

Small project execution

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How to execute small projects fit for purpose?

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At
Shell
Pernis

Project management improves the execution of large projects focusing on the planning and controlling of the project. The smaller projects, with lower financial dimensions and lower risks, might suffer from over-processing when this type of 'traditional' project management is applied. This thesis addresses project management of small projects and looks particularly at the situation of efficient small project execution at Shell Pernis.

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Executive Summary

Project management has always been an interesting topic and has received much attention, not only because of the method but also in its application. It has been observed that in literature 'mega-projects' receive much attention while little is written about small projects. There can be several reasons for this, but it is believed that this is mainly due to the idea that the project management practices can be used for any project, occasionally leaving some prescribed project activities out or by using a scaled version of the activity when applied to small projects.

The developed project management bodies of knowledge provide guidelines for project execution. These guidelines are referred to as 'traditional' project management practices, as they are focusing on planning and controlling the project. Traditional project management approaches are based on a predictable, fixed and relative simple model with little focus on behavioral and complexity aspects. Nowadays, environments are much more dynamic compared to the environment where the traditional project management approach was developed. Adaptive project management can be seen as a derivative of traditional project management but is less focused on tasks and activities but more on a strategy-based management approach to achieve maximal benefit of the project.

Adaptive project management is of importance for the smaller projects, because the project management approaches can be too cumbersome for this kind of projects. Adaptive project management is not in conflict with traditional project management, but it ensures that the activities used are made fit for purpose towards the project.

Royal Dutch Shell has developed a project manual for downstream projects with expenditures over USD 100 million. This manual is also used for the smaller projects at the refinery of Shell Pernis but the question is whether this improves or hinders the efficient execution of small projects.

The goal of this thesis is to investigate and contribute to knowledge on project management for small projects and to provide recommendations for the current situation for small projects at Shell Pernis. To reach this goal, a qualitative research study at Shell Pernis was carried out.

The research started with exploratory interviews as there was little specific knowledge on the topic available. These exploratory interviews led to the identification of four themes: project classification, fit for purpose execution, project team and front end development. These themes refer to possible improvement areas for the execution of small projects. Literature review was provided to define the themes in more detail and to compare the project management approach of Shell (called Opportunity Realization Manual - ORM) with the information found in literature. The following step was to identify possible issues that were not apparent from the literature study and comparison with the ORM. This is done via surveys, in-depth interviews and project data. The data is analyzed and ranked to find the most important issues that influence fit for purpose execution of small projects. Improving these issues is likely to increase fit for purpose execution. Fit for purpose is used to describe that sufficient and efficient effort must be undertaken in order to reach a goal successfully.

The top six issues that were identified are:

1. Difficult cooperation between stakeholders
2. Unclear tasks and responsibilities of team members
3. Different performance indicators per stakeholder group

4. The usage of the same project structure for every project
5. The lack of a good and complete scope definition
6. The business model of the engineering contractor and the communication with Shell

In order to prevent these issues from occurring, the following minimal requirements are identified in order to enable fit for purpose execution of small projects:

- Project team formation and integration
- Focus on contracting and procurement
- Stakeholder management
- Usage of a project assurance plan
- Scheduling (including 'the way forward' of a project)
- Opportunity framing for proper scope development (including lessons learned)
- Risk management

To improve the current situation at Shell Pernis there are three main recommendations:

1. Shell Pernis has skipped several steps in the ORM in order to ensure fit for purpose execution. In order to improve the current situation at Shell Pernis it is recommended to scale the project manual instead of skipping steps. One of the items that should receive more attention is the formation of a project team. It is likely that focus on this team will enhance cooperation between stakeholders and improve the development of a project.
2. In the current situation, a project starts from the 'Select phase' while prior to this phase, scope development and assessment of different options are important. Because the phase prior to Select is not officially part of a project, many steps that are important in this phase are not addressed. The stage gate process as described in the ORM must be followed in order to reach sufficient "front end development". The main goal of front end development is to sufficiently complete the image of the project to be able to decide whether or not to invest in the project. Front end development has a great impact on the outcome of a project and therefore it is important to start with some project management requirements in an earlier phase prior to the Select phase.
3. Shell Pernis uses a project classification between 'plant changes' (changes with expenditures below USD 50,000) and small projects (changes with expenditures between USD 50,000 and USD 3 million). The classification determines the manner of initiation and the 'way forward' for a project. It is recommended to make one initiation point to avoid a classification based on financial size and to ensure that changes are classified based on their complexity. Complexity is important as it requires a focus on the project characteristics and environment and it enables a good scaling of the ORM towards the needs of a project. This would enhance fit for purpose execution of small projects.

Preface

Dear reader,

I have always been triggered by the fact that every project was considered to be unique, but that a generic approach was used to develop the project from initiation to execution. A generic approach can be used because it can be scaled (or skipped?) towards the requirements of the projects.

I was almost finished with my master Chemical Engineering when I discovered that I would like to broaden my expertise. The double degree with Management of Technology was an excellent combination between technology and management.

This study was performed as a final graduation project for the Master's degree Management of Technology at Delft University of Technology and for Shell Pernis. I choose this project because I was interested in how projects would be executed at a refinery. The focus of the project was on small projects and apparently there is little literature available about this topic. Therefore a different research approach was followed, based on the information found at Shell Pernis about small projects.

The main question in this research relates to 'fit for purpose execution'. Fit for purpose execution relates to 'do what is necessary to be successful but don't do too much'. How can someone be sure that something is 'fit for purpose'? I discovered this during my research that a good scope definition and stakeholder management are the main topics when talking about fit for purpose. I not only discovered this by performing my research; I also experienced it myself. The emphasis of this thesis is on small projects; because in these projects the work packages are often small and therefore underestimated leading to certain processes to be scaled too much or skipped. And that is not fit for purpose.

From an academic point of view this study extends the knowledge about small projects, although the main focus is on the improvement of small projects within Shell Pernis. Based on findings in this research minimal requirements for fit for purpose execution can be presented and this can form the basis for further research into the small projects.

I would also like to use this preface to thank the ones that were involved in this thesis. I would like to thank my graduation committee, Hans Bakker, Rob Stikkelman and Herman Mooi for their support and guidance throughout the project. From Shell I would like to thank Peter Arnoldy and Michiel Bovendeert, who were always available to provide support where needed and to listen to my findings.

This research would not have been possible without the opportunity Shell that gave me and the respondents that I interviewed for this research and I am very grateful for the time they took to answer my questions.

Lastly I would like to thank my family and friends for the support throughout the project,

Sara Kraus

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List of abbreviations

A	Assess phase
AI	Asset Integrity
BDEP	Basic Design and Engineering package
BOD	Basis of Design
BOM	Business Opportunity Manager
BOT	Business Opportunity Team
CAPEX	capital expenditures
COD	Chemie, Oplosmiddelen en Derivaten
COFFEE	Plant change on CAPEX
CVP	Chemie, verlading en polyolen
DE	Decision Executive
Def	Define phase
DMS	Downstream Manufacturing Shell
DRB	Decision Review Board
DRB-1	Decision Review Board -1
EAR	End of Assess Report
FED	Front End Development
FEL	Front End Loading
FID	Final Investment Decision
GR	Growth
HAZOP	Hazard and Operability Study
HSE	Health Safety and Environment (sometimes HSSE: including security)
HoQ	House of Quality
I	Identify phase
IPA	Benchmarking Tool (amongst others)
IPF	Instrumental protective function
MM	Maintain Margin
NAP	Dutch Process Industry Competence Network
NPV	Net Present Value
OPEX	operational expenditures
ORM	Opportunity Realization Manual
PAR	Project Assurance Review
PAV	Plant change accoderings vergadering
PEP	Project Execution Plan

PIN	Project Initiation Note
PMI	Project Management Institute
PU	Production unit
QBM	Qubic Based Matrix
RBO	Refinery Base Oil
RDS	Royal Dutch Shell
RDU	Refinery Distillation Utilities
REA	Technical disciplines
RFC	Ready For Construction
RFSU	Ready For StartUp
RHP	Refinery Hydro and thermal cracking
RMS	Refinery Maintenance Services
ROM	Refinery Oil Movements
RT	Refinery Technology
RTA	Refinery Treating and Alkylation
RTP	Refinery Turnaround and Projects
RVC	Refinery Vacuum and Cat cracking units
RWH	Refinery Water treatment and Hycon
Sel	Select phase
SIPOC	Supply, Input, Processing, Output, Customer
SNR	Shell Nederland Raffinaderij
TA	TurnAround
TECOP	Technical, Economical, Commercial, Organizational, Political
TOE	Technical, Organizational, Environment
VIR	Value Investment Ratio

1. Introduction

This chapter introduces the subject by providing background information on the thesis. The chapter also discusses the research objectives, questions and scope. The research approach is presented in chapter 2.

1.1. Project background

Project management receives much interest because projects are believed to be a key to success for a company, enabling innovation and change. There are different bodies of knowledge that describe project management and these practices assume that the practice is scalable for any type of project. These bodies can be summarized as a general approach to solve a specific case, as every project has its own unique characteristics. However, a high failure rate of projects¹ may raise questions on whether the current approach is still applicable and useful. It might be necessary to adapt the project management approach to a specific type of project in order to be successful.

This study was initiated by Shell Pernis, an oil refinery near Rotterdam. This refinery has on average 150 projects in progress with a variety of purposes. Some projects are compliance driven, others are carried out to achieve growth or to maintain asset integrity. Shell is known for its enormous upstream projects (recently the Pearl in Qatar was built with a development cost of 18-19 billion dollar²) but the projects carried out at downstream are smaller in size. A project manual has been developed for the downstream projects, based on the upstream project procedure and known project management bodies of knowledge. This project manual is also used for the smallest projects but the risk exists that over-processing of these projects occurs: it seems reasonable that small projects do not need the same procedure and amount of control as large upstream projects. Based on that idea this research will look into the execution of small projects at Shell Pernis to determine whether small projects can be executed more efficiently while ensuring the same quality and safe execution.

1.2. Research objectives

The goal of this thesis is to investigate and contribute to knowledge on project management for small projects and to provide recommendations for the current situation for small projects at Shell Pernis. To reach this goal, a qualitative research study at Shell Pernis was carried out.

¹ 85% of the project studied by Shenhar and Dvir did not meet time and budget (Aaron Shenhar, 2007)

² (Qatar, 2012)

1.3. Research questions

The main research question is defined as follows:

What are the minimum requirements for fit for purpose execution of small projects?

This main research question can be split into a number of sub questions:

Table 1: Sub questions

#	Question	Approach:	Chapter
1.	What differences are found between small and large projects other than financial value?	Literature	4
2.	What other criteria for project classification are known?	Literature	4
3.	What is fit for purpose execution?	Literature and research	4, 6
4.	How can the issues be solved found at Shell Pernis in small project execution?	Research	6

1.4. Research scope

The scope of this research is defined as follows:

- In this research fit for purpose execution for small projects is considered: medium and large projects are not discussed. Shell Pernis defines an additional fourth type of project called plant changes. Plant changes are discussed in this research but are not the main focus of this thesis. Projects executed in a turnaround are not part of this research.
- A project is discussed from project initiation until the final investment decision (no project implementation), because this is believed to be the part where the largest inefficiencies can be found as the project is still undefined (in the first stages it is possible to influence the project the most, the so called front end development stage). If inefficiencies occur during implementation this can also originate from the front end not being well developed, but many other factors can contribute to bad implementation. These implementation factors will not be included in the research.
- Shell is used as an industrial example for the execution of small projects. The data obtained for this research is based on the findings within Shell and literature. There is no other company data used in this research other than Shell's and therefore the results cannot be generalized directly. However, suggestions for further research and improvements are made. It should be taken into account that the global project structure of Shell is discussed which will be referred to as the ORM (Opportunity Realization Manual). Shell Pernis specific approaches will be emphasized.
- Issues concerning process safety are considered to be outside the scope of this research. Process safety is not defined by project management and safety is considered independent of the project management approach.
- Project portfolio and project success are mentioned but not further discussed. These topics contain so many aspects that they can easily be the subjects of a full research thesis.

2. Research Approach

This chapter provides details on the research approach used in this thesis. The study includes several steps, as is shown in Figure 1. The blue box describes the input of the action (described in the text) while the white box denotes a deliverable or an outcome. This approach is developed to identify possible causes that influence fit for purpose execution of small projects from interview data and literature.

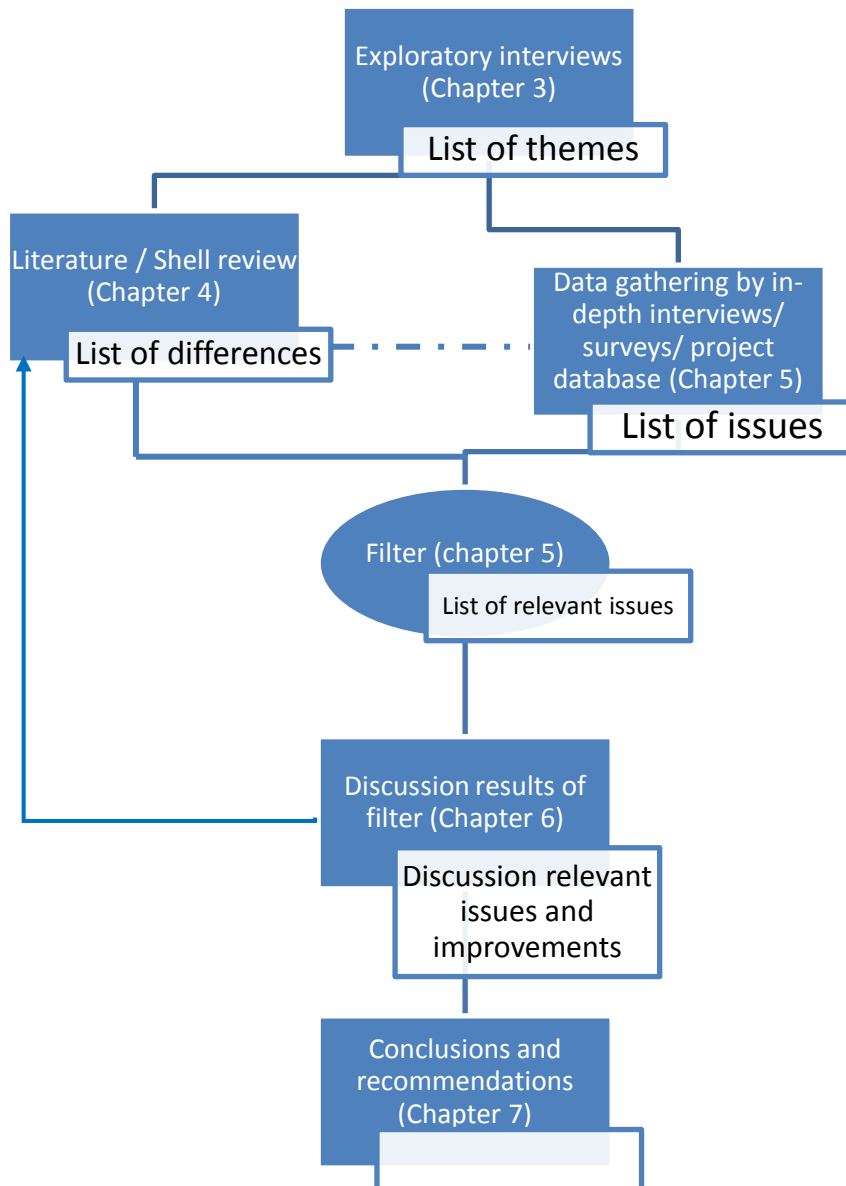


Figure 1: Overview of research approach

Each step in Figure 1 will now be explained in more detail but first the terms ‘theme’ and ‘issue’ need to be defined. An issue refers to a single problem/observation and several issues that are related with each other form a theme (collection of different issues). For example, several issues may be found related to team work. These issues are then grouped in a theme with the description ‘project team’.

Exploratory interviews (chapter 3)

The research starts with exploratory interviews to define the problem, because the literature about project management for small projects was not abundant. These exploratory interviews were used to map the problem and identify important stakeholders in project execution. With the acquired information a list of themes was created. The themes are related to possible improvement areas in small project execution and provide the structure for this research project. People involved in (predominantly) small projects were interviewed for this step.

Literature and Shell project management review (chapter 4)

The themes are further defined using literature research. Additionally, a comparison was made per theme between literature and Shell's global project management approach. This results in a list of differences that might contribute to reduced fit for purpose project execution.

