delegates but often this is provided in the form of solution-oriented specifications and that is not desirable. This input is then translated in to suitable functional and performance specifications for in the OS.”

Respondent O

This means that the discussion and collection of information is related to a high abstraction level and not related to the formulation of performance specification. Robertson (2001) states that in order to increase the quality of the requirements of a client multiple methods should be used to refine these statement and to identify requirements which otherwise would not be stated by the client. In this DBFMO project it is perceived that multiple techniques are used to create insight in the preferences and requirements of the Hoge Raad. The respondents stated on the use of “requirements trawling techniques”:

“Multiple user groups (in Dutch: klankbordgroepen) are formed to discuss the different themes in the OS and to increase the input from the end-users organisation.” Respondent P

“To increase the perception of the user groups on the themes multiple excursions are organised to identify the preferences of the delegates and to show what consequences there decisions will have on the provided real estate.” Respondent O

These methods are used to identify the requirements of the end-user in relation to the architecture but also to the other relevant elements as functionality, sustainability and services. In the process of identification of the requirements related to the architectural quality the experts of the Rijksgebouwendienst and Rijksbouwmeester had a significant role. An advantage in this project was the fact that the delegates of the Hoge Raad highly respected the Rijksbouwmeester and were committed to the process in which they were asked to state their preferences on architecture. By the use of reference images and excursion the preferences on architecture are identified.

In the work of Robertson (2011) multiple kinds of requirements are identified: conscious, unconscious & undreamed. Conscious requirements relate to requirements of which the stakeholders are aware of. A stakeholder is conscious of the requirement because of his view of the world and therefore it is something he is likely to mention in the requirements management process. Unconscious requirements relate to requirements of which the stakeholders don’t realize they have them. Reason for this is because they can be satisfied during an long period by the – for example – real estate that they don’t perceive it as a requirement they have towards the real estate. Undreamed requirements are related to the requirements which they think cannot be delivered by the project and therefore they don’t perceive them as relevant for the project. This is an interest group of requirements. As is stated by Robertson (2001): “If a stakeholders has a fixed idea of what he believes is possible then he is unlikely to mention requirements that he thinks cannot be carried out within his understanding of the constraints.” In relation to the DBFMO projects of the Rijksgebouwendienst this can mean that the end-users and other relevant stakeholders are unlikely to state their undreamed requirements if
the experts don’t use techniques to encourage these requirements. The experts of the Rijksgebouwendienst are likely to be the “inventors” of these requirements because the end-user don’t have sufficient knowledge to constrain their requirements properly.

In relation to these types of requirements respondents stated:

“When we asked the delegates of the end-user which functionalities the required they reflected their requirements to their current situation. They had difficulty to relate to their new environment. By using experts of the Rijksgebouwendienst we try to remove the constraints provided by their current situation and tried to increase the perception of the end-users on the new situation and decrease their assumed constraints. This provides an different perceptive on the requirements of the end-user.” Respondent O

“It is important to identify the underlying requirements (in Dutch: Vraag achter de vraag). This is performed on multiple levels, in the Project Team and with direct cooperation with the delegates of the end-user to identify their requirements and objectives. Experts of the Rijksgebouwendienst – and Rijksbouwmeester – are used to advice the delegates of the Hoge Raad and helping them to identify their requirements which otherwise were not identified.” Respondent B

“This type of process forces you to think how the processes work in the organisation. In addition, you are obliged as end-user to think on how these should be designed in the future.” Respondent W

These statements indicate that the delegates in the project organisation identify these three types of requirements as significant and effort is undertaken to identify these requirements. However, it is questioned how the experts of the Rijksgebouwendienst did perform these efforts due to the fact it is stated multiple times that these operate in an traditional manner but no data is collected on the efforts of these experts.
G.3 Case study 3 – DUO/Belastingdienst

G.3.1 Project organization DUO/Belastingdienst

Different stakeholders can be identified in the DBFMO project Defensiemuseum which each have their own means, interest and power. The following stakeholders are identified in combination with their overall position in the DBFMO project:

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Role in project</th>
</tr>
</thead>
<tbody>
<tr>
<td>DUO</td>
<td>Public sector client</td>
</tr>
<tr>
<td>Belastingdienst</td>
<td>Public sector client</td>
</tr>
<tr>
<td>Rijksgebouwendienst</td>
<td>Procurement manager</td>
</tr>
</tbody>
</table>

The DUO (formally known as the IB-Groep or and Belastingdienst are not the owners of the real estate object. The Rijksgebouwendienst is owner of the ground and real estate and this means that the ownership will return to the Rijksgebouwendienst when the DBFMO agreement is completed. This results in a different position of the Rijksgebouwendienst, compared to for example the Defensiemuseum, because their interest may – or may not – be of significant influence in the requirements management process and their position towards the two public sector client, the DUO and the Belastingdienst.