Data gathering (chapter 5)

Data gathering consists of obtaining information from in-depth interviews, surveys and the project database at Shell Pernis. This information allows identification of issues that are not apparent from literature and issues that may be specific to the project approach taken at Shell Pernis.

Filter (chapter 5)

The input of the literature/Shell review and in-depth interviews, surveys and project database is used to create a list of relevant issues with the execution of small projects at Shell Pernis. Selection criteria were defined for data reduction so that the relevant issues can be determined. Although separate steps in the research itself, the presentation of the data and application of the filter is discussed in one chapter (chapter 5) to increase the readability of the report and to identify the relevant issues.

Discussion results of filter (chapter 6)

With the relevant issues in small project execution identified, this section discusses the issues in more detail including the possible correlation between the issues found. A method called House of Quality is used to define relationships and to obtain a ranking of the most important issues. The issues found in the top six of the House of Quality are checked against literature. For these issues recommendations are suggested.

Conclusions and recommendations (chapter 7)

The research ends with conclusions with respect to the research questions and by making recommendations for further research.

3. Exploratory Interviews

This chapter is used to define the themes found in the exploratory interviews. The exploratory interviews were held prior to a literature review to get a clear understanding of the problem statement. This benefits the literature research because it would help identifying relevant literature from the large amount of literature available on project management.

3.1. Data Collection

The exploratory interviews are held with two Capital Team Leads, the Project Leader Plant Changes, the Chemicals & Base Oil Technology Manager (who is the initiator of this research) and the CAPEX coordinator. These people were chosen because they were recommended by the initiator of this research and likely to be helpful in the identification of the problem statement. Open, unstructured interviews were used in order to be able to get as much different angles and areas where issues may play a role. Minutes of the meeting were made but these were not sent to the respondent. A short summary is presented in Appendix I³.

3.2. Data analysis

The respondents gave information about different topics concerning small projects. Every respondent described his/her perceived issues that occur with small projects. Based on similarities between issues indicated by respondents, themes are defined. An example of the analysis is: The respondent indicates that projects are initiated too late and that the cost estimate of the first deliverable is often too low (which has an impact on the project portfolio). These problems are shared under the theme: front end development.

Although it may be argued that this leads to biased themes as the respondent group was limited, the next step of data gathering by semi-structured in-depth interviews reduces this bias because other respondents will mention similar or different findings. Thereby the themes are reinforced or refuted and any existing bias is reduced. If completely different findings are suggested, an additional theme is introduced. Such findings are discussed in section 5.3.

3.3. Data evaluation

The exploratory interviews have resulted in the following themes. A theme is first introduced, followed by a description and an explanation why this theme might be of importance.

- **Project classification**

Project classification comprises how different classes of projects are defined. It relates to the method and criteria that are used to discern small projects from large projects. A project is carried out because a change in the system must be made and for the smallest changes this step is called a plant change. At Shell Pernis, the division between plant changes and small projects is a financial division: everything under USD 50,000 is considered to be a plant change while a small project is considered to include all changes below USD 3 million. Some respondents indicated that this classification is not supporting fit for purpose execution for small projects because simple, expensive changes automatically become a project based on cost alone. A project has more deliverables compared to a plant change and thus requires

³ The rough data is available on an additional CD but not presented in this report

more work, which is not always required for the change. Another difference between a plant change and a project is that a plant change is considered as operational expenditures (OPEX) and a project as capital expenditures (CAPEX). This classification depends on whether the change adds value to the current installation or not⁴.

- **Fit for purpose execution of projects**

Fit for purpose describes how a goal is sufficiently reached with minimal effort. This theme is based on the fact that Shell Pernis uses a third 'route' to execute simple, expensive changes (which would be a small project per definition) by executing these projects via a plant change route. It is not clear whether this strategy will solve the issues currently found in small project execution as the same project process is used for small projects. In general, issues related to structure of the small projects belong to this theme. For example, if a respondent would indicate that too many documents are required for a small project, such an issue would belong to this theme as it relates to small project structure.

- **Project team**

A project's success is very dependent on the team that is working on the project. In this team everyone should be aligned and there should be proper communication between the stakeholders. However, some production units have to deal with many different project managers which makes communication more difficult. Other issues mentioned were that the people's role in the project team is not clear and the expectations and project goals often do not seem to be well aligned. Any possible issues that are related to the team members or the way a team operates will be part of this theme.

- **Front end development (FED)**

FED is the process of developing sufficient strategic information which enables owners to address risks well and to make a decision which (and how much) resources have to be committed to the project. This maximizes the chance for a successful project. (Bosch-Rekvelde, 2011) If projects are initiated too late there is less attention for front end development. This results in a unclear and incomplete scope definition, which results in inaccurate cost estimates and has an impact on the progress of the project as in later phases a unclear scope definition will often lead to rework.

Stakeholders

A schematic representation (organogram) of the organization at Shell Pernis is shown in Figure 2. The important stakeholders for development of projects are also shown in this organogram. There are three more departments that form Shell Pernis: Refinery health, safety and environment and human resources which are not part of the organogram as they have no direct involvement in projects. Every department exists of more sub departments but only the most relevant to project management and execution are shown to keep the organogram clear.

⁴ More information about CAPEX/OPEX can be found in appendix IV

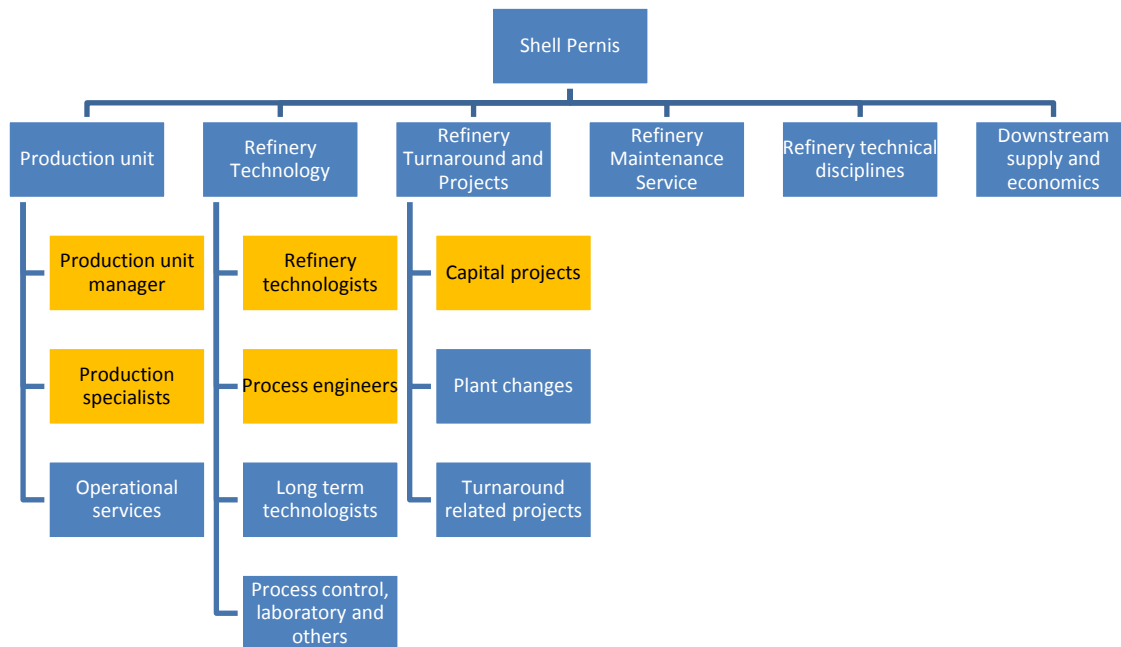


Figure 2: Organogram Shell Pernis, yellow blocks show stakeholders involved with development of projects, blue blocks are stakeholders involved with implementation of projects (Arnoldy, 2012)

The following stakeholders are most important in the development of small projects (colored yellow in Figure 2):

- Refinery Turnaround and Projects department (RTP) – capital projects: in this department the project managers are based and a division is made between non turnaround related projects and turnaround related projects. In this research only non-turnaround related capital projects are discussed. There are contracted project managers that are mostly handling the small projects and Shell project managers that are mostly responsible for the medium and large projects. Each project manager is assigned to a part of the refinery although this division is not strict and project managers can be responsible for several projects across several units. An area project manager is appointed per unit to maintain an overview of the projects ongoing in that area. The plant change engineers are also a part of RTP but these engineers are not interviewed as the preparation and management of plant changes is not within for the scope of this thesis.
- Refinery technology (RT) - refinery technologists and process engineers are often involved because they are linked to a production unit that requires a change. These technologists often are responsible for the first two deliverables of the change (Project Initiation Note (PIN) and the End of Assess Report (EAR)) and fulfill the role of Business Opportunity Manager (BOM) for a small project. For medium and large projects this role is often separated in two different persons.
- Production Unit (PU): there are a lot of different people involved within the production unit with projects on different levels. The production unit managers and production specialists are often involved in the initiation or development of a project and therefore together form the stakeholders of the production unit. A production unit manager is also responsible for

the execution and end result of the project. The operational departments of the production unit (technical services) are not considered as a stakeholder as they are responsible for the execution of the project and not for the development of the project.

- A fourth group is sideways involved with project planning, cost estimation or finance (referred to as Rest). This group is also interviewed to obtain more information about the process and their view on small projects. Although the stakeholders in this group are found in two departments (Refinery Turnaround and Project Department and Downstream Supply and Economics) they are discussed as one stakeholder because they are not involved in the projects themselves but only in activities related to the project.

The blue blocks in Figure 2 show the stakeholders involved in the execution of the project. These stakeholders are not indicated as main stakeholders because they are not responsible for the development of the project.

Conclusion

This chapter introduced four themes: project classification, fit for purpose execution, project team and front end development. These themes refer to areas that are likely to affect the execution of small projects. The themes enable a focused literature study and this study will also be used to define the themes in more detail. The exploratory interviews also helped identifying the important stakeholders that form the respondent group for the data analysis in chapter 5.

4. Literature and Shell project management review

This chapter is used to provide an overview of the available literature and Shell's project approach in order to provide a more elaborate definition of each theme identified in chapter 3. The literature study is also used to validate possible issues (chapter 5) and to support recommendations (chapter 6). Literature review is based on articles, papers and books about project management and for Shell's project approach the Opportunity Realization Manual (ORM) is used. Possible differences between literature and Shell's project approach are summarized at the end each paragraph.

Each paragraph discusses one theme by first introducing literature findings followed by Shell's approach. Paragraph 4.5 is used to provide an overview of the items discussed per theme.

As projects are the main subject in this thesis, this chapter starts with a definition of a project as found in literature:

A project is defined as a unique change or innovation and is temporary with a clear start and end. The end is reached when the project's objectives have been achieved or when the project is terminated because its objectives will not or cannot be met, or when the need for a project no longer exists. Projects have a unique character because of the uncertainties that are involved. Besides this a project needs resources and a temporary organization in order to deliver a change to address the requirements of the business case." (PMI, 2008) (Turner, 2007) (Murray, 2009) (A. J. Shenhar, 2007)

4.1. Project classification

The paragraph discusses project classifications as mentioned in literature and in the ORM. Project classification is dealing with how a project can be labeled to group similar projects.

The classifications that are discussed are:

- Project classification based on size
- Project classification based on type
- Project classification based on complexity

4.1.1. Literature review project classification

This subparagraph provides an overview about the literature findings concerning project classification.

Project size:

A division on project size can be based on the financial size of the project, but also in terms of strategic impact. Size determines the amount of assurance and governance needed. The risks involved with a large project are higher since a large project consumes more time and requires completion of more tasks compared to a small project. (Griffiths, 2007) The project team is often smaller for a small project compared to a large project and vice versa, the larger the scope of the project, the more people will be involved. (Shih-Wen Chien, 2007) (Hass, 2010)

Project type:

Three different classifications based on type can be made. The first class is based on how often a project is done and what purpose it serves, the second looks at certain project characteristics to decide how the project should be approached and the final classification uses project complexity to judge the best approach.

The Dutch process industry competence network (NAP) uses a classification based on type of project that is undertaken. There are four different projects identified by the NAP: (NAP, 2002, p. 29)

1. Routine projects: reduction of time-to-market and CAPEX is not a priority. These projects should focus on minimizing contracting effort and increase the role of procurement systems.
2. Leverage projects: priority to cut CAPEX by eliminating the redundancy costs by:
 - o Value engineering
 - o Standardization
 - o Eliminating double functions in the project organization
 - o Global sourcing
 - o Incentives on ideas that can reduce contract value
 - o Functional equipment specifications
 - o Buy back clause for excess equipment
 - o Packaged units
3. Fast track projects: reduce time to market. The critical path must be analyzed and the unnecessary hurdles in the critical path must be removed by e.g.:
 - o "Off-the-shelf" equipment
 - o Advanced scheduling of long-lead equipment
 - o Incentives and penalties for all contractors on planning milestones
 - o Concurrent or parallel engineering and 24 hours construction shifts when applicable
 - o Planning and throughput of activities are dominant
4. Critical projects: projects with business case that have demanding goals where time-to-market and CAPEX must be reduced.

Shenhar and Dvir classify projects based on their nature following a diamond approach. In this approach they identify four characteristics of a project that determine how a project should be dealt with (Aaron Shenhar, 2007). Every project is judged on four dimensions:

1. Novelty relates to how new the product or process is to the market and it indicates the projects level of uncertainty. This dimension is comparable to the classification of derivatives, platform and breakthrough technologies.
2. Technology or technological uncertainty is important to characterize a project because it shows whether a technology is low-tech, medium-tech, high-tech or super-high-tech. The identification of level can be difficult, but helps choosing the right value processes.
3. Complexity is representing how many different items, people or functional groups are involved. It can be divided into assembly (one component), system (several related components) and array (system of systems).
4. Pace involves the urgency and criticality of meeting the project's goal. The higher the pace, the more governance is needed in a project. There are four differences in pace, regular, fast/competitive, time-critical and blitz.

The four dimensions together form a diamond in which a project is judged on its characteristics. The shape of this diamond shows how a project should be approached. It helps also reconsidering project's goals and the diamond approach positively influences the front end development of a project.

Another classification can be made based on the type of goal of the project and how well the methods to achieve these goals are defined. This classification method results in four types of projects: (Kumar, 2009)

1. Engineering projects: goals and methods are well defined, which enables quick planning and execution with a high chance of project success.
2. Product development: functionality of the project is well defined but the methods to achieve this are poorly defined. The work method must be determined progressively as milestones are completed.
3. Systems development: the goals of project are poorly defined, but the methods to achieve the goals are known.
4. Research: both goals and methods are unclear and significant information can only be discovered by various milestones.

Complexity:

Projects can be distinguished based on their technical and human difficulty. Technical difficulties involve dealing with an innovative technology, risks and dependencies. Human difficulty results from the interests of internal and external stakeholders. (Kumar, 2009)

Complex systems are systems that consist of a large number of components that interact with each other. Complexity arises from the fact that multiple actors and facets interact with each other in a physical/technical environment. Complexity of projects influences decisions on and in project management. Complexity also arises from the fact that projects are dynamic; they evolve in time.

Complexity can be represented in Figure 3. It should be taken into account that each contributor to project complexity could originate from technical, organizational or social issues. Complexity is part of a project characteristic. (Bosch-Rekveltdt, 2011)

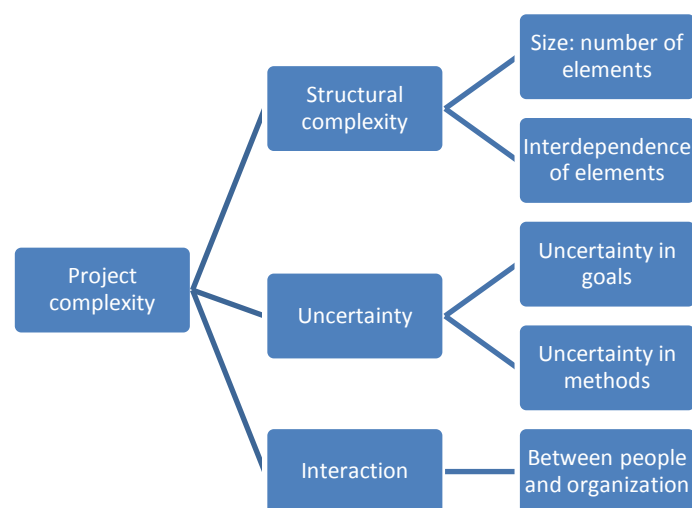


Figure 3: Overview of dimensions in project complexity (Bosch-Rekveltdt, 2011)

Note that the aspects of complexity listed in the figure above are also found in the project classification by type in the previous section. Kumer et al (Kumar, 2009) classify projects based on uncertainty of methods and goals, which are also aspects of project complexity given by Bosch-

Rekvelde (Bosch-Rekvelde, 2011). The latter description includes more aspects of project complexity and is considered to be more complete.

Research shows that the contribution to complexity is not only due to technological uncertainty, but it shows also that social and organizational aspects play a role in the assessment of project complexity. The different aspects are grouped in a TOE-framework (technical, organizational, environment):

- Technical: goals, scope, tasks, experience and risks
- Organizational: size, resources, project team, trust, risks
- Environmental: stakeholders, location, market conditions and risks

If the complexity of a project is determined, it can help the assessment of the governance and assurance steps that are needed to achieve project success. The front-end development should be adapted to project complexity, because this would benefit the overall project performance, as will be discussed in paragraph 4.4.

4.1.2. Opportunity Realization Manual review project classification

This subparagraph provides an overview about the ORM findings concerning project classification.

Project size and complexity:

Shell classifies projects based on financial dimensions and divides its projects into 3 categories; small (from USD 50,000 up to USD 3 million), medium (up to USD 20 million) and large (from USD 20 million onwards). The ORM is developed for the large (upstream) projects (plus USD 100 million) or projects with an unusual risk. (RDS, 2010) These kinds of projects are often involving green field projects and are not common at Shell Pernis. Projects can be very complex and involve large teams, but there are also projects with small financial dimensions and low risks. The ORM takes into account both dimensions.

Project type:

Shell's ORM makes a difference between capital projects and operational expenditures. Operations and projects share a few characteristics: they can be performed by individuals, are limited by constraints and they are planned, executed, monitored and controlled. They differ from each other since operations are ongoing and produce repetitive products, services or results while projects are temporary and end. Operations sustain the organization over time and do not terminate when the current objectives are met. (PMI, 2008)

Operational expenditures (OPEX) are the ongoing costs for running a product, business or system. This includes license fees, but also maintenance and repairs and office costs. Capital expenditures (CAPEX) are the costs for non-consumable goods, such as the purchase of a new property, plant and equipment. Capital expenditures do not appear as expenses on the income statement directly but are depreciated over a period of time, whereas operational expenditures are mentioned completely in the income statement. (Jonathan Berk, 2011) (Maguire, 2008)

In order to implement a change, a management of change procedure is used. This procedure is not required for maintenance, repair and one on one replacement. Management of change should be followed when implementing a plant change or a small project and it is a procedure that is specific

for Shell Pernis. Plant changes are financed as operational expenditure although are different from operations. Plant changes involve a change in the current system, but are small changes with a cost below the capitalization threshold of USD 50,000. A plant change can include replacement or addition of a part of a unit (e.g. boiler, heat exchanger, vessel, pump, tank, generator etc.). (Sliwakowski, 2012)

A project is classified as capital expenditure. When an asset is changed there must be an expected material increase in:

- Useful economic life of the asset
- Capacity and throughput of the unit

The main difference found between plant changes and small projects is that a plant change is including all changes below the threshold of USD 50,000.

Discussion and conclusion

This paragraph introduced project classification. Project classification refers to the possibilities how different projects can be grouped according to a particular project characteristic. The first project classification introduced was based on size which can be based on a financial size of a project or the size of the strategic impact. The second classification concerns project type. This involves how often a project is carried out, what purposes it serves or is related to the complexity of the project. The list of project classification is likely not to be complete, but it indicates the difference between the methods chosen by Shell (size) versus type. Project characteristics are often linked to project management practices (type of project, industry) (Bosch-Rekvelde, 2011) but it appears often not to be linked to size. There is a lot of literature found about mega projects (e.g. described in the book: Industrial Megaprojects by Ed Merrow (Merrow, 2011)) but literature is hardly found specifically for small projects. Although not supported by literature this might be because mega projects receive more attention and are easier described because more data is available because mega projects are attention-drawing projects, where small projects have that characteristic not to that extent. It might even be the case that small projects are ought to be 'simple' and therefore they are hardly described in literature.

4.2. Fit for purpose execution of small projects

This paragraph discusses project management of small projects as mentioned in literature and in the ORM. Fit for purpose execution of small projects implies that minimal effort is put in to achieve the result for which the project was started. In order to explain the need of fit for purpose execution, a short introduction in project management practices is given. The methodologies of project management are well documented and therefore not discussed in detail in this research. The reader interested to read about project management practices is referred to project management bodies of knowledge such as PMBoK®⁵.

4.2.1. Literature review fit for purpose execution

The approach to execute projects is called project management. Turner defines project management as follows: "Project management is the process by which a change is successfully delivered and

⁵ Note: Shell's ORM is based on such project management bodies of knowledge

benefit achieved. This is achieved by assigning work and resources to a temporary organization.” (Turner, 2007, p. 104). Project management is important because standard work processes throughout the company will lead to successful projects. (NAP, 2002)

The project management bodies of knowledge provide potentially useful guidelines to execute projects well, but these practices originate from large projects and are focusing on the planning and controlling of a project (R. Turner, 2010). Project management practices provide general guidelines to execute a project as every project is considered to be unique. Repetitive elements may be present but it does not change the fundamental project work that needs to be done for every project. (PMI, 2008) It is a wide known technique and assumed to be scalable for any type of project (D. Dvir, 1998), but often little attention is paid to human and behavioral aspects of project management. (Pravesh Valecha, 2010) The question is whether the project management bodies of knowledge can be scaled to any type of project or that a different approach is needed for a particular type of project, such as small projects.

A shift has been observed towards a more “adaptive” project management approach. Adaptive project management refers to project management in which the type of the project is taken into account. (A. J. Shenhar, 2007) This implies that project management should be made dependent on contingency factors (e.g. the project environment and/or characteristics such as complexity). Projects cannot be approached with a ‘one size fits all’ approach, as is assumed in traditional project management approaches which are described above. (Maylor, 2001)

In spite of the observed shift, traditional project management still forms the basis of many project management books and still plays an important role. (Lenfle, 2008) (Bosch-Rekveltdt, 2011) These methods do not take into account project complexity and do not always make use of existing innovative learning environments and techniques. (Janice Thomas, 2008)

The next section will briefly discuss the approach taken by traditional project management practices and the approach of adaptive project management. The last part of this paragraph will discuss Shell’s project management approach.

Traditional project management approach

Traditional project management describes project management as the accomplishment of a clearly defined goal in a specified period of time, within budget and quality requirements. Project management in traditional theories is often seen as being about controlling, planning and scheduling within the boundaries of an organization. (D. Dvir, 1998)

Managing a project via the traditional project management approach typically includes: (PMI, 2008) (Rodney Turner, 2010) (Bentley, 2006, pp. 210-217)

- Identification of the requirements (function of the project)
- Addressing to the various needs, concerns and expectations of stakeholders as the project is planned and carried out.
- Balancing the competing project constraints including: scope, quality, schedule (planning), budget, resources (work break down schedule but also human resources) and risk.

It should be taken into account that for any given project the project manager, in collaboration with the project team, is always responsible for determining which processes are appropriate and the appropriate degree of rigor for each process.

Adaptive project management approach

Traditional project management approaches are based on a predictable, fixed and relative simple model with little focus on behavioral and complexity aspects. Nowadays environments are much more dynamic compared to the environment where the traditional project management approach was developed. (A. J. Shenhar, 2007) (Bosch-Rekveltdt, 2011) Adaptive project management can be seen as a derivative of traditional project management but is less focused on tasks and activities but more on a strategy-based management approach to achieve maximal benefit of the project. This focus will determine which project management steps are required to execute a project: (Jafaari, 2001) (A. J. Shenhar, 2007)

- Strong focus on the recognition and proactive management of complexities, uncertainties and project type.
- Project management should include environmental variables such as community perception, safety, environmental and social impacts.
- Different project phases should always be integrated with the business objectives.

The adaptive approach is focused on the influence of the environment and nature of the project on the project management approach, which is (often) ignored in traditional approaches (Bosch-Rekveltdt, 2011). Differences between traditional and adaptive project management approaches are:

- Traditional project management is based on the belief that project teams should prepare detailed plans at initiation and then stick to the plan as much as possible. This approach focuses on the triple constraint of project success (within time, budget and meeting performance goals), but in reality this often is not viable as projects are not predictable. It is suggested that a rough planning would be sufficient at the start of the project. (A. J. Shenhar, 2007)
- The same holds for scope development which should be checked every time with the stakeholders in order to avoid uncertainties as the project progresses. The number of iterative loops depends on the initial levels of uncertainty⁶ in the project. In traditional project management the scope is set at the beginning and revision is not standard during the project. (A. J. Shenhar, 2007)

Taking into account the type of project would increase efficiency in project execution. Organizational efficiency would be gained by creating working blocks that are repetitive or easy to execute or to be outsourced. Adaptive project management approaches argue that there are buildings blocks that are comparable to other buildings blocks. Using this knowledge would increase efficiency. (Aaron Shenhar, 2007)

Adaptive project management is believed not to conflict with traditional project management approaches, but the focus on the approach of a project is more dynamic and organic compared to

⁶ Examples of uncertainty are: technical uncertainty or scope uncertainty

the relatively linear approach, focusing on command and control, seen in traditional approaches. The traditional project management bodies of knowledge do not account for the interaction with the project context whereas adaptive approaches do and the shift towards these adaptive approaches is observed. The adaptive approach describes that the front end development should be made contingent upon certain project characteristics. (Bosch-Rekvelde, 2011)

Fit for purpose execution of small projects

The generic approaches described in different handbooks for project management can include too many steps for a small project and therefore it is the responsibility of the project team to decide when to apply what step in order to ensure a fit for purpose approach for the project. (PMI, 2008) (Rodney Turner, 2010) This implies that processes can be left out in order to ensure fit for purpose execution. Another point of view is that these processes must be scaled (instead of skipped) to the nature of the project, instead of skipped. (Murray, 2009)

The literature available about project management for small projects is not abundant (Rodney Turner, 2010), which might be due to the fact that the traditional approach focuses on the scalability of project management and thus not on specific approaches for small projects. Turner has investigated projects carried out in small companies (that undertake small projects) and discovered that small companies suffer from traditional project management because:

- The processes are formal and often bureaucratic
- The procedures encourage specialization and formal decision making
- Roles are well defined and traditional project management stifles innovation
- Traditional project is focused on systems rather than people

This list is based on projects executed at small companies, but it is assumed that a comparison can be made for small projects within large companies. It is important to scale project management to the size of the project as better results are obtained doing so (R. Turner, 2010).

Project management procedures for medium-sized projects exist (e.g. Prince2), but these are still too bureaucratic for the smallest projects. It should be considered that larger size companies need a formal project structure because people fulfill more specialist roles. (R. Turner, 2010)

Project management for small projects has its challenges because of the size of the project it is sometimes tempting to make shortcuts or skip steps. This might be due to the fact that project management has its genesis in the management of large projects which makes the method to appear to be cumbersome and too much for small projects. (Larson, 2012)

There are no clear strategies for small projects as there is for large(r) projects. However, it is said that small companies must focus on a few items to select the right project management practice. Although small and large companies differ from each other, it is believed that these selected items are applicable for every small project, independent in which company it is carried out. In order to select the right project management approach the following items should be identified: (Rodney Turner, 2010) (A. J. Shenhar, 2007)

- The strategic objectives of the company
- The appropriate success criteria and key performance indicators for the project
- The appropriate success factors

These items lead to the appropriate project management tools and techniques such as a resource schedule, road map and risk management (Rodney Turner, 2010).

The question can be raised whether there should be a need for a special small project management approach as there are advantages for a company to adopt a common project management approach. These advantages are:

- A consistent reporting mechanism
- Resource requirements can be calculated on a consistent basis and people can move between projects without having to relearn the management approach
- Small projects can be used as a learning exercise for larger projects.

However, research shows that projects with a tailored approach show more successful results compared to projects with a consistent procedure regardless of project type, size and skills of the project team. (John Payne, 1999)

4.2.2. Opportunity Realization Manual review fit for purpose execution

This subparagraph is used to introduce Shell's project management approach, followed by the ORM approach for fit for purpose execution of projects. Downstream Manufacturing has left the ORM open for interpretation for the smallest changes and this paragraph will explain how Shell Pernis is dealing with these changes.

Shell uses the "Opportunity Realization Manual" (ORM), a manual that provides mandatory instructions and guidance with respect to the management of opportunities. Opportunity realization is defined as any value creating activity that requires an investment proposal (capital investment⁷). The ORM is introduced shortly to familiarize the reader with the terms and abbreviations used.

The Opportunity Realization Manual is developed to set out a rigorous approach to the management of opportunities to ensure that they are appropriately defined, evaluated and executed. The ORM is developed based on the existing project management bodies of knowledge. (RDS, 2010) The ORM focuses on planning and on activities that are involved with a project but it takes into account the complexity aspects of a project as it classifies projects based on their financial size, risk dimension or complexity.

The process to deliver opportunities is a decision driven, stage-gated process and is divided in six stages. At the end of every stage (at the gate to the next stage), a go/no go decision must be made as to whether to advance the project to the next stage and this decision is made by the decision executive. This stage gate process is briefly explained in this paragraph, but a more extensive explanation can be found in Appendix II. (RDS, 2010)

Shell Pernis defines a project as follows:

"A project is a structured approach to realize a new plant or the modification (permanent or temporary) of a process unit, building or complex, with complexity and integrity as key characteristics. A project has a start and completion date and is larger in costs than USD 50,000."

⁷ Capital investment refers to the fact that the activity adds value

Projects are referred to as 'opportunities' and are executed because of three different reasons: (Shell, 2012)

- To maintain margin (requirement of customer, loss of production)
Maintain margin projects are ranked by a value improvement ratio (VIR). This VIR is the net present value (NPV) divided by the present value of the proposed investments.
- To establish growth (extra margin, new product development)
Growth projects are ranked by a value improvement ratio (VIR). The VIR is the net present value (NPV) divided by the present value of the proposed investments.
- For compliance reasons (HSE⁸, asset integrity, reliability, law, license)
Asset integrity projects are ranked by a risk assessment matrix (RAM) and VIR. The projects are executed to mitigate business risks, such as legal requirements, health, safety and environmental or financial risks due to an accident.

Fit for purpose execution of small projects

The ORM is used as a guideline to execute all projects, including small projects: "The application of the ORM is intended to be scalable so that it is fit-for-purpose for the dimensions, complexity, and risk profile of the opportunity". Originally the ORM was set up for opportunities with a size exceeding USD 100 million or with unusual risks, but can be downscaled for small and medium projects although there are no strict guidelines as to what to in- or exclude.

The ORM describes the following minimal requirements (RDS, 2010):

- All opportunities shall have a common governance structure which consist of:
 - A **Business Opportunity Manager (BOM)**, accountable to the Decision Executive (DE) for the overall management and delivery of the opportunity
 - A **Decision Executive (DE)** who provide support, steer and supervision of the BOM and is accountable to the next person in the "Line of Sight" for the delivery of the opportunity, ensuring that the appropriate assurance is in place
 - A **Decision Review Board (DRB)** that contains the relevant expertise to support the DE in his/her decision-making
 - A **Line of Sight** defined from the opportunity team through the BOM and DE to the person with organizational authority for the opportunity
 - A **Mandate** agreed between BOM and DE that gives the BOM instructions and also room to manage the opportunity
- The DE is personally accountable that as a minimum there shall be:
 - **Opportunity framing:** Opportunity framing is an activity which defines the scope of the opportunity through consideration of the Technical, Economic (and financial), Commercial, Organizational (including all stakeholders) and other Political (TECOP) aspects of the opportunity. Mandatory outputs of opportunity framing are:

⁸ Health, Safety and Environment

- o **Opportunity roadmap:** outlines the plan for the opportunity; including timeline, milestones, decision gates, resource requirements and key deliverables.
- o **Stakeholder engagement plan:** identifies key stakeholders, what is known about them and sets out the plan to understand stakeholders' perspectives, engage with them and create both internal as well as external alignment.
- o **Risk management plan:** identifies key risks (upsides and downsides) and plans the mitigation and responses.
- o **Opportunity assurance plan:** sets out the assurance events and reviews that will promote good quality decisions in all phases of the opportunity and how functional/technical discipline controls will be applied.