The figure below gives a first indication of the organisational structure of the project.

![Project organisation DUO/Belastingdienst](image)

The organogram of the project organisation indicates 4 hierarchical layers in the project organisation. All of the teams are seated by delegates of the three stakeholders, namely the Rijksgebouwendienst, DUO & Belastingdienst. However, the above three layers (Steering Committee, Project Team and Procurement Team)
are seated by an delegate of the Rijksgebouwendienst. The Steering Committee is and the Project Team are both seated by the Director of the PPP department of the Rijksgebouwendienst. The decision-making structure runs from the Procurement Team (which prepares subjects) to the Project Team. The Steering Committee has the role to formalize intermediate goods, decisions and discuss subjects which fall outside the scope of the project plan. This means that the mean decision-making power is located in the Project Team and when they reach an consensus this will be formalized in the Steering Committee. The Steering Committee will also be integrated in the decision-making process when a subject is escalated – meaning that no consensus can be found in the Project Team.

The Procurement Team is seated by delegates of the Duo, Belastingdienst and the Rijksgebouwendienst and the chairman is found in the project director of the Rijksgebouwendienst. In this project team, the process manager of the Rijksgebouwendienst is responsible for the preparation and execution of the procurement process and the integration of all different components produced by the different teams. This process manager is also internally responsible - within the Rijksgebouwendienst – for the performance of the project. Next to these delegates, the project team is seated by the team coordinators of the expert teams: Financial team, Communication team, Output-Specification team, and Juridical team. Each of these expert teams is chaired by a delegate of the Rijksgebouwendienst.

The Output-Specification team consists on paper of on team but practice shows that an diffusion is made related to elements of the building and of the service and facilities of the real estate. The team coordinator of the Output-Specification team is responsible for the formulation of the output-specification and this delegate have changed many times during the process.
Appendix G – Findings of within-case analysis

G.3.2 Timeline of output specification process

Figure 10 - Timeline DUO/Belastingdienst

- April 2006: Project Team indicates concerns on amount of personnel changes in teams; - Integration of DUO and BD discussed but no final decision/knowledge is provided.
- May 2006: In Procurement Team it is discussed that there will be only 1 OS for both organisations.
- December 2005: Procurement Team indicated importance of facilitator knowledge in Technical Team.
- July 2006: Procurement Team indicated importance of facilitator knowledge in Technical Team.
- September 2006: Procurement Team indicated importance of facilitator knowledge in Technical Team.
- October 2006: Procurement Team indicated importance of facilitator knowledge in Technical Team.
- November 2005: Start Technical Team who shall be responsible for the formulation of the output specification document.
- December 2005: Separate functional concepts of DUO and BD shall be integrated in one document.
- January 2006: Initial project planning aims to complete output specification in July 2006. Coordinator Technical Team expects this can not be achieved.
- February 2006: Formulation of models, requirements and objectives related to the new real estate.
- March 2006: Realization of models, requirements and objectives related to the new real estate.
- April 2010: Change in design of process of BD and has effect on the OS; BD wants no “silent management” in the building.

- August 2005: Project Coordinator DUO and Director BD discuss importance of project organisation and processes.
- November 2005: BD and DUO are facilitating Design Specification. DUO is almost complete but BD states that it only be ready in February 2006. Other documents will be provided for the start of the OS process.
- January 2006: Discussion on how to deal with the wish of end-users and PPP concept in general.
- February 2006: Start amendment document by process manager of Rg1 based on standard model of Bank Group.
- Project manager Project two RPP project in cooperation with Belastingdienst and evaluation of office real estate DUO/BD.
- Teams indicate that there is much distance between them (technical, juridical etc) and with the higher teams in organisation.

- October 2005: BD and DUO are facilitating Design Specification. DUO is almost complete but BD states that it only be ready in February 2006. Other documents will be provided for the start of the OS process.
- November 2005: BD and DUO are facilitating Design Specification. DUO is almost complete but BD states that it only be ready in February 2006. Other documents will be provided for the start of the OS process.
- December 2005: Procurement Team is to be made by Project Team.
- December 2005: Procurement Team is to be made by Project Team.
- January 2006: Procurement Team is to be made by Project Team.
- February 2006: Procurement Team is to be made by Project Team.
- March 2006: Procurement Team is to be made by Project Team.
G.1.2 Findings on Requirements Management

**Variable 1 - Experience of team with process**

DBFMO DUO/Belastingdienst is perceived to be one of the pilot DBFMO project performed/managed by the Rijksgebouwendienst. The renovation of the Ministry of Finance (KV7) was the first DBFMO project and this project still was labelled as pilot project by the management. So, it can be expected that the delegates of the three participating stakeholders have limited knowledge on the performance of an output-specification process in the context of a DBFMO project. However, the team coordinator of the OS team was familiar with this process and the concept of PPP and performance requirements due to the fact that she had an important role in the project of KV7 where all of the concepts – BOM, OS, DBFMO agreement – needed to be designed from scratch. This was an extern expert from KPMG and hired by the Rijksgebouwendienst to participate in these project while they acknowledged that they were lacking the knowledge on these subjects.

The positioning of the stakeholders – and the empowerment in the process – is perceived to be an important element in the process of formulating the requirements. Initially, the public sector clients indicated that they would not have to participate in the requirements management process performed in the OS team.

“The Belastingdienst indicated that they are not willing to provide someone to participate in the OS team because this is to be performed by the delegates of the Rijksgebouwendienst.”

However, the process manager indicated that input from the public sector clients is required and this resulted in the fact that the public sector clients provided delegates to participate in the team.

In order to increase the knowledge-base delegates of the DUO and Belastingdienst were selected who had experience with real estate projects and facility management. “These end-users were unfamiliar with the process and concept of OS and performance requirements. For this reason we selected delegates from the facility services of these organisations. These are members who have partial experience with real estate projects and related Services and Facilities” (Respondent AA) In addition, one of the delegates of the Rijksgebouwendienst stated that the activities that are to be performed in an OS team in the context of an DBFMO project can be compared of those in an traditional construction project.

“In my function I am active in the field of spaces and functionalities. In traditional construction projects I am mainly active in formulating spacial and functional Design Specifications and this closely relates to these activities in formulating the requirements in the OS process.” Respondent J

**Variable 3 - Roles of stakeholders**

As the knowledge on PPP projects is limited this knowledge is mainly derived from traditional construction projects in which the client briefing is performed with private design parties. In the case of DBFMO project the Rijksgebouwendienst acts as an liaison between the public sector clients – in this case the Belastingdienst and DUO – and translates the client requirements in to system requirements or performance specifications in the
OS. However, during the analysis of the archival data and – mainly – the interviews it is observed that the Rijksgebouwendienst – as manager of the procurement of the project – obtained an “central” position in the process of formulating the requirements with respect to these public sector clients.

“We developed a team around the delegates of the Rijksgebouwendienst and the two end-users. However, in the project it was made clear that the Rijksgebouwendienst took the lead in the procurement of the project.” (Respondent AA)

“The relation between the two end-users and the Rgd should, in theory, be such that the Rgd acts in our service. However, because the real estate shall be in owned by the Rgd when the DBFMO agreements ends they took an greater role in the process then was initially agreed upon”. (Respondent T)

This is stated by Respondent AA - who was the coordinator of the OS team but was hired for this project from an extern consultancy company – and Respondent T. The role of the public sector clients was mainly related to the requirements management on the Services and Facilities of the real estate. This indicates a differentiation in the responsibilities for the requirements related to the Building and the Services and Facilities. It is questioned whether or not this providence of responsibility towards the specification of performance requirements towards the public sector clients safeguards the quality of the formulated requirements and performance specifications. Respondent AA indicated the following:

“These end-users were unfamiliar with the process and concept of OS and performance requirements. For this reason we selected delegates from the facility services of these organisations. These are members who have partial experience with real estate projects and related Services and Facilities. Respondent AA

This indicates that the safeguarding of the quality of the requirements management process is managed by providing the responsibility towards delegates of the public sector clients who have a significant amount of experience with Facility Management and services in their organisations. Proper management and “education” on the concept of PPP and performance specification could safeguard this process. However, archival research found a statement towards this responsibility which indicates that these delegates of the public sector clients were not able to perform this responsibility and safeguard the concept of PPP and performance specifications:

“Within the OS team there is the perception that the delegates of the Belastingdienst are not able to formulate performance specifications related to Services and Facilities but they mainly think in solution-oriented specifications.”