Projects at Shell Pernis (Saraber, 2012) (Hirtum, 2012) (Arnoldy, 2012)

The ORM can be downscaled and this is left to the interpretation of the site for changes under USD 3 million. Therefore the information that is given in the exploratory interviews is used to provide an overview over the current project situation for execution of small projects at Shell Pernis.

If a problem or opportunity requires improvement of the current system, this involves a change in the system. In order to ensure safety of the change, every change must follow "Management of Change". This ensures that a change is executed safely and according to the law. Operating a plant or maintenance is not considered a change. A change exists of a plant change or a project. The division between a plant change and project is based on a financial division:

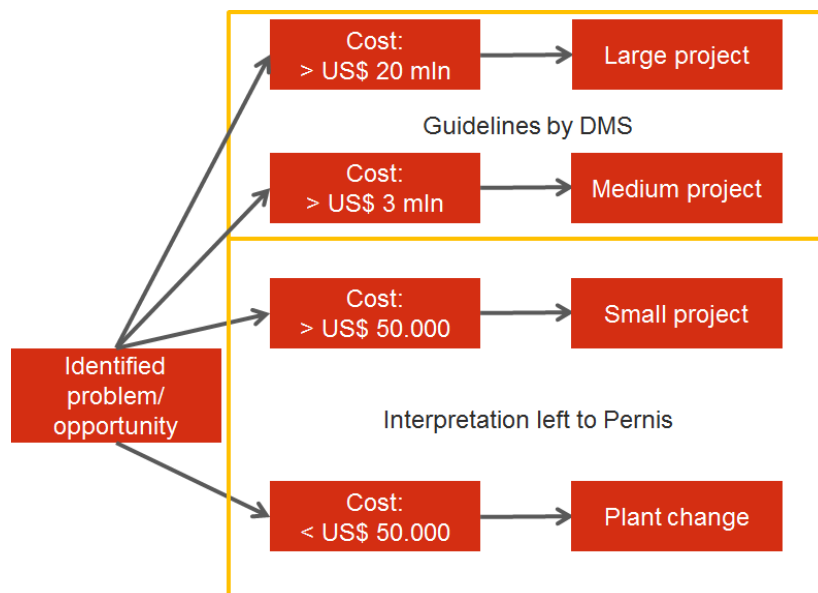


Figure 4: Division between plant change and project

The upper block (medium and large projects) is executed using the guidelines by Downstream Manufacturing. Every problem or opportunity with costs lower than 3 million USD (lower block) is left to the site's interpretation. Shell Pernis has decided to divide the block into two types of changes, called plant changes and small projects.

The difference between a plant change and a small project is shown in Figure 5:

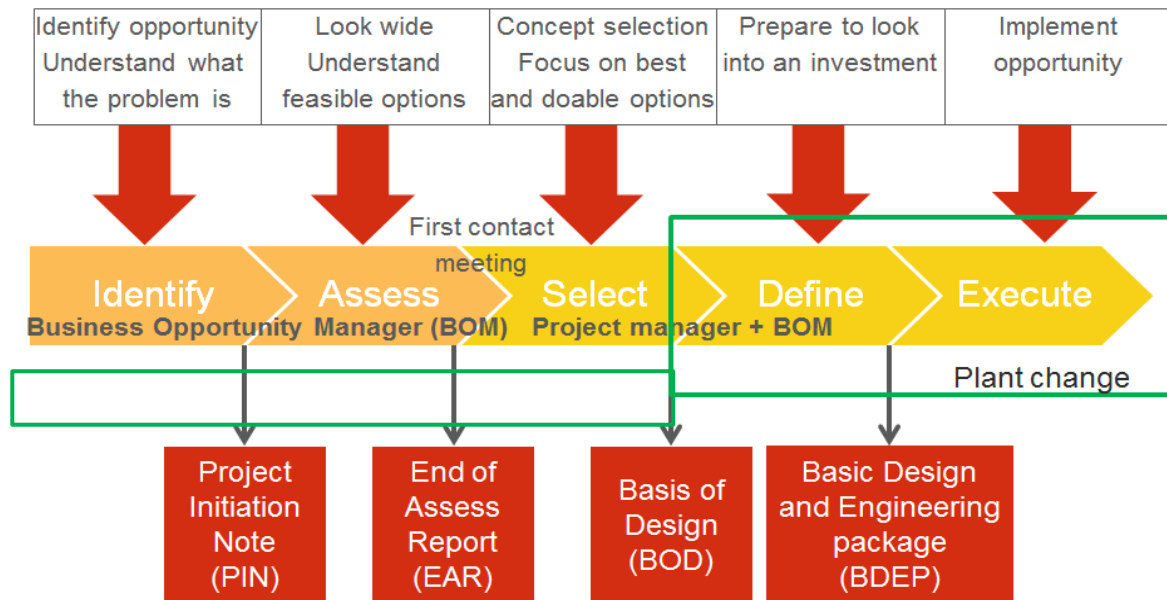


Figure 5: Project structure as defined in the ORM and adjusted by Pernis (RDS, 2010) – figure adjusted for this report. The small green box indicates a lighter process where the large green box refers to a ‘full’ process

The green boxes in Figure 5 show the difference between a plant change and a capital project. A plant change is a delivery-focused execution because the solution is simple or already known and the first three phases are therefore only executed lightly (e.g. discussed in a meeting but not requiring the deliverables). A plant change is due to its nature (e.g. no additional value added to the current system) paid by operational expenditures. A plant change is executed within control of a plant change engineer, who works closely together with the production unit. This is different from a project, where development of a project in the first three phases receives more attention and are not in direct control of the production unit (development is done by technologists who are involved with the production unit but not standard working at the same location). This does not necessarily mean that there is no interaction between the production unit manager and the technologists, as the production unit manager needs to sign for approval for the PIN, EAR and BOD. The time between these approvals might be longer as it takes longer to develop the different deliverables (compared to a plant change).

The project structure of Shell Pernis for small projects is comparable to the structure outlined in the ORM. A short introduction of the project structure is given below while a more extensive description (including assurance and governance steps) is presented in Appendix II.

The project structure exists of five phases and each phase has a different purpose (Figure 5). The first two phases are used to understand the problem well and diverge in possible solutions. Shell Pernis has added two deliverables to the ORM, the Project Initiation Note (PIN) and the End of Assess Report (EAR)⁹. Both deliverables include also a cost estimate based on the scope described in the deliverable. The Business Opportunity Manager (BOM) is responsible for the delivery of the first two phases and is often the author of the two deliverables. After the Assess phase a First Contact Meeting is held where an official handover occurs between the BOM and the project manager and the project becomes officially a project (before then it is called an initiative). The BOM stays

⁹ The Basis of Design and Basic Design and Engineering package are standard deliverables

responsible for the delivery of the business opportunity, the project manager for all technical details that are involved in the project.

The deliverable of the Select phase is the Basis of Design (BOD) while the Define phase results in the Basic Design and Engineering Package (BDEP). At Shell Pernis these two phases are almost always outsourced to an engineering contractor.

The project structure is accompanied by a governance and assurance system where the Decision Review Board (DRB) is the most important one as they are responsible for the decision to continue or discard a project. Shell Pernis has introduced a site committee called DRB-1, which is responsible for the first two phases. The Decision Executive (DE) is the responsible individual within Shell with the appropriate organizational approval authority for the opportunity.

Shell Pernis has developed a route that enables execution of 'expensive' plant changes (expenditure over USD 50,000) via a plant change route in order to address lightly the first three project phases. This route is called the COFFEE route, which is described in Appendix III. The COFFEE route focuses on type of funding, necessary front end development and the implementation of a project. If a project involves for example single discipline, replacement-in-kind and no anticipated issues, the project could be executed as a plant change with the production unit largely managing the opportunity, but a project manager is still involved. This would lead to lean front end development and less execution lead-time and cost because not all the project deliverables are required.

Discussion and conclusion

The theme fit for purpose execution refers to all kind of project management related items. Fit for purpose refers to the fact that sufficient work is done to achieve the project goals. It is not clear whether fit for purpose must be 'skipping' of project processes or 'scaling'. The ORM clearly indicates that scaling should be applied as every step in the project process is important and done with a good reason (e.g. to develop the project well, as will be discussed in the theme front end development). There is not a clear strategy how small projects should be executed or how project management should be scaled towards the project. It is defined which items must be identified in order to determine the project management approach.

Differences between ORM and Shell Pernis:

- Shell Pernis has added two extra deliverables in the project structure (PIN and EAR) of which the BOM is often author and responsible for the deliverable of the two phases. These two phases are not part of the project structure (starting from Select) and officially a project manager does not have to be involved during the development of the first two phases.
- Shell Pernis applies the ORM fit for purpose by not using all the mandatory ORM requirements. The requirements can be used when it is assumed to be necessary, but it is not a standard practice. The BOM and DRB are used often, the other requirements are not used often.

Difference between literature and Shell Pernis:

- Small project starts within Shell from USD 50,000. A project is normally defined based on its nature (e.g. start and end date, temporary organization, different from ongoing and repetitive operations) and not defined based on its expenditure type (OPEX/CAPEX) or financial size.

4.3. Project team

The paragraph deals with the importance of a project team in a project as found in literature and in the ORM.

4.3.1. Literature review fit for project team

In this paragraph the role of a project team and the role of a project leader (or manager) are discussed:

Project team:

A project team can be described as a mix of different disciplines ((with different cultures) that work together to achieve a goal (Bernard K. Baiden, 2011). A project team is composed when a project needs to be executed because a project team enables faster execution as the work can be divided amongst (specialized) team members (Bradley R. Staats, 2012). The team formation is an important aspect in project management, as the personalities of the members of the team can determine the outcome of the project. Also the talents and capacities of the individual team members are important. A team should be composed according to the nature of the project, project needs and stakeholders. (Turner, 2007) The project team should exist of intelligent and reflective practitioners that could make use of their own informed decisions on principles, concepts, models and techniques. (Bosch-Rekvelde, 2011)

Project teams often try to follow a well-established set of guidelines that are standard in project management. In this traditional approach, the project complexities may not be taken into account, although this might have an impact on the project and the cooperation within the project team. (A. J. Shenhar, 2007) A team must have the freedom to express their ideas, but at the same time the team must have the same perceptions of the goals otherwise the team might be too divergent and no productive conclusions can be made. If the corporate climate is positive, the quantity and quality of ideas, knowledge and information for an organization is increased. (Shih-Wen Chien, 2007)

Project leader:

A project leader should be able to integrate people and motivate a team for a collective action. The project manager should possess knowledge about project management and should know how to apply it. Project managers should also have personal traits that enable them to guide the project team while achieving project objectives and balancing project constraints. (PMI, 2008, p. 13)

A project leader should solve problems and coordinate cooperation between different team members and functional groups (stakeholders). (Shih-Wen Chien, 2007) A project manager should address to all processes, but can decide to focus on one process more than the other because it fits the project better. (PMI, 2008, p. 72)

Influence project team and leader:

The role of a project team largely influences three important project outcomes: cost, schedule and operability. Project team efficacy, cross-functional project teams, project team structure are strongly related to project cost effectiveness. Continuity of project leadership and cross-functional project teams have an impact on project schedule. Clear project goals and effective communication are influencing operability. (Christina Scott-Yong, 2008) The influence of the project team and project leader on the project progress is large and one even argues that the lack of continuity of individual managers is thought to be “the primary factor behind inadequate project execution”. But also the

continuity of team members is important to avoid unnecessary loss of knowledge. (NAP, 2002, pp. 61-63) Organizational context can thus not be ignored when developing a project. (Stephen K. Parker, 2005).

4.3.2. Opportunity Realization Manual review project team

The project team within Shell is called a Business Opportunity Team (BOT). The composition of this team must be well planned, promote clear responsibilities and accountabilities. It must exist of an appropriate mix of expertise, such as technical, financial, commercial, HSSE (Health, Safety, Security and Environment) and other disciplines relevant to the opportunity.

The ORM has a mandatory requirement that opportunities should be led and staffed by people with the appropriate level of competence and experience. One of the skills is that they must be able to define and agree objectives, frame an opportunity, create, resource and implement a plan with control and report on the process correctly. The project team should be decision or risk-driven rather than activity-driven and should take an integrated approach. The size of the project team is adapted to the size of the project.

Conclusion

The theme project team refers to all kinds of cooperation between different stakeholders that are involved with the project. The project team is important for the progress and outcome of a project and should be composed of a mix of people with different backgrounds and expertise as the project team will have a large influence on the outcome of a project.

There are no clear differences or relevant gaps identified between the project team description in literature or in Shell, however it is emphasized that a project team should be composed based on the expertise and personalities of the project members. It is the question whether the formation of a project team receives sufficient attention to ensure effective project execution. If this is not the case, this will become apparent in further analysis of small projects at Shell Pernis.

4.4. Front end development

The paragraph discusses the importance of front end development as found in literature and in the ORM. Front end development refers to the phases early in the project life cycle (idea generation until concept definition) in which strategic decision making is important. (Dennis Nobelius, 2002) Effort spend during this front end development is referred to as front end loading (FEL). (Bosch-Rekveltdt, 2011)

4.4.1. Literature review front end development

During the front end development of a project, the why, what, when, how, where and who questions are answered (IPA, 2009). An effective and sufficient front-end development phase implies that good project performance is enabled in terms of meeting technical specifications within cost and time but with not unnecessary (or too little) effort spend to reach this. The main goal of FED is to sufficiently complete the image of the project to be able to decide whether or not to invest in the project (so called Final Investment Decision – FID). A stage gate process is required to go from an idea to actual work, in order to collect enough data to proof the viability of the project. The stage gate process is needed to ensure that the steps are followed in a logical sequence of activities, ensuring that the right information is available at the right moment. (Bosch-Rekveltdt, 2011)

Front-end development enables owners to address risks well and to make a decision which (and how many) resources are committed to the project. This maximizes the chance for a successful project. (Bosch-Rekveltdt, 2011) FED is visualized in Figure 6, where it is shown that good front end loading, or good project definition, leads per default to a better project; even if it is poorly executed.

Front end development is therefore very important. (NAP, 2002, p. 41) FED implies to balance the effort spent during the project compared to the results.

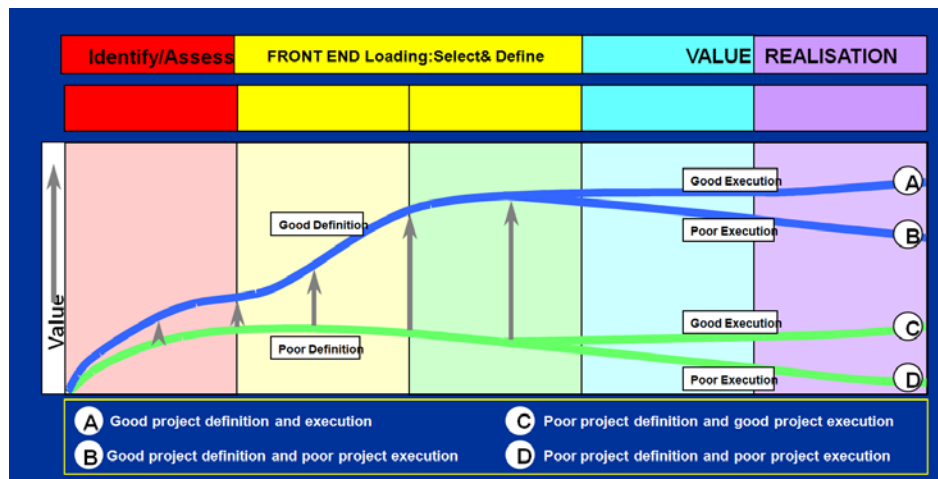


Figure 6: A good front-end development leads to a better project, even if it is poorly executed (Shell, 2012)

The nature of the project determines how the front end development should be adjusted and it should be realized that, in this stage, the influence on the outcome of the project is the largest. After the initial stages changes are harder to implement and are more expensive (Figure 7).