However, despite the fact that this responsibility was provided towards the public sector clients, they only formulated the functional concepts and not formulate the performance requirements in the output-specification document. The role of the Rijksgebouwendienst was two-faced as is perceived in this – but also in the other projects – project. This means that delegates of the Rijksgebouwendienst – in this case the team
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coordinator and Respondent J – (1) “actively” discuss with the delegates of the two public sector clients on their whished and requirements towards the real estate – in addition to the scope and information input from other “arenas” of the project organisation – and (2) translate this input in requirements in the output-specification document – functional and performance specifications. In this project it is observed that there is a differentiation in the OS team. The formulation of the performance specifications is performed by the team coordinators (OS and Building) and by expert teams:

- **We - delegates of the two end-users - were not given the responsibility to write in the actual OS model. This responsibility was mainly given to the AV’ers and Respondent J. We reviewed their work and this cost allot of time. Respondent T**

- **For every specific element a different - mostly experts of the Rgd - person was responsible for the formulation of the performance specifications. So, a total of 5 a 6 people had the possibility to write in the OS model. Respondent J**

- **In the OS team delegates from the end-users, Rijksgebouwendienst and Rijksbouwmeester participated and this team was supported by multiple expert teams of the Rijksgebouwendienst. Respondent AA**

The latter statement of Respondent AA indicates the fact that the Rijksbouwmeester also had a significant role in the process related to the formulation of requirements in the output-specification document. Combining these statements it can be concluded that the public sector client was given the responsibility to “design” the Facilities and Services requirements and performance specifications but the delegates of the Rijksgebouwendienst would formulate these in the output-specification document. In relation to the specification of the Building elements they were expected to provide information as input and this would be translated by the delegates of the Rijksgebouwendienst in functional concepts and performance requirements.

It is stated by Respondent AA that the Rijksbouwmeester also had a role in the Steering Committee and the OS team of the project. This can be partially confirmed by archival research on the project organisation but the role of the Rijksbouwmeester in a DBFMO process can – and is – disputed. An study performed by an graduate student of the TU Delft indicated in their work on the role of the Rijksbouwmeester in DBFMO projects – and especially the procurement and the definition phase – is very limited in comparison with traditional procurement projects (Geerligs, 2006). This research indicated that internally there is a difference in perception between the department Rijksbouwmeester and the PPP department and that the Rijksbouwmeester mainly operates based on traditional knowledge. The use of an output-specification would mean that close cooperation with private designers is not completely necessary and juridical supported and therefore it is questioned how the role of the Rijksbouwmeester have influenced the process. In the archival data a statement of the process manager is found which can be related to this subject:
Process manager: “Research shall be performed how more control on the design can be obtained. More control on the design process and the architectural quality is required and in an “normal” DBFMO there can only be little control on the design and design process.”

This gives rise to the impression that the delegates of the Rijksgebouwendienst performed the process in an traditional manner in which they mainly focussed on architectural quality and only limited integrated the concept of performance specifications and the business process of the public sector clients (their key interest) in the process. This finding can be supported by the fact that the OS team indicated in their OS team plan (in Dutch: plan van aanpak) that requirements and concepts towards the building specifications are mainly formulated by using the Design Specifications (in dutch: Plan van Eisen) of DUO and handbook performance levels Belastingdienst offices (in Dutch: handboek prestatieniveau Belastingkantoren). The Design Specifications were formulated – as will also be addressed in the topic Preliminary document and project statement – preceding the decision to combine the two public sector actors in one DBFMO procured real estate thus based on a traditional approach which integrated an significant amount of control on the design process instead of from the perspective of performance requirements. The risk is that – due to a different scope and context of these documents – not the right information is integrated; and the public sector clients will not feel integrated in this process. In addition, some of the respondents of the DUO and Belastingdienst indicate that they have questioned the approach of the delegates of the Rijksgebouwendienst on the concept of PPP and the use of performance indicators. One respondent stated on this subject:

“The delegates of the Rgd found it difficult not to work in solution-oriented specifications because they are used to work in traditional procurement projects and this knowledge was integrated in the OS process.” Respondent T

These statements give an indication of the position of the delegates of the Rijksgebouwendienst in the process and their possible “traditional” mindset towards the DBFMO project. This can be related to the fact that at time of the project the Rijksgebouwendienst did not fully supported the policy to use PPP in real estate projects instead of traditional procurement. An internal brainstorm of the Rijksgebouwendienst indicated some management approaches to decrease the length of the process:

- Wait for new governmental administration supposing that this will withdraw the decision to use PPP within real estate construction, and start with traditional procurement of the DUO/Belastingdienst project
- Withdraw decision based on PPC to use the concept of DBFMO and start the project as an traditional procurement project.

This can be expected, due to the fact that the public sector clients in this case had no experience with the performance of a DBFMO project and this can, if performed effective, result in an optimal briefing – and translation of requirements – if this role is performed properly. However, some question the performance of
this process and the consequences of the “game” between the public sector clients and the Rijksgebouwendienst.

During an internal evaluation of this project - which is performed on the realisation phase and an evaluation of the phase in which the output-specification document is formulated is lacking – it is concluded that the position of the actors in this project lead to an overall increase of the amount of adjustments made in the output-specification after it was “completed”. This amount of adjustments of the output-specification – which mainly relate to adjustment originated from the side of the public sector clients because they have different requirements than was originally integrated in the document by the delegates of the Rijksgebouwendienst – can’t be directly related to this aspect but it can be assumed that there is an causal link. This assumption is based on the interviews with the respondents of the two end-users, who frequently indicated their lack of satisfaction by the process, and on internal reviews and conversation with experts of the Rijksgebouwendienst.

**Variable 4 - Consideration of multiple perspectives & Variable 5 - Method used for collection of information**

For this project the challenge mainly can be related to the fact that there will be two main end-users in the DBFMO project. The character of this project demands requirement management process which focuses on the integration of multiple perspectives because there are multiple public sector clients. In theory, integration of multiple perspectives from one stakeholder is desired in order to provide an good overview of the requirements of the entire organisation. In this project, multiple delegates are integrated in the project organisation on different levels.

“In different levels of the project organisation there were different delegates and members from the end-users. A central position was given to the B/CFD which formulates the housing policy of the Belastingdienst and these had multiple delegates in the OS team but also in other levels of the project organisation.”

This is stated by Respondent AA and it is indicated that the B/CFD is given a central position in the process. This is the department of the Belastingdienst which formulates the housing – and facility – policy towards real estate project as this project. The process manager of the Rijksgebouwendienst indicated that the fact that this department represents the Belastingdienst and there is limited participation from the organisation which shall be using the real estate can influence the quality of the information input. However, the director of the Belastingdienst does not support this statement and therefore this is kept unchanged in the process. In addition, due to the fact that this service – B/CFD – has experience with real estate projects of the Belastingdienst this was provided an “central” position in the providence of information in the output-specification process related to objectives, goals, concepts and requirements on the building and services & facilities elements.

“The Belastingdienst – and primarily the B/CFD – had more experience with construction and facilitation of services of real estate than compared to the DUO. The requirements on real estate
**Appendix G – Findings of within-case analysis**

"**concepts of the Belastingdienst were used as a basis to reflect the input of the DUO.**” Respondent AA

In this project one of the stakeholders – Belastingdienst – had more experience with the performance of real estate projects and this was used in the approach to formulate “one” perspective towards the real estate project and the facilities and services that are to be provided by this project. The consideration of multiple perspectives is performed from one of the stakeholders and then reflected to the input of the DUO next to the use of the Design Specifications as is indicated in the section on the role of the stakeholders in the process. In relation to the integration of the perspectives of the stakeholders Respondent T stated:

“**It was difficult to operate in one team with the DUO. We had confidence in the quality of the Rijksgebouwendienst and therefore the process. However, the DUO didn't had this trust and wanted more control on the process.**” Respondent T

A relationship can’t be identified and proven but it can be expected that this desire of the DUO to control the process can be a result of the fact that the Belastingdienst had an more centralized position in the position compared to the DUO.

With respect to the use of requirements “trawling techniques” as discussed by Robertson (2001) the team coordinator of the OS team indicated:

“**For the KV7 project we develop all kinds of tools and techniques to increase the discussion and conversation with members from the end-users organisation to increase the quality of the information input. We used these techniques in this project to increase the participation and commitment of the end-user organisations.**” Respondent AA

Examples of this are days of teambuilding, informal conversations and excursions to exemplary projects. However, this is only a limited use of the techniques available and only takes limited consideration of the multiple internal perspectives of the two end-users organisation. To increase this integration of these perspectives, the OS team proposed to form a user groep (in Dutch: klankboordgroep) to increase the discussion on elements and requirements which directly relate to the to organisations and to increase the support and commitment to this process. However, no records are found of the approval of this group or on output used in the OS team.