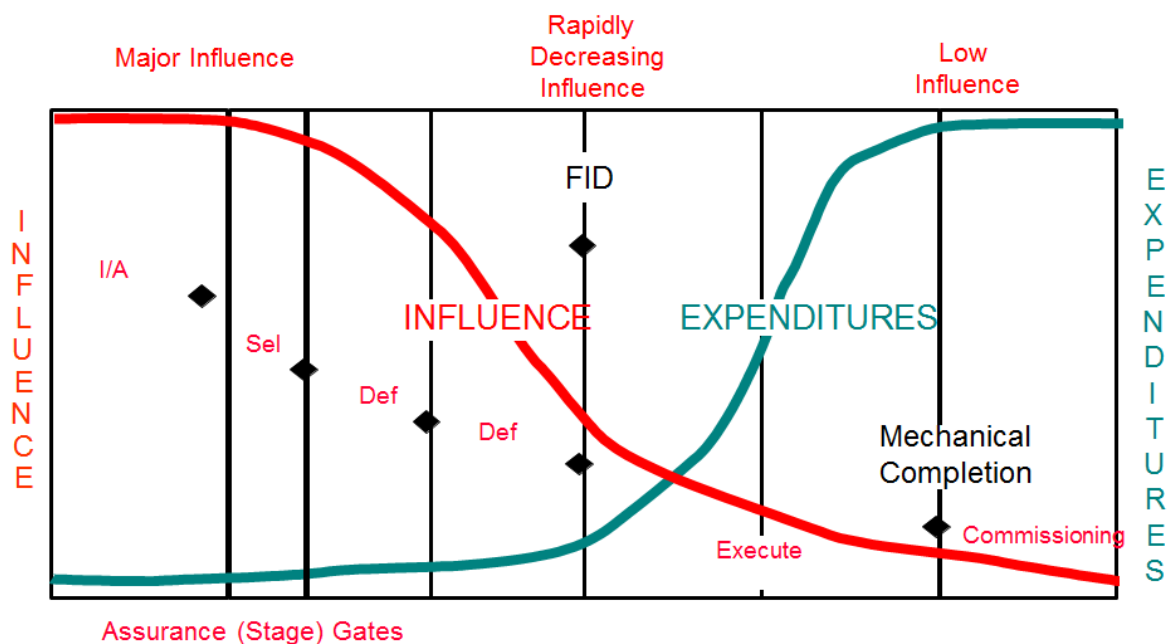


Figure 7: The influence at the beginning of a project is larger and the costs are lower compared to the final phase (Shell, 2012) I = Identify, A = Assess, Sel = Select, Def = Define referring to the different phases

4.4.2. Opportunity Realization Manual review front end development

Screening is an important aspect of a project initiation/definition in order to prevent that effort is put into non-viable ideas. Screening can be executed via a checklist that contains items such as a cost/benefit analysis, scope limitations, technological aspects, risks, alternatives, timing and success criteria. Within Shell Pernis, the DRB-1 is responsible for the screening of viable projects.

If a project is initiated, a first contact meeting (FCM) is organized. In this meeting the necessary value processes are chosen based on the financial size, complexity and available expertise of the project. The Select and Define phases are considered to contribute to front end development because in these phases the design is decided and completed. The phases prior to execution (Identify and Assess) are used to judge the necessity and the attainability of a change. (RDS, 2010)

One of the methods to obtain sufficient front end development is called opportunity framing. Shell uses opportunity framing to obtain good front end development. Opportunity framing is a scalable activity, which is undertaken as early as possible after an opportunity comes up (Identify/Assess phase). The opportunity framing can be repeated several times and updated if new information becomes available. Opportunity framing is used to reach internal alignment on the scope of the opportunity, define key success in explicit terms and to identify key relationships. The stakeholder requirements and value drivers should be considered. In this framing the experiences from earlier opportunities are taken into account and the timeline is used to identify when and how the most value can be delivered. An opportunity framing is not mandatory within Shell Pernis for small projects. (RDS, 2010) Figure 6 is a picture used within Shell to show the importance of front end development.

Discussion and conclusion

Front end development refers to all activities that happen in the beginning of the project life cycle. Front end development is of importance because the influence on the project is the largest in the initial stages and good front end development leads to better project results. The necessity of front end development can be more visible for large projects compared to small projects. Again the question is raised whether scaling or skipping must occur in the project management approach. There are also no clear differences or relevant gaps identified concerning the theme of front end development. The ORM describes which steps must be minimally taken. It is possible that this manual is not translated sufficiently to common practice at Shell Pernis, in which case this should become apparent in the next chapters where the issues are discussed.

4.5. Concluding remarks literature and Shell project management

This chapter presented the current literature standing and Shell's approach concerning four themes: project classification, fit for purpose execution, project team and front end development. The research is used to define each theme in more detail but it was also used to determine any differences between the literature and Shell's approach and to identify potential relevant gaps that need to be addressed. Also, the importance and relevance of the different themes as discussed within literature are presented. Although the four themes do not cover all the possible improvement areas that might be possible when looking at project execution, the four themes that are addressed find support within literature that improvement is needed and/or careful attention in the project execution to this theme is important.

The literature review is used to determine the differences between small and large projects and showed that other differences than financial value can be used to determine the size of a project. Risks, project team, duration and strategic impact are also likely to increase when the project becomes bigger. The list presented is not exclusive, but it shows together with the presented classification on 'type' that projects could be classified differently.

The reason why this is believed to be important is because project type is likely to influence how project management practices should be applied in order to achieve fit for purpose project execution. Taking into account the type and environment of a project is likely to enable scaling of the traditional project management practices into a more adaptive approach. This does not imply that the current project management practices should be changed, but it should be made contingent to the contextual factors around the project. This has a strong influence on which activities should receive more attention than others during front end development or even could be skipped. The project team should also be adapted to the project because research shows that the project team has direct influence on the project outcome.

There are not many differences found between the ORM and literature which is not surprisingly as the ORM is based on project management practices. However, there are differences found between the ORM and Shell Pernis. Shell Pernis classifies the projects based on financial size and a project officially starts at the beginning of the Select phase.

The next chapter presents and explores issues that are not found in the literature or ORM review using in-depth interviews, surveys and project data. This analysis will show whether how the practices on paper are implemented at Shell Pernis and the information presented in this chapter will be used as an input for chapter 5 and 6.

5. Data gathering

This chapter discusses the data that is gathered via in-depth interviews, surveys and project data from the projects archive at Shell Pernis. The chapter is used to identify the relevant issues that prevent fit for purpose execution of small projects. First, the data collection method is presented, followed by the data analysis method. The last paragraph exists of the data reduction that includes the filter to find the relevant issues from all identified issues. Readers interested in the discussion of the relevant issues are referred to paragraph 6.1, because this chapter ends only with a presentation of a list of relevant issues (thus without discussion). The limitations of the selected data gathering method are discussed in chapter 7.

5.1. Data collection

Data was collected via in-depth interviews, surveys and project data that was obtained from executed projects. This paragraph describes for each method how the data was collected.

In-depth interviews

The in-depth interviews were held by approaching different groups of stakeholders. The selection has been made as follows:

- RTP: Head of RTP, two project team leads and several project managers were interviewed. Introduction was done via e-mail followed by an interview. The project managers were selected based on the recommendations of the project team leads. It was decided not to talk with all project managers because in this large group the information obtained would be relatively similar.
- PU: All PU managers (except for one who indicated not to have time available) and all production specialists (four out of fifteen responded) were contacted. Introduction happened per e-mail followed by an interview. It was important to interview every production unit manager as it was expected that there would be differences between the units in how they organize their projects¹⁰.
- RT: Technologists who indicated in the survey that they would like to be interviewed were interviewed (three survey respondents indicated to be available for an interview).
- Other relevant respondents were interviewed concerning planning, cost estimation, turnaround projects and finance. For each of these topics one interview was held due to the limited amount of people involved in these topics.

The interviews always began with a spoken introduction by the interviewer, to explain the nature and purpose of the research and to address the potential problem. The questions asked were related semi structured questions in order to gather as much information as possible about small projects. The main focus on this research is on small projects and therefore most of the questions asked were about small projects.

The questions asked during the interview are not based on the themes as this would lead to biased questions as the themes are formulated based on exploratory interviews and thus are based on opinions. The interview consisted of the following questions:

¹⁰ This was mentioned in the exploratory interviews

1. How are you involved with small projects?
2. What are your experiences (positive/negative) with small projects?
 - How do you experience cooperation between different stakeholders?
 - How do you experience the current structure for small projects (including deliverables)?
 - What are advantages and disadvantages in the current process?
3. How do you experience the small project classification?
4. What would you like to see improved?

The interviews were recorded and minutes were drafted and send to the respondent as a check. The number of respondents per group is summarized in Figure 8.

It was not possible to speak to one of the production unit managers, but it was ensured that the production specialist of that unit was interviewed.

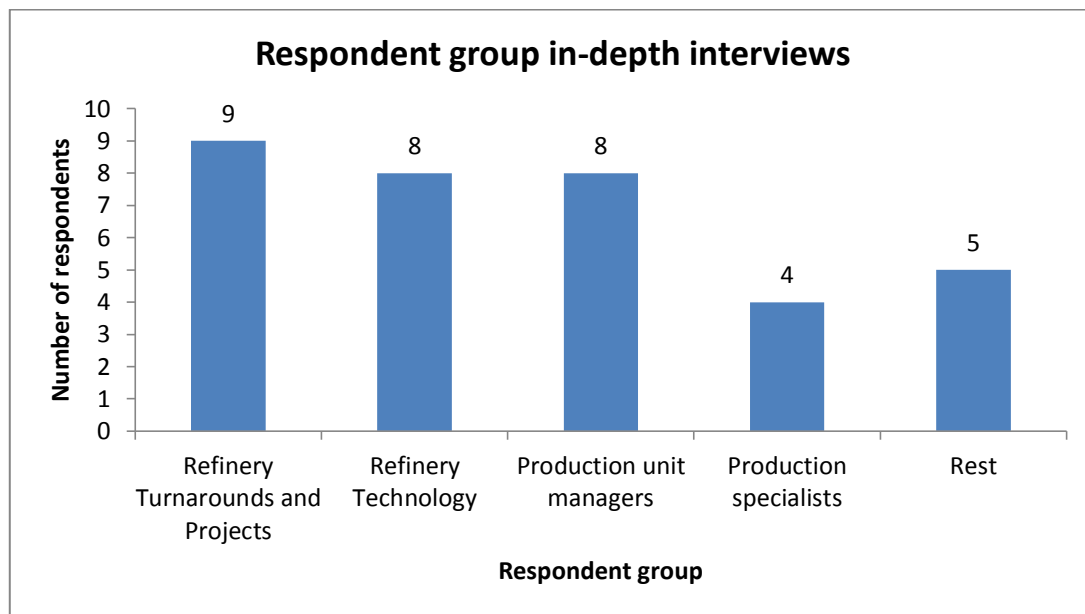


Figure 8: Overview of the number of respondents per stakeholder group

Surveys

Surveys were sent out per e-mail to the technologists that are directly involved with the production units. Fifteen surveys from the 35 surveys sent were returned and used in this research. Similar questions as in the interviews were asked. This method of gathering information was chosen because it was a different method to obtain data compared to interviews. This method of data gathering is only tested at one respondent group, the technologists. Surveys were not used for the respondents of the interviews, because these respondents preferred providing information in an interview instead of per e-mail. Three technologists indicated that they would like to be interviewed to give additional information.

Archived project data

Data of executed projects was examined to indicate any (new) possible issues. The projects that were selected for this analysis were the projects that became Ready For StartUp (RFSU) in 2011 because

then the first five phases would certainly have been executed. Respondents were also asked if they had any projects that would be suitable for analysis and if these projects were in Execute (before RFSU) these projects were also taken into account.

In order to collect the data, access was needed to the digital archive (called LiveLink) of the project department. However, this digital archive only exists since 2011 and many projects had started before 2011 and thus not all documentation was available. Some information was retrieved via a physical archive, but most of the information was not found. Therefore it was not possible to use the project data to identify new issues, but it was possible to find support for some other issues that were mentioned in the surveys and interviews. For the same reasons, the established themes could not be used in the project data examination because not all themes are covered (traceable) in the data. The project data archive only keeps track of certain documents which do not address all the themes. Therefore other criteria are defined to compare project data which is presented in the list below:

- Planned deadlines versus actual deadlines
- Difference between cost estimates per phase (including ratio)
- Number of scope changes recorded
- Number of schedule driven projects
- Number of switches within the project team
- Projects executed via the COFFEE route/ bundled in another project
- Format of documents (PIN, EAR, BOD)

This selection was made because it enabled comparison between projects and the selection criteria were based on the data that was found in a few projects. During the analysis of other projects there were no additional criteria found. Sometimes the project approach was mentioned but this was not found for all projects and is therefore not used for the analysis.

In total there were 21 projects analyzed. Of these 21 projects four projects were left blank because no information was found. The sample thus existed of 17 projects but the data that is found for these projects is not complete. It was therefore not possible to use the project data to draw conclusions, but it can be used as supporting evidence in the determination whether an issue is relevant or not.

Literature review

The differences and remarks that were found in the literature review are compared to the issues found in the surveys, in-depth interviews and project data. If the differences and remarks from literature cannot be attributed to an existing issue, a new issue will be added. The findings of the literature review are included per issue where applicable. Discussion about the literature related to the issues is found in chapter 6.

5.2. Data analysis

The interviews provide the main bulk of data and therefore these will be discussed first, followed by a short description of the survey analysis and the contribution of project data and literature to the list of issues.

The questions used in the interviews were semi-structured and open-ended, following a constructionist approach. This implies that the research method considers knowledge to be the production of social and personal processes of meaning-making and that it is concerned with the pragmatic utility of its application. (Levitt, 2001) The validity is important but not the main focus on this interview method. This resulted in the fact that different respondents referred to one issue using different wordings. In order to determine the relevant issues; it is important to find the common denominators in the different answers that can be summarized in one issue because this enables counting of the number of respondents per identified issue. The following approach is used:

The recorded data is summarized in documents (in Dutch). These documents are used to transform opinions into issues. In order to transform an opinion into an issue, the first interview is selected and issues are identified. These issues were used in the analysis of the other interviews and any new issues were added. The list of issues was thus growing the more interviews were analyzed. This resulted in a list of 61 issues after the analysis of 34 interviews. These issues were compared to see if the list could be reduced, for example when different wordings of the same issue were present. This resulted in a reduced list of 24 issues. Sometimes opinions are shared under the same issue but the respondent had a particular idea about it. This is shown in the column “suggested improvements”.

After the identification of the issues they were grouped per theme based on the definition presented in chapter 3 and 4. Some issues fitted into two themes. The theme that is mentioned most is considered to be the main theme. Possible relationships between issues are discussed in the chapter 6.

The approach is illustrated by the following example:

Respondent 1 indicates that projects that are not complex should be executed as a plant change because there are fewer steps involved. Respondent 2 suggests that different small projects should be combined (e.g. in a turnaround) because deliverables can be combined in one document and stakeholders only have to attend one meeting. Respondent 2 also indicates that complexity should be taken into account when considering a project or plant change execution. This is summarized in the issue: “the same structure can be used for every small project, but over processing is a risk” (implicitly referring to the notion that the structure must be set up differently). The themes of the issue are project classification and fit for purpose execution. Although other linkages might be apparent for other themes (front end development for example) this is not taken into account as the issue does not directly affect front end development. To illustrate this with another example:

“The project team should work better together”. This is linked to the theme: project team, but this also indirectly affects front end development. This indirect effect will be described in the next chapter if the issue is found to be relevant. It is possible that some issues are linked to two themes because the respondent indicated this relationship.

The issues that cannot be classified in a theme will be presented at the end of the chapter. A fifth theme is defined for this called “Other”. Some issues are not addressed in this research because they concern topics that are outside the scope of this research.

The surveys are analyzed in the same manner as the interviews, using the issues identified in the interviews. One additional issue was found (i.e. not present in the list of issues from the interviews) and added to the current list of issues.

The project data is used to find support for or contradict the issues. This could not be done for every issue found as not all data necessary was available in the archive. Additional interviews were held with the people involved in the project to find more information about the project. This resulted in new information such as:

- Project is carried out together with a large project
- Switch of project manager
- Project executed via COFFEE route

Minutes were made of these interviews but they were not used as in-depth interview information as the questions asked were purely related to this specific project as supporting data and not to the project process.

There were no issues added when the literature review is compared to the issues that were already found.

An overview of the data reduction approach of the surveys and interviews is schematically represented by Figure 9.