The previous section already shortly indicate the fact that the DUO/Belastingdienst is perceived to be one of the DBFMO projects in which the most adjustments are made after completion of the output-specification document. One example is found during the archival research and this relates to the fact that DUO changed on aspect of their primary process which resulted in a significant adjustment of the requirements related to the ground level of the real estate. This is perceived to be the first adjustment that was made by one of the public sector clients after the output-specification document was completed. It is questioned by some of the respondents – and also perceived during observations of internal evaluation of the project – that this could
have been prevented when the interest and the business process was more subject of discussion in the project. However, it is perceived that the perspectives of the end-users are considered in relation to the rooms and spaces they would need in the real estate. Based on the assessment on their previous situation – situation before they would use the new real estate – and their requirements on the new office environment an estimate of the rooms, dimensions and specialty spaces is formulated.

What happens is that the end-users have demands, the experts of the Rgd have demands and this results in that everybody wants to have influence on the project and the OS. Important is to continually ask why someone wants something. I have the opinion that the OS should not integrate any solution-oriented specifications unless the end-users can give reasonable arguments why it is desirable for their process. So, the process is inverted and the end-users should give proof and not the Rijksgebouwendienst. This approach is new - also for the delegates of the Rijksgebouwendienst - but this resulted in the right discussions in the OS team. Respondent AA

Variable 2 - Commitment & resistance towards the project

“A good process can be performed, but as a result the client deceases.” This is a statement heard during an meeting of the Management Team of the Directie Projecten. This relates to the relationship between the delegates of the Rijksgebouwendienst and the public sector clients of a DBFMO project. The “quality” of an process – for this project the output-specification process or requirements management process – is related to the user satisfaction towards the process and – even more important – towards the end-result of the project – the realized real estate object. The quality of the project is found – however only during the exploitation of the 25/30 year DBFMO contract – in the user satisfaction and this finds it origin in the translation of the user requirements in performance requirements in the output-specification document. However, Respondent AA stated:

“It is not an easy task to create commitment and support from the end-users to the project. This can also relate to the length of the initial phase and due to the fact that the end-users think individually and not as an collective.”

This was supported by the fact that there were complaints from the end-users – in addition to complaints on the substance of the process – on the process management performed by the delegates of the Rijksgebouwendienst and primarily the process manager which was appointed for this project:

“In addition to the substantive complaints of the end-users there are also complaints directed to the performed process management. They indicated that they demanded more attention on this subject. This resulted in the fact that the process manager of the Procurement team was replaced by an new process manager.” Statement derived from Procurement Team meeting during archival research
This indicates that for this project the staffing of the Rijksgebouwendienst influenced the progress and process with the two public sector clients. As a result they demanded a different process manager and this demand was granted.

The difficulty of creating support and commitment towards the project was increased by the fact that they two end-users found it difficult to work together:

“It was difficult to operate in one team with the DUO. We had allot of confidence in the quality of the Rijksgebouwendienst and therefore the process. However, the DUO didn't had this trust and wanted more control on the process.” Respondent T
Appendix H – Discussion relevance SE for variables

H.1 Experience of team with process

It is not to be claimed that the use of SE can influence the experience of the team with the performance of the process. Therefore no elements are identified for this variable which are influenced when integrating SE in the project management. However, one acknowledgement that can be made is on the fact that the use of Systems Engineering does not require the practitioners to learn a whole new project management paradigm and related skills and activities. From the practical perspective it is mentioned that the use of SE is not an entirely new management approach for projects and its substance is not significantly different then for example Prince2 (ProRail, 2011) but the steps are performed more explicitly and extensively (BAM Infra, 2008). More attention should be provided on the design choices and the formulation of the related documentation and analysis.

This view based on practical insight from BAM and ProRail is also discussed in multiple academic works20 which assessed the application of SE for the construction sector. From this perspective it is learned that the performance of the activities in an SE process is not significantly different but the key conceptual difference between SE and traditional PM tools is found in their different focus or perspective. SE is viewed to have a “system” perspective as traditional PM is primarily performed with an “project” perspective. The holistic approach of SE – which incorporates technology, environment and organisation management – does radically change the point of view of the performance of the underlying SE activities.

H.2 Commitment and resistance of stakeholders

For this variable two factors are identified to be relevant which are influenced by the integration of SE in the practice of the Rijksgebouwendienst. Firstly it is learned that resistance towards the requirements management process is increased as they feel they are “left out of the process” and have no control or influence on the process. Second, it is learned that a significant problem in the process is to be the low level of requirements traceability or structural documentation of information-input provided by the stakeholders in the process.