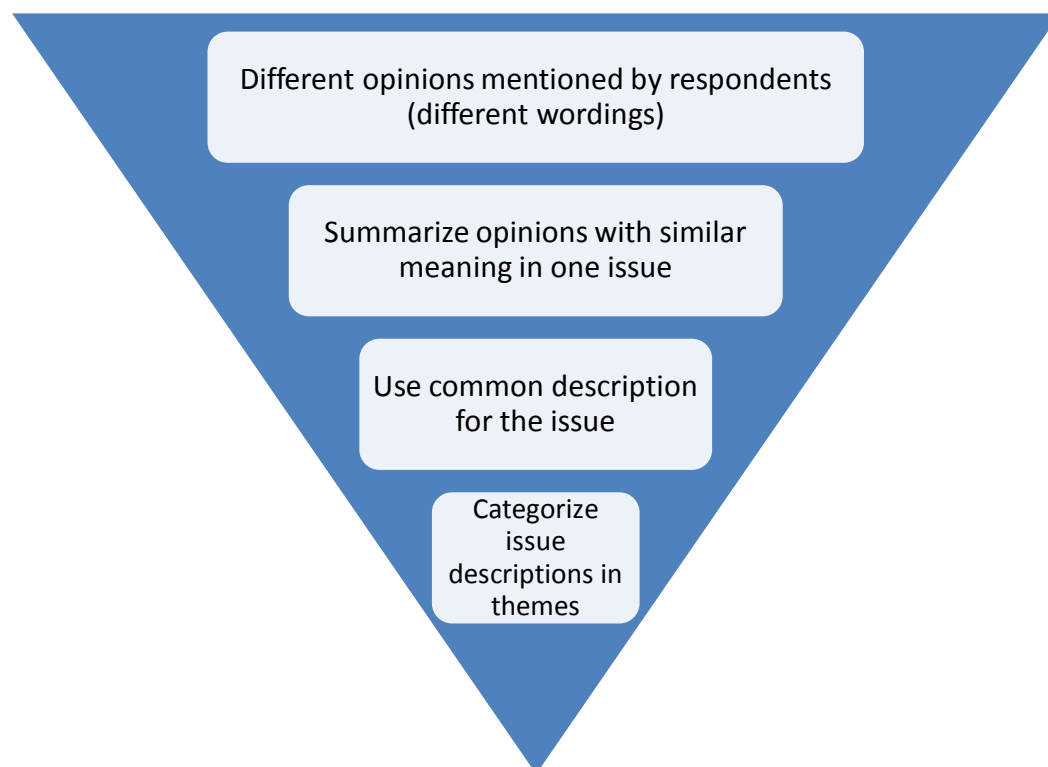


Figure 9: Schematic representation of the data reduction method

Selection of relevant issues

The data presented in the surveys and interviews were opinions and therefore biased. In order to select issues that are most likely to be valid or at least not based on a single opinion selection criteria were defined. An issue is considered to be relevant if it meets the following selection criteria:

- The issue must be indicated by at least three respondent groups because this shows the issue is concerning different stakeholders. One group can have a very strong opinion about a project, but if three groups mention the issue, it is more likely a real issue.
- The issue must have been mentioned by at least seven respondents. This number is found by dividing the total amount of opinions by the total amount of issues. 195 opinions were found and summarized in 27 issues, resulting in an average of 7.2. For this case all issues with an average higher or equally to 7 is used. This criterion is used to select between 'single' opinions and 'shared' opinions
- The same criterion is used for the surveys where 51 issues were mentioned in fourteen issues (average 3,6) so in case of the surveys the equally to four or higher is used for the same reason as the interview criterion

For each criterion that is true the issue is flagged with a '1', otherwise '0' for false. The entire procedure is visualized in Figure 10. The following score is used to determine the relevant issues:

Table 2: Meanings of scores towards validity of issue, 0 = false, 1 = true

Score issue	Meaning to issue
0	No support found
1	Little support found
2	Supported issue
3	Likely to be valid

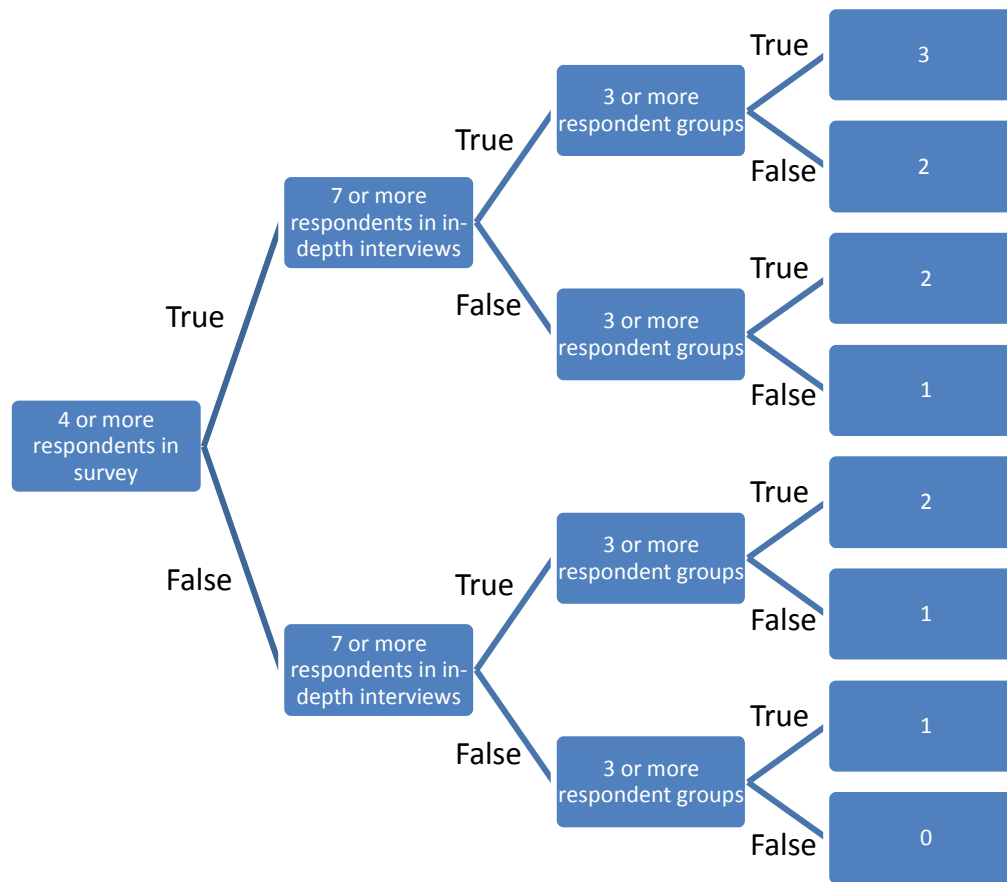


Figure 10: Decision tree to show how the scoring of issues works

Project data is used to support or contradict an issue. The issues that score a '1' or '2' are assumed to be valid if several respondent groups have indicated the problem. If no support found the issue is considered not to be relevant as the opinion of a respondent is not supported by any other respondent. The limitations of this research approach and the corresponding data reduction method are discussed in chapter 7.

5.3. Data evaluation

This paragraph is used to evaluate the data according to the scores introduced in the previous chapter. The 25 issues are presented per theme¹¹. For each issue it is decided whether it is believed to valid or not. A detailed discussion can be found in the next chapter. If an issue is not considered to be valid, a short explanation is given why not. If support is found in the examined project data, this will be explained in this chapter. For each of the issues presented in the tables, the issue score as given by the schematic in Figure 10 as well as the number of people per respondent group that mentioned the issue is given.

5.3.1. Project classification

This paragraph discusses the issues found related to the theme of project classification.

Table 3: Results project classification; RT = refinery technology, PU = production unit, PM = project manager, number indicates number of respondents, dash indicates no information available

Issue number	Issue	Survey	Interviews	Project data	Score issue
2	CAPEX/OPEX issues may distract people from in which manner a change should be executed	0	2 RTP 4 PU 1 RT 1 Rest	-	2
20	The financial division is not always suitable as only selection	2	2 RTP 3 PU 2 RT	2 projects executed via COFFEE route	2
38	Plant changes are faster and cheaper compared to a small project	8	0	Not valid, based on cost ratio hardware/total	1

- Issue number 2 is considered to be relevant as it is mentioned by more than seven respondents in the interviews and by more than three respondent groups however no support in project data was found for this issue.
- Issue number 20 is considered to be relevant. Additional support for this issue is found in literature, where projects are defined as changes that have a beginning and an end. Shell Pernis primarily focuses on the larger or smaller than USD 50,000 classification to determine what a capital project is.
- Issue number 38 is only found in the surveys. Half (8 out of 15) of the technologists share the idea that plant changes are in general cheaper and faster executed compared to small

¹¹ Issue number 5, 27 and 33 do not exist because in the analysis stage it was discovered that they were mentioned twice (and changing the numbers would mean much rework). Issue number 4 and 26 are used to support other issues (but differ too much from the related issue to be considered as one issue). Issue number 12, 25, 28, 29, 30, 31, 32, 34, 35 and 37 are not discussed because they are considered to be related to areas that are outside the scope of this research.

projects. Their opinion might be true, as plant changes in general concern smaller changes compared to a small project (thus less expensive), where the idea is often already known (solution driven change and thus faster). This results that the first three phases are skipped. It should be taken into account that the plant change approach might be more vulnerable for ongoing changes due to the minimizations of the first three steps.

As plant changes were not the main focus of this research only a small selection is taken to compare cost of plant changes against cost of small projects. When the cost of plant changes is compared to the cost of small projects, it is seen that the percentage hardware cost (total installed cost) for plant changes is lower compared to small projects. This contradicts the fact that plant changes would be executed cheaper compared to small projects. The run time of plant changes is generally shorter (but still over a year), but this is because a plant change is a relatively easy change. So, project archive data provides evidence contrary to the idea that plant changes are faster and cheaper. Therefore, this issue is not considered to be valid.

5.3.2. Fit for purpose execution

Fit for purpose execution means project execution without any unnecessary steps involved. The issues mentioned that belong to this theme are summarized in Table 4:

Table 4: Results fit for purpose execution; RT = refinery technology, PU = production unit, PM = project manager, number indicates number of respondents, dash indicates no information available

Issue number	Issue	Survey	Interviews	Project data	Score issue
1	The same structure can be used for every small project, but over processing is a risk	9	7 RTP 9 PU 4 RT 2 Rest	Different processes selected depending on type of project	3
7	Contracting engineer focusses on quality and not on fit for purpose engineering	4	7 RTP 8 PU 3 RT 4 Rest	Engineering cost increase from EAR/BOD to BDEP	3

- Issue number 1 is relevant. When looked at project data it is seen that project managers select different processes to mitigate certain risks in the process indicating that the structure is adapted to prevent over processing. In the project data it is observed that the Select and Define stages are often combined to avoid over processing. It is also seen that the processes chosen by the project manager differ per project, but this observation could not be generalized as much of these plans were missing in the examined project data. With the supporting project data and the score of the surveys and interviews this issue is considered to be valid. This issue is supported by literature where the adaptive project management approaches plead for a project specific approach (instead of a general approach).
- Considering the score of issue number 7 in the interviews and surveys this issue is considered to be valid. Additionally the project data show that the engineering cost increase during

development of the project (from the BOD estimate to the BDEP estimate). This is often not a problem because the total cost estimate stays within range, but a trend is observed in increasing cost which might be related to the fit for purpose engineering of the engineering contractor. There are many respondents that have indicated that this issue is valid.

5.3.3. Project team

The issues related to the theme project team are tabulated in this paragraph.

Table 5: Results project team; RT = refinery technology, PU = production unit, PM = project manager, number indicates number of respondents, dash indicates no information available

Issue number	Issue	Survey	Interviews	Project data	Score issue
8	The BOM role is not clear	2	5 RTP 2 PU 1 RT 2 Rest	-	2
9	Performance indicators differ per stakeholder	1	3 RTP 2 PU 2 RT 1 Rest	-	2
10	Different stakeholders do not work well together	6	6 RTP 9 PU 5 RT 1 Rest	-	3
13	High turnaround of project managers leads to loss of knowledge	1	2 RTP 4 PU - 1 Rest	Supported by 2 projects (causing delay)	2
14	Traits of a project manager are important in project execution	1	2 RTP 1 PU 3 RT 1 Rest	-	2
17	Contracting engineer is sometimes limited in capacity	0	1 RTP - - -	-	0
22	The perception of different responsibilities per project result in varying expectations and commitment in a project	0	- - 1 RT 1 Rest	-	0
26	Cost estimate of RTP could be more challenged on reduction of cost	0	- - 1 RT -	-	0

- Issue 8 describes the role of the Business Opportunity Manager in a project. It is indicated by the respondents that the role is unclear. The issue is likely to be valid and important because if roles and goals are not clear this is likely to impact the outcome of a project.

- Issue 9 describes a part of the dynamics of a project team. It relates to the importance specific stakeholders attribute to performance indicators. For example, stakeholders with a technological role in the project may consider the performance indicator of technological quality to be more important than other performance indicators such as within budget and time. The issue is considered to be valid.
- Issue 10 together with issue 1 (similar structure that is used for every project is risking over processing) and issue 7 (fit for purpose engineering by the engineering contractor) scores the highest in the interviews with respectively 21 respondents that have given an answer concerning team work. There is no direct support found in project data for this issue (difficult to measure team work) but considering the score this issue is found to be supported.
- Issue 13 describes the turnaround of project managers. The finding is ranked with a '2' and supported by two projects in which a switch of project managers is mentioned and project delay is observed. This issue is mentioned in the literature review as having a high impact on the progress of a project and it is therefore assumed to be valid.
- Issue 14 is ranked with a 2 and is assumed to be valid, also based on the findings in literature.
- Issue 17 concerns the capacity of the contracting engineering. The respondent is worried that the workload of the contractor is too high and that work is shifted from one pile to another pile. As no other respondents mentioned this when talking about the cooperation with external parties, this issue is not deemed to be valid.
- Issue 22 is discussing the varying expectations and commitment in a project. It is believed that this is an issue although no direct support is found for it. This is because the issue is hidden in other issues. It was not possible to place the issue under another one. The respondents who said this might summarize many issues in one. This issue is not further discussed, but in the discussion in the next chapter it will be indicated where commitment and expectations can play a role.
- Issue 26 deals with the cost estimate of the project organization which is stated to be over-estimated by a few respondents. Although hardly any support for this issue is found the issue might be playing an indirect role in issue 9. One of the performance indicators of a project manager is whether the project manager has finished projects within budget. An over run (although within the range that is allowed) is difficult as additional financial resources must be requested (which is challenged). This might give cause for over estimating. However, considering the fact that the cost estimate is not made by the project manager, it is not likely that this is the case. Given the fact that no support is found for this issue; the issue is not discussed any further.

5.3.4. Front end development

The last theme concerns front end development. Issues related to this theme are given in Table 6:

Table 6: Front end development; RT = refinery technology, PU = production unit, PM = project manager, number indicates number of respondents, dash indicates no information available

Issue number	Issue	Survey	Interviews	Project data	Score issue
3	Projects are initiated too late	2	5 RTP 4 PU 3 RT 1 Rest	17 % is schedule driven	2
4	Late scope changes require much planning and resource rescheduling of the organization	-	1 RTP 1 PU 1 RT -	-	0
6	Scope definition is not always clear and complete	7	6 RTP 3 PU 0 RT 3 Rest	-	3
15	The quality of the EAR is not sufficient	4	3 RTP 4 PU 5 RT 3 Rest	1 project used to assess different options	3
16	Cost are underestimated in a PIN	0	4 RTP 2 PU 2 RTP 1 Rest	Cost growth occurs	2
18	Sometimes people are focused too much on the solution and not on the possibilities	0	1 RTP 1 PU - -	The PIN requires a possible solution	0
19	Efficiency should be gained in Identify, Assess and Select	0	2 RTP 4 PU - -	-	0
23	At the end of BOD a selection must be made but big ticket items are often still open	0	- - 1 RT 1 Rest	-	0
24	Deadlines for cost driven projects are easier moved	0	- - 1 RT 1 Rest	-	0

- Issue 3 is discussing project initiation. Support is found for this issue, also in project data. Although the project data is not complete, at least 17% of the projects (assuming that all projects for which no data was available were cost driven projects) are schedule driven compared to 10% of the industry standard (benchmarked by IPA). This issue is considered to be valid.