For the first factor, the SE framework incorporates the stakeholder integration as core element of a good and qualitative process (Sage & Armstrong, 2000). A properly performed SE process constitutes of the consideration and integration of “both the business and technical needs of stakeholders (or customers) with the goal of providing a quality product that meets the user needs.” (Yahiaoui, Sahraoui, Hensen, & Brouwer, 2006; BAM Infra, 2008; Stichting Pioneering, 2013). The primary characteristic of a good System Engineer and SE process is that they are responsibility for the management and realization of products, systems and services which are required to meet the needs of a sector or the influenced society (Sage & Armstrong, 2000). This core concept on stakeholder integration of a proper SE process transposed to the activities/steps/phases to be

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20 For example (Locatelli, Mancini, & Romano, 2013; Emes, Smith, & Marjanovic-Halburg, 2012; Yahiaoui, Sahraoui, Hensen, & Brouwer, 2006; Sage & Armstrong, 2000; Department of Defense, 2001)
performed as significant effort is done to analyse the stakeholders and external requirement which influence the system development.

For the second factor it is found that the requirements management in a proper SE process is performed in order to capture, analyse and track system requirements (Cant, McCarthy, & Stanley, 2006). As it is referred to by Gotel and Finkelstein (1994), a critical activity in requirements management is to maintain traceability as it constitutes the “ability to describe and follow the life of a requirements, in both a forwards and backwards direction.” By means of a diverse set of SE and Requirements Management related tools the goal of a SE process is to constantly integrate and document the input of stakeholders in the process. Due to the highly iterative nature – with constant verification and validation of SE phases and steps – the development of the system meets the requirements and constraints provided by these stakeholders. To manage the development of the requirements and performance specification it is the task of the System Engineer to prepare a objective, specification and/or documentation tree. In addition it is framed that the explicit nature of an SE process – which entails the continuous communication of progress towards clients/stakeholders – decreases the distance of these stakeholders towards the substance of the process. This positive aspect of SE is acknowledged and extended in the work of Bam Infra (2008). They stated that the structural documentation of design decisions and analysis-output decreases the loss of information as result of information-transfer during the life-cycle of a SE process.

**H.3 Roles of stakeholders**

For the variable on the roles of stakeholders in the process it is learned that the performance of the process was highly influenced due to the lack of a structural definition of roles and responsibilities of stakeholders in the process. From the four factors identified in Chapter 5 it is observed that the use of SE can positively influence the effect of this factor as the performance of a SE process can only be properly performed with an clear and known definition of roles in the process. In a SE process there is made a distinction between clients/stakeholders (influenced by the developed system in the process) and the System Engineer (the developer(s) of the system). It is the role of the System Engineer to identify the important stakeholders who are to be integrated in the process but safeguard the distance of them to the development of the system itself (Sage & Armstrong, 2000). This doesn’t mean that the stakeholders cannot be part of the project team as it is acknowledged in multiple work that the organisation of Integrated Product Teams (IPTs) is a SE management technique which guarantees the integration of different viewpoint in the process during the entire system lifecycle (Locatelli, Mancini, & Romano, 2013; Pyster, 2012). In this context, the System Engineer acts as consultants towards their clients and therefore must understand and integrate human; organisational; technology and behaviour concerns in the process of system-development (Sage & Armstrong, 2000). This therefore creates the need for a clear differentiation and management of roles and responsibilities of the stakeholders in the process but SE practice learned that the open nature of the process decreases the desire of stakeholders to have a leading role in the organisation (BAM Infra, 2008; INCOSE, 2010; Sage & Armstrong, 2000; Yahiaoui, Sahraoui, Hensen, & Brouwer, 2006).
H.4 Consideration of multiple perspectives

It is learned from the case study that the current requirements management practice lacks a structural method for integration of multiple perspectives of stakeholders to develop the OS document. Most recent observations learned that only limited attention and effort is performed to structurally perform the problem definition; stakeholders analysis; and objective analysis. This is frequently explained to be the result of the differentiation of the responsibilities of the directorates of the Rijksgebouwendienst. The latter relates to the situation that the Directie Vastgoed is responsible for the initial analysis of the problem and stakeholder network and the Directie Projecten starts the process when the potential of the project is acknowledged. In addition it is claimed in the findings of the case study that the current requirements management practice lacks a structural analysis of the input of the stakeholders. No consequent analysis and valuation of objectives, goals, ambitions and requirements is performed when input is provided.