- Issue 6 is supported by issue 4 (“If there are after scope freeze scope changes then much planning is required to implement these changes”) but issue number 4 is not directly supported. In order to prevent issue 4, issue number 6 must be solved. It is believed that a good scope definition leads to better execution and this is also shown in the score. The issue is considered to be relevant, also because scope definition is an output of front end development. The EAR and BOD format require describing scope changes. These scope changes are minor changes compared to the first scope and are allowed (a final selection must be made at the end of Select).
- Issue 15 is considered to be valid and the project data shows that at the End of Assess often a selection is already made (only one project is used to assess different options). It is also supported by the literature because the EAR is part of front end development. If the EAR is not the quality it should be this would hamper the stage gate process of front end development.
- Issue 16 is considered to be valid and finds support in the project data. Additionally it has been observed in project data that 40% of the cost estimates are deviating from PIN to BDEP outside the cost estimate range¹². This trend is also present from BOD to BDEP (18%) and therefore this issue is extended to: Costs are generally underestimated.
- Issue number 18 discusses the function of the first two phases where Identify should be used to understand the problem and Assess to determine whether all solutions have been considered. Because the PIN requires a possible solution (as observed in the PIN format), it might be the case that people (e.g. the BOM) remain focused on that solution during Assess. The Assess phase is then not used a scouting study. The issue does not receive a lot of support and this is probably due to the fact that people are not aware of this behavior. This is an assumption that is not supported by project data and this issue is not further discussed.
- Issue 19 describes the importance of front end development. The score of this issue is 0 although it is an important issue (as mentioned in literature, see section 4.4). This is probably due to the fact that most of these issues related to front end development are more specific (and therefore this issue is not taken into account).
- Issue number 23 describes the fact that sometimes big items are not addressed at the end of the Select phase. This is a problem, but not acknowledged by many respondents and therefore not discussed any further.
- Issue number 24 is involving the planning of deadlines. There is no proof in project data nor any support found and therefore it is not likely that this is an issue.

¹² Every cost estimate has a certain range. A BOD cost estimate is allowed a 15% under run and a 25% over run. These numbers are taken into account when determining whether the cost estimate is accurate or not.

5.3.5. Additional issues

During the interviews different issues were mentioned which did not fit in a theme. These issues are presented here with a short discussion.

Table 7: Front end development; RT = refinery technology, PU = production unit, PM = project manager, number indicates number of respondents, dash indicates no information available

Issue number	Issue	Survey	Interviews	Project data	Score issue
11	Engineering contractor works according to a fully reimbursable contract which is not competitive	0	1 RTP 2 PU 1 RT -	-	1
21	If one project/daily activity requires more attention the other projects receive less	2	2 RTP 4 PU 1 RT 1 Rest	-	2
36	There are not enough projects cancelled in the first three phases	0	1 RTP - - 1 Rest	-	0

- Issue number 11 involves the cooperation with engineering contractor and could be valid in relationship with issue 7. This will be discussed in the next chapter.
- Issue number 21 is considered to be valid although no project data it was found to support it.
- Issue 36 is discussing the project funnel at Shell Pernis. There is no support found that too few projects are cancelled and therefore this issue is not considered in the following chapter.

5.4. Conclusion relevant issues

There are 15 issues that are considered to be relevant and no additional themes were identified. The list of relevant issues is as follows:

Table 8: Presentation of the relevant issues

Issue number	Issue	Theme	Score issue
1	The same structure can be used for every small project, but over processing is a risk	Fit for purpose execution	3
2	CAPEX/OPEX issues may distract people from in which manner a change should be executed	Project classification	2
3	Projects are initiated too late	Front end development	2
6 (+4)	Scope definition is not always clear and complete	Front end development	3
7	Contracting engineer focusses on quality and not on fit for purpose engineering	Fit for purpose execution	3
8	The BOM role is not clear	Project team	2
9	Performance indicators differ per stakeholder	Project team	2
10	Different stakeholders do not work well together	Project team	3
11	Engineering contractor works according to a fully reimbursable contract which is not competitive	Additional item	1
13	High turnaround of project managers leads to loss of knowledge	Project team	2
14	Traits of a project manager are important in project execution	Project team	2
15	The quality of the EAR is not sufficient	Front end development	3
16	Cost are in general underestimated	Front end development	2
20	The financial division is not always suitable as only selection	Project classification	2
21	If one project/daily activity requires more attention the other projects receive less	Additional item	2

The issues are discussed in more detail in the following chapter including the possible relationship the issues have. This possible relationship is an interpretation of the research and not based on data.

6. Discussion

This chapter is meant to provide a discussion and interpretation of the relevant issues established in the previous chapter and to provide recommendations for the top five important issues. The information that was presented in chapter 4 (literature and ORM review) is summarized per issue summarized whenever this is relevant. The discussion is again summarized in themes. The chapter is divided into three parts:

1. The issues are explained and interpreted in more detail based on the information gathered from interviews, surveys and project data. Based on the interpretation of the data and experience gained through the project some issues are considered to be related to others (paragraph 6.1).
2. A ranking method is introduced which is often used in product and process development. This method is used to indicate relationship between different issues and to determine which issues are the most important. This tool is called House of Quality (from the Quality Function Deployment method) and is introduced in paragraph 6.2.
3. The five most important issues are then used to provide recommendations to improve the current situation (paragraph 6.3).

6.1. Relevant issues

This paragraph is used to provide more background and discussion about the relevant issues. The information that is described is specific to Shell Pernis unless indicated otherwise.

6.1.1. Project classification

Two issues (number 2 and 20) are considered to be relevant in this theme.

Table 9: Identified issues in the theme project classification

Issue number	Issue	Theme	Score issue
2	CAPEX/OPEX issues may distract people from in which manner a change should be executed	Project classification	2
20	The financial division is not always suitable as only selection	Project classification	2

Issue 2:

This issue describes the fact that initiators of projects are looking in ways to classify the change as operational (plant change) or capital expenditure. Two factors are identified to contribute most to this issue:

- Some production units prefer plant changes above small projects because they have the feeling to be more in control of time and cost and can prevent over processing. The cost estimate is the factor that is determining whether something becomes a plant change or a small project.
- People could leave scope out to stay below the capitalization threshold (or just put too much scope in to ensure it becomes a project on CAPEX budget). This is done because operational

expenditure is part of the production unit's budget, whereas capital expenditure is a site-wide budget.

This issue is moderately related to issue 1 because some stakeholders believe that small projects are over processed.

Issue 20:

This issue describes the classification based on operational and capital cost.

- Everything below USD 50,000 is considered as a plant change and everything above the threshold a capital project. It is acknowledged by the respondents that another classification is more suitable because the differences between plant changes and small projects. The main differences between plant changes and small projects are:
 - A plant change is initiated by a plant change form and a small project by a Project Initiation Note. In general a plant change exists of a simple change to the system, where not a lot of divergent thinking is required because the solution is simple or already known. Projects on the contrary, following three phases in order to select the best option and have three deliverables as output (PIN, EAR and BOD).
 - A plant change starts with a plant change “accorderings vergadering”, where all relevant disciplines are involved. A project starts with a First Contact Meeting but this is primarily meant as formal handover of the project from the BOM to the project manager. The involvement of relevant technical disciplines at the beginning of a project is not self-evident as it is for plant changes.
- The finance department determines whether it is operational or capital expenditure but this still does not have to mean that operational expenditure should follow a plant change route and a capital expenditure will follow a project route. Some plant changes could need the project structure while some projects require a plant change approach.
- The project definition of Shell Pernis differs from the project definition in literature. The question is whether the current project definition of Shell Pernis is sufficient enough to separate plant changes (which are assumed to be relatively simple compared to projects) from small projects. Other classifications might be more suitable such as a classification based on project type or complexity.
- The use of complexity of a project or the amount of risks involved is not standard taken into account in Pernis, although a shift is made by introducing the COFFEE route. The COFFEE route enables simple CAPEX projects to be executed via a plant change route. However, this does not cover fit for purpose execution for other small (more complex) projects.

This issue is strongly related to issue 1 and weakly to issue 2 because the financial classification may cause over processing and reasons for stakeholders to work around the financial classification (although insufficient proof has been found to support this idea and therefore this relationship has been indicated as weak).

6.1.2. Fit for purpose execution

Issue number 1 and 7 are identified in the theme fit for purpose execution.

Table 10: Identified issue in the theme fit for purpose execution

Issue number	Issue	Theme	Score issue
1	The same structure can be used for every small project, but over processing is a risk	Fit for purpose execution	3
7	Contracting engineer focusses on quality and not on fit for purpose engineering	Fit for purpose execution	3

Issue 1:

This issue suggests that for some projects it is too much to follow each step described in the process.

- The same project structure is used for every small project, while there is a large difference between these projects concerning complexity and type (e.g. similar to maintenance or implementing a new technology). The project steps are followed because this ensures that nothing no important details can be forgotten, but the question is whether this is needed for every project or whether a fit for purpose approach is needed.
- The added deliverables (defined in the literature review) in Pernis (PIN and EAR) could play a role with this issue as for some projects an extensive scouting phase might not be needed and the EAR could be a deliverable with too much requirements.
- The ORM prescribes the minimal requirements that are needed when projects are executed. These requirements are not mandatory for every project at Shell Pernis, in order to enable fit for purpose execution. It became clear from the interviews that Shell Pernis skips steps from the project process in order to avoid over processing instead of scaling them.
- The COFFEE route is initiated to provide a route for simple capital projects to be executed as a plant change, but this does not completely solve the issues found in the execution of small projects

This issue shows a moderate relationship with project classification (issue 20), because the structure is chosen based on the classification, but it is not the main reason why over processing might occur (and thus it is not considered to be strongly related to issue 20).

Issue 7:

Issue number 7 is discussing the alliance with the engineering contractor.

- The engineering contractor receives assignments from Shell. The engineering contractor is responsible for making sure the designs are meeting the engineering standards and comply with the law. In previous years, quality was very important. With the financial crisis, it becomes more important to reduce cost while maintaining the same quality. This can only be done when the assignment is specified and when there are clear agreements about the

progress of the project. According to the information given by the respondents, this is not always the case.

- The engineering contractor receives assignments which are not clear or do not seem to fit with their work approach.
- Both parties have important interests but use a different business model, where the engineering contractor is paid by hour. This might impact the incentive for fit for purpose engineering.
- The current cost estimate¹³ for engineering cost often rises from BOD to BDEP. It could be that the engineering work is overestimated and or that the assignment is not clear leading to rework or that there is too much work outsourced while it would be more fit for purpose to do this work in-house by site based engineers (as the refinery of Shell in Germany often does).
- A lot of the work in the Select phase and Define phase is outsourced. The Define phase requires a BDEP in which detailed engineering is needed and therefore outsourcing is needed because detailed engineering is not the core business of Shell. The BOD is often outsourced which requires a detailed EAR. There is some engineering knowledge available at site and the projects in which this knowledge is used seem to be more efficient. It might be the case that too much work is outsourced in the Select phase¹⁴.

This issue is strongly related to issue 10 because it describes cooperation between Shell and the engineering contractor. It is also strongly related to issue 9 as the business model of the engineering contractor is based on a different performance indicator than is most important for Shell. Issue 7 has a moderate relation with issue 15 because if the engineering contractor is responsible for the BOD, often the BOD seems to be re-written to adhere to the quality standards.

¹³ The cost of the engineering contractor is bench marked and in some cases the engineering contractor is more expensive but it was not possible to retrieve data from this bench mark.

¹⁴ The site in Moerdijk often writes its BODs internally and outsources the BDEPs. This might be possible because the site is smaller compared to Shell Pernis (4 units in Shell Moerdijk against 9 in Shell Pernis)

6.1.3. Project team

The theme project team now consists of five issues.

Table 11: Identified issues in the theme project team

Issue number	Issue	Theme	Score issue
8	The BOM role is not clear	Project team	2
9	Performance indicators differ per stakeholder	Project team	2
10	Different stakeholders do not work well together	Project team	3
13	High turnaround of project managers leads to loss of knowledge	Project team	2
14	Traits of a project manager are important in project execution	Project team	2

Issue 8:

The role of the Business Opportunity Manager is to manage the business opportunity in a project. The role of the BOM (together with the project manager) has a large impact on the outcome of the project (literature review, paragraph 4.3.1).

- One respondent answered that he did not understand which business opportunity should be managed. The BOM is responsible for the delivery of the first two phases and for small projects he/she is the author for these deliverables. A BOM should manage the business opportunity by finding the most suitable option possible but this might be difficult because he/she is also the author of the first two documents, which can make it difficult to remain objective. Often the BOM is focusing on one solution because the PIN and EAR are single-author documents and because the BOM has a particular background.
- A BOM has a particular discipline (technologist or process engineer) while the project requires more areas of expertise. The BOM is responsible to involve the relevant disciplines to provide input and to take into account the economical, commercial, organizational and political aspects of a project. But the BOM role description states that all alternatives must be considered and that the BOM should take care of a complete scope. This is not always observed. A kick off meeting is held between Identify and Assess with the people involved of the production unit, but often technical disciplines are not involved in these meetings to keep them fit for purpose. The valuable input of these disciplines who know the field, is then missed.
- Furthermore a BOM is not experienced or trained to be responsible for the first two phases. A BOM often is only a few times involved with a project. This results in the fact that a project often focusses on the area of expertise of the BOM, not taken into account other disciplines. The BOM should involve other disciplines in the development of the project to ensure complete scoping, but sometimes it is difficult to get these other disciplines involved as it is not 'their' project. The experience of the BOM is hardly taken into account when people are assigned to the project, whereas a balanced project team is important for the progress of a project and to ensure that all items are addressed to.

- From project data it is seen that the EAR is often not used as a scouting phase. The first two phases are important to diverge and at the end of Select there should be a selection made. Within Shell Pernis there is a lot of challenge of the EAR (as the refinery technologists indicate in the survey) forcing the BOM to make a selection at the end of Assess. This is important, because often the next phase is outsourced to a contractor party. If the EAR is not detailed, outsourcing would not be possible without a lot of rework. This has an impact on the level and quality of the EAR and often the BOM did not anticipate this and sometimes the BOM has underestimated the amount of work involved for the EAR. This causes delays in the delivery of the EARs which are checked by the DRB-1. This is not a problem as long as the project does not immediately become schedule driven, because a schedule driven project (often) pressurizes the organization in terms of workload.

This issue is related to issue number 6 (strong) as the influence of the BOM on the definition of the project scope is large because he/she is responsible for a proper scope definition. The issue is also moderately related to issue 9 and 10 because it is hard to form a project team (as the BOM is responsible for the phases where it is officially not a project yet). Lastly this issue is strongly related to issue 15 because the performance of the BOM is of great influence of the quality of the EAR.

Issue 9:

Every team member has different performance indicators which can influence the project.

- The first two phases are not part of the project, but are still important for the development of the project. These phases are for instance not taken in to account in the project key performance indicators (such as within time and budget). Officially a project manager is not involved in the development of the first two phases.
- The project performance indicators for the project department are based on whether the project was within budget, but these performance indicators are not shared with, for instance, the BOM. This results in a force field which is healthy, but it also leads to the fact that project managers may be aloof in their estimation (as it is a performance indicator). There is no hard proof found, but it is indicated by several respondents. The fact that people have different interest in a project ensures that some people are dedicated to a project while others are less committed.

This issue is considered to be moderately related with issue 21: when the daily work of the team members requires immediate attention, this results in less attention for the project. A strong relationship with issue 10 is assumed because the performance indicators seem to hinder good cooperation between stakeholders.

Issue 10:

The cooperation between different stakeholders is already mentioned in the previous issues. But this issue also includes the communication between stakeholders about the project and the involvement of stakeholders. The cooperation between different groups is visualized in Figure 11. This is an interpretation of the information that was gained during the research, but illustrates the following:

- The relationship between the four stakeholders is represented in Figure 11. Front end development is referring to the preparation phases of the project (Identify, Asses, Select, Define) and back end development is referring to Execute and Operate where the operational disciplines become involved. As shown in the figure the current situation already divides the involvement of different stakeholders in the project process. When there is little focus on the middle segment of the four stakeholders and cooperation between front end and back end stakeholders, it is less likely that a project is executed fit for purpose. The back end developers might have valuable input for the front end developments (or a more practical solution from their field of expertise). Earlier involvement of relevant stakeholders also prevents iterative loops and ensures that discussions are held prior to project definition which enhances fit for purpose execution.