The theoretical works on SE provide claims in which is stated that using SE in the project management enables the practitioners to cope with the identified shortcomings in the practice of the Rijksgebouwendienst. Firstly, the life-cycle approach in an SE process forces the project organisation to firstly perform a proper Problem Definition and System Definition. This entails the identification of the relevant stakeholders in the social environment which is influenced by the SE process. By means stakeholder and objective analysis the System Engineer creates an initial overview of the objectives and requirements of the stakeholders and their perspective on the problem. In the current performance this analysis is perceived as a individual tool which can be used to increase the knowledge on the stakeholders but in an SE process this activities in the initial phase constitute to the first decomposition of objectives towards the system.

In addition to these SE tools to create insight in the social environment of the system and their influence on the system development it is perceived that the use of SE can contribute to the structural analysis of the information input of the stakeholders next to the performance of the already stated objective analysis. As this objective analysis is performed to create insight in the high-level goals and requirements the SE framework and related methodologies integrate a wide array of tools to structurally analyse the requirements of the stakeholders. As the goal of any SE process is to design and realize a system which meets the requirements of the customer or clients in an effective and efficient way (Blanchard, 1991) it is stated in academic works on SE that the process must entail a proper requirements development or analysis process. Bahill & Henderson (2004) frame this requirements development as it includes (1) eliciting, analysing, validating, and communicating stakeholders needs; (2) transforming customer requirements into system requirements; (3) allocating requirements to system elements; (4) verifying requirements; and (5) validating set of requirements. These steps are not required to be performed in this order as they – as all SE processes – should be done in a parallel and iterative nature. An example of a tool – which has a growing popularity in the works on SE and in construction projects (Pheng & Yeap, 2001) – is the Quality Function Deployment (QFD). This initial quality

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21 As is already defined in the theoretical framework, this is dependent on the definition of the life-cycle for the SE process.
22 Also addressed as Requirements Engineering or Requirements Trawling in works on SE.
23 QFD was conceived in Japan in the late 1960s and was newly developed under the umbrella of Total Quality Control by Akao (1997).
improvement technique is used to identify client needs and then link; sort and rank them to the system elements and design requirements. This is only an example of a methodology used for the analysis of the requirements of the stakeholders towards the system. Bam Infra (2008) propose the use of System Breakdown Structure (SBS), Work Breakdown Structure (WBS) and Requirements Breakdown Structure (RBS or Requirements Tree) as means for analysis and allocation of different abstraction levels of requirements towards the system elements.

H.4 Methods used for collection of information & Knowledge on formal procedures of process

In the discussion of the findings of the case study it is already indicated that the current process only integrates a structural requirements collection framework on a limited basis. For the integration of SE this step closely relates to the statements provided for the previous variable – on the consideration of multiple perspectives in the process. It is perceived to be the responsibility of the System Engineer to gain a clear perspective on the requirements of the stakeholders. In the SE literature used for this research project a broad discussion of analysis tools are discussed but the System Engineer who performs these analyses is responsible for the proper use of information collection tools in combination of verification and validation of the information input. The latter is perceived as a value element of SE since the continuous verification and validation of the requirements with the stakeholders enable the enrichment of this set (Sage & Armstrong, 2000) In addition, the process of requirements engineering must be performed in such a way that it acknowledges the different types of requirements, namely conscious, unconscious of undreamed (Robertson, 2001).

Another shortcoming of the current requirements management practice relates to the fact that the moment on which the decision to use DBFMO as mode of procurement highly influence the performance of the process. In the projects it is observed that traditional efforts are performed when this decision is made and this provides grounds for resistance as it determines the user expectation towards the process. This shortcoming shall not be overcome when using SE elements but the added value of this framework for these shortcomings is perceived to be its highly structural performance and pre-determined activities which are to be performed in the process. This relevance can also be identified for the findings on the variable Knowledge on formal procedures of process as these identify the limited knowledge on formal process as an significant area for improvement of the current requirements management process. The SE framework provides an structural process or life-cycle for the top-down development of the system in which the logic dimension consists of three fundamental steps (System Definition, System Development and System Deployment) in which the structured framework of steps, phases and activities are discussed in detail in the SE literature. Therefore it is stated that the use of SE can provide a structure for the performance of the process of the Rijksgebouwendienst. However, it must be acknowledged that how this process is performed is highly dependent on the influence of the system – real estate buildings – which are to be developed, and the wishes and perception of the private stakeholders in the process.

24 The work of Sage & Armstrong (2000) provide an detailed theoretical description of the performance and structure of an SE process. A more practical discussion is presented in CROW (2011) which discusses the SE process and – more importantly – the performance of the SE methodologies and tools in order to formulate the functional decomposition and performance specifications for the system.