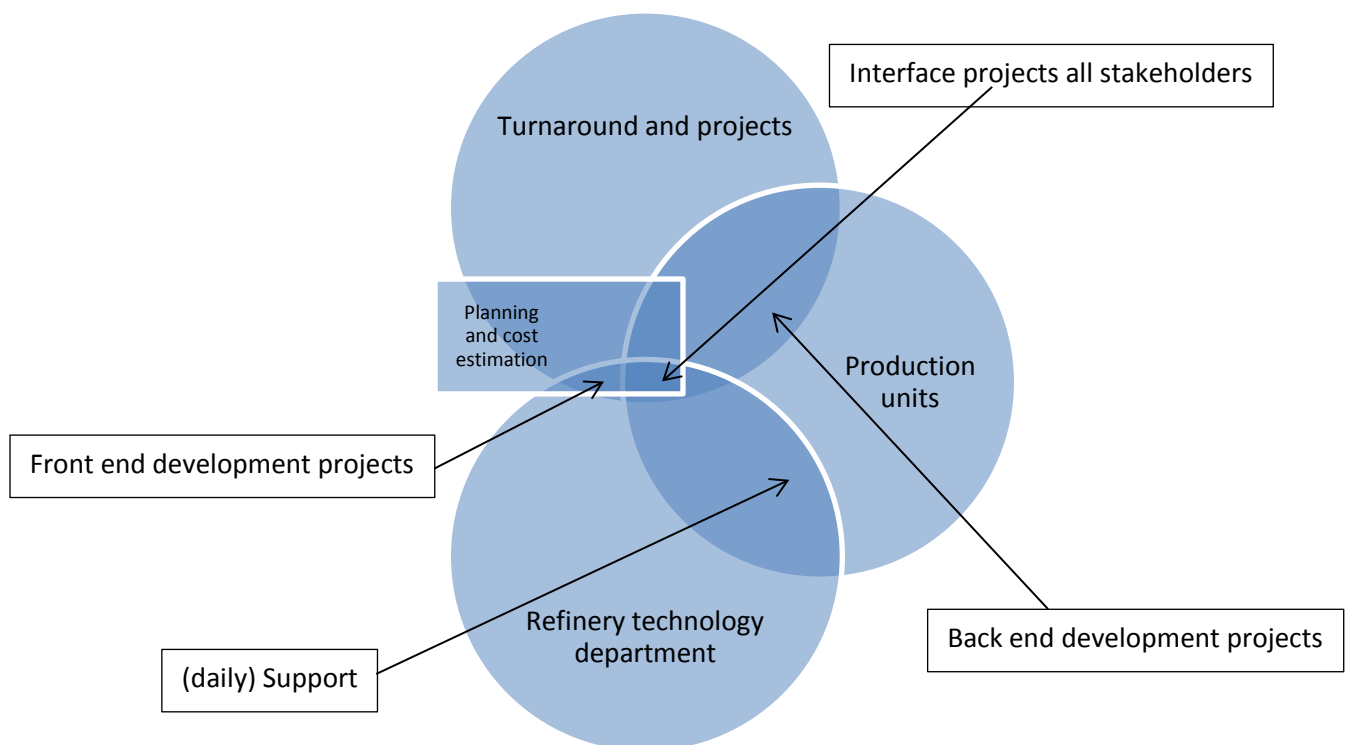


Figure 11: Schematic representation of stakeholders in this research¹⁵

- The formation of a project team (a Business Opportunity Team) is done but the formation of the team is often a formal process. The team does not meet regularly and if meetings are planned the priorities to attend these meetings appears to be low according to the respondents.

¹⁵ The engineering contractor is not visualized in Figure 10, as it only shows the linkages between internal stakeholders at Shell Pernis. The engineering contractor is mainly involved with the project department and process engineering of the refinery department when projects are involved.

- Stakeholders should also show more commitment to the project because often they provide input too late, which sometimes results in a missed deadline or iterative loops because rework must be done to implement the changes.
- Sometimes meetings are held (a kick off meeting between Identify and Assess) and a First Contact Meeting (between Assess and Select) where not all stakeholders are present. This can have a great impact on the progress of a project because during these meetings the way forward is determined and this should be accepted by all stakeholders. In these meetings it can also be decided who is accountable for what which aligns expectations and ensures that someone is responsible for a particular part of the project.
- Management of expectations and good communication is also very important because the production units sometimes feel that projects are 'far away'. The first phases can be developed by process engineers or unit technologists (related to the production unit but not physically located in the unit) or production specialists (located within the production unit). The latter occurs mostly at the chemical production units, as there are more resources available compared to the refinery, but it creates awareness of the project by the production unit. Also the production unit should show involvement to improve fit for purpose project execution.
- This issue also involves the cooperation with the engineering contractor because if these groups are not working well together this is of great impact on the progress of the project. If the assignment is formulated well this might lead to less 'quality engineering' (and more fit for purpose engineering).

This issue is moderately related to issue 21 because other priorities require more attention making it not possible to attend meetings. The issue is strongly related to issue 7 because the cooperation with the engineering contractor is also directly dependent on the interaction between the different stakeholders.

Issue 13:

Most small projects have an average running time of two years. Job rotations occur (on average) every four years within Shell.

- The issue describes that when a project manager is changed, there is loss of knowledge and this is not efficient for the progress of the project. Often there is no time for a good handover of the project, which often results in rework.
- If a formation of a project team changes this should be communicated to all stakeholders to ensure that it is clear who is the project manager and thus the leader of the project.

This issue has a weak relationship with issue 14 because a project manager is important for a project team and this might be underestimated. It is also moderate related to issue number 10 because if a change is not well communicated this impacts the cooperation between the involved stakeholders.

Issue 14:

This issue describes the characteristics (such as leadership) of a project manager and the important influence in project execution.

- A project manager is in the lead of a project but this must also be clear towards the other stakeholders. This issue is based on the fact that some project managers are capable of aligning stakeholders and keeping them informed, while others are less strong in this. The task of a project manager is to lead the project team and to cut scope discussions if that is necessary to keep momentum in the project.
- Some project managers are able to apply the minimal steps that are needed for fit for purpose execution but others keep very strict to the rules in order to adhere safety.
- Not every project team is working well together.

This issue is moderately related to issue 10 because the traits of a project manager influence a project team.

6.1.4. Front end development

There are five issues identified concerning front end development.

Table 12: Identified issues in the theme front end development

Issue number	Issue	Theme	Score issue
3	Projects are initiated too late	Front end development	2
6 (+4)	Scope definition is not always clear and complete	Front end development	3
15	The quality of the EAR is not sufficient	Front end development	3
16	Cost are in general underestimated	Front end development	2

Issue 3:

Projects are initiated too late which might give a problem because the project becomes schedule driven or pressurizes the organization because resources are required for the project to finish it in time.

- Cooperation is needed to recognize projects in time. If this happens, projects can be well prepared. This is especially valid for turnaround related projects. A reason that projects are not in time initiated can be that other daily priorities require more attention or because there are resource constraints which makes it (or appears to be) difficult to initiate a project as there are not enough people within the production unit. If a project is started in time there is enough time for preparation which will benefit front end development.
- Some groups know already that a project is coming but they do not initiate the project because it is not their responsibility. They report their findings in terms of an advice, so the 'problem' is handed over to the next stakeholder who is not committed to do something with it until it is really necessary.

This issue is related to issue number 10 (strong) because if different stakeholders work well together this might also lead to in time project initiation (shared feeling of responsibility) and it has a weak relationship with issue 6 because when a project is initiated too late this might impact scope development due to time pressure.

Issue 6:

The scope must be clear and well defined including all scope elements otherwise this will influence the project result (as shown in Figure 6). The scope is allowed to change until the end of Select. But the scope must be as complete as possible in an early stage to ensure that stakeholder expectations are aligned.

- Prior to a good scope definition a good problem definition is required and this is related to issue 16 where is stated that the PIN cost estimate is often lower than the real project cost. This is (partially) due to the fact that the problem might not be well formulated, which makes it difficult to define the scope, which impacts the cost estimates. A project manager is involved at the End of Assess to ensure that all items are addressed, but then the problem and scope are already defined.
- This issue is related to the BOM role because the BOM is responsible that the problem is clear and the scope is complete (including input of all relevant disciplines).
- “Go and see” is needed to check whether the drawings are still up to date and no unnecessary work is carried out.
- If the scope is not well developed this will lead to inefficiencies in a later stage and it is likely that rework will occur (unexpected issues). It should be taken into account that not everything is predictable, so there must be room for discovery scope (e.g. a vessel is opened in a turnaround and the damage is more severe than expected).
- Another contribution of a proper scope definition is that a good focus is provided on the risks involved. This enables decision making which tools are needed to mitigate the risks.

This issue is related to issue number 10 because if all stakeholders are committed and aligned, it is believed that the scope can be better developed because all input and comments are given in time. This issue is also strongly related to issue 16 because the definition of the scope leads to a proper cost estimate in the PIN.

Issue 15:

This issue exists of the two seemingly contrary ideas that the quality is not sufficient or too many details are included in the EAR. This indicates that the current EAR is not carried out satisfactorily. To improve, respondents suggest to either increase or decrease the level of detail, but not something in between.

- It is observed in the project data that this phase is not used a scouting phase (as the ORM describes) but as a selection phase.

- It should be clear in the project structure where the EAR is intended for (e.g. for assessment or selection) and the BOM should be aware of what the function of an EAR is, thus an EAR should not only focus on a technical scope but should include broader aspects.
- The EAR is a lighter version of the BOD (same format).
- Often an engineering contractor is involved in the Select phase. Respondents mention that a good EAR does decrease the work for the BOD but this remains unnoticed when it is outsourced because the engineering contractor needs to guarantee quality and would rewrite the EAR in a BOD format.
- Another fact that can impact the development of the EAR and the BOD is that the EAR belongs to an initiative and the BOD to a project phase. This stresses the importance of the handover between EAR and BOD.

Issue number 15 is assumed to be strongly related to issue 1 because the project structure requires the writing of an EAR, followed by a BOD. It is also strongly related to issue 8 because if the BOM role is not clear, it is not likely that the EAR is of sufficient quality. Agreement about the function of an EAR should be obtained in an early phase (moderate related to issue 10) which also impacts the influence the cooperation between the engineering contractor and Shell because it can be made specific what is required (moderate relationship with issue 7). A low quality EAR is likely not to include a good scope definition (issue 6, moderate relationship).

Issue 16:

The cost estimate is often not correct in the different deliverables.

- The PIN is used as an idea box. The initiator is asked to describe the problem, a possible solution and give a cost estimate (which enables portfolio planning). The possible solution distracts an initiator from describing the problem well and often he/she does not include all relevant disciplines and thus does not describe the complete problem. The requirement of a possible solution is needed for a cost estimate, but it must be clear that this is not the mandatory solution and it is still necessary to diverge in the next phase to find the best solution. There is no challenge on the cost estimate before the DRB-1 endorses the PIN (or freezes it).
- The cost estimate also raises expectations of the project. It must be clearly communicated that this cost estimate is accurate within the given margins.
- It is observed in project data that the cost estimates (especially concerning engineering cost) raise gradually the further the project progresses because the scope might be not complete enough for the cost estimate that is required at the end of each phase.

This issue is strongly related to issue number 6 because if the problem is not well described it is assumed to be more difficult to define a complete scope. The BOM often has not enough knowledge

to provide a clear cost estimate (issue 8) and it has a weak relationship with issue 10 because several stakeholders should cooperate in order to align expectations (including cost) about a project. The BOM role has a role in this issue by ensuring that the phase after the PIN is still used to diverge to find the best options available (weak relationship identified).

6.1.5. Additional issues

This paragraph discusses the two issues found that cannot be classified in a theme.

Table 13: Identified additional issues (not classified in a theme)

Issue number	Issue	Theme	Score issue
11	Engineering contractor works according to a fully reimbursable contract which is not competitive	Additional item	1
21	If one project/daily activity requires more attention the other projects receive less	Additional item	2

Issue 11:

The engineering contractor works according a fully reimbursable contract.

- The engineering contractor therefore has (in theory) little incentive to work as effective as possible. The respondents have indicated that this might be an issue but it is hard to prove.
- There is only one engineering contractor at site and this might also reduce the competitive character of the contractor. On the other hand, this contractor is familiar with the site which also enhances faster execution because they know the site.
- A restriction is that the amount of job rotations within the engineering contractor is large, but no information is available about this topic.
- It is difficult to challenge the engineering contractor on cost estimates, especially because there is no other contractor on site to switch to for the engineering assignment. Some respondents indicated that it is hard to challenge on contracts because there is little engineering knowledge in house, but this could not be validated.

This issue is strongly related to issue 7, because it shows the importance of a well-defined assignment in order to prevent higher costs for the engineering contractor.

Issue 21:

This issue concerns fragmentation of work.

- The BOM for medium and large projects is fulfilled by an experienced person or by someone who is full-time BOM (but not the author for the EAR – so he/she is not challenging their own work as it is now for small projects). For small projects the BOM role is appointed to someone who is not very experienced and has another fulltime job. If a unit technologist is a BOM but operational upset occurs at the unit, it is important to solve that which results in

the fact that the project may become delayed. This can cause problem because in a later stage the BOM needs to reserve more time for the project.

- This can also happen to a project manager who manages several projects at once. Another reason for this issue might originate from the fact that small projects are executed besides people's daily job and underestimated in the amount of effort that is still needed.

Source analysis and impact of individual projects on project portfolio were also mentioned by the respondents but not discussed further because it was outside the scope of this research.

6.1.6. Additional remarks

During the research there are a few items discovered that were not emphasized in the data analysis or literature research.

- A project starts within Shell Pernis officially from the Select phase, although a project manager is often involved at the End of Assess. A project assurance plan, opportunity roadmap and a risk register are often made at the beginning of Select.
- Each production unit has an area project manager. The role of this area project manager is to track the different ongoing projects in the unit and to see whether it is possible to combine projects. This is often difficult because the level of complexity that is required to determine such issues is high.

Conclusion

Fifteen issues were discussed content-wise and relationships were indicated. These relationships provide the input for a ranking tool, called a "House of Quality" (HoQ) which is explained in the next paragraph. This ranking method is used to determine the top five issues, for which recommendations for improvement are given. The additional considerations are taken into account (if relevant) when recommendations are given to improve the current situation.

6.2. House of Quality

In this chapter several relationships have been indicated (subjectively). A tool that may be used for ranking issues based on subjective relationships is the House of Quality (HoQ). This tool originates from a strategy in product and process development called Quality Function Deployment where it is used to, for example, determine the most important technical requirements to a product based on (subjective) customer requirements. The purpose of this particular HoQ is to rank the issues to find the issues that are most likely the ones with the highest impact. This paragraph introduces the House of Quality and how it is normally used. The second part discusses how the House of Quality is used for this analysis purpose and the third part presents the results.

6.2.1. Introduction HoQ

A House of Quality analysis can be used in many situations where the relationships between, for example, customer and technical requirements need to be prioritized. It allows one to roughly quantify the relationships and obtain a weighted score for each technical requirement. It then becomes clear on which technical properties one needs to focus. The House of Quality may be used for many situations where a ranking of certain properties in relation to other characteristics is desired. Very generally, it is a tool for evaluating relationships between known properties with known weights to a set of properties with unknown weights.

However, the House of Quality analysis is not a quantitative tool: it allows one to obtain a ranking, but the values for each relationship are chosen subjectively. For each relationship, it is necessary to assign a number indicating the strength of the relationship (1: weak, 3: moderate and 9: strong). The difference between a weak and a moderate relationship often turns out to be debatable. Some relationships may, for example, be moderately weak. Thus, quantifying these relationships is not the purpose of the House of Quality. Instead, it is often very obvious where the strong relationships between properties may be found. If a technical specification has multiple strong relationships with desired properties, the technical specification will be ranked in the top. The strength of the house of quality analysis is to be able to single out the most important properties and the ranking is accurate for those properties that rank highest. In the lower ranks, there is more uncertainty due to the relationship values becoming more debatable.

In addition, the ‘roof’ of the house of quality allows for easy identification of the interrelationships between technical properties. For a high ranking, and thus important, technical property, the other technical properties that need to be addressed are immediately clear.

6.2.2. Adapting the House of Quality

The House of Quality is normally used to relate (e.g.) client requirements also called “the whats” to (e.g.) functional requirements also referred to as “the hows”. In this case the HoQ is adapted because the list of issues is not linked to such “hows”. In principal the roof can be used to relate issues to each other, in this case that is not possible. The reason for this is that sometimes one issue influences another, but not vice versa and this cannot be indicated in the roof (the roof connects requirements to each other and always assumes influences between properties are also valid vice-versa). Therefore the row and the column that are normally used for client requirements and functional requirements are now used for the same list of issues to allow directionality of relationships and circumvent the limitations of the original ‘roof’ of the HoQ.

The relationship of an issue (strong, moderate or weak) with another issue is determined based on the experience gained during this research and not based on data. This situation is similar to the original application of the HoQ where subjective customer requirements must be related to technical product properties. No reference has been found that the HoQ has ever been used for ranking results of interview data, so as an aside, it is investigated whether this tool is appropriate to rank issues retrieved from interview data. If this is the case, it can be used amongst several respondents to get a more detailed and supported overview of the relationships between the issues. This is not done in this research.

As an example: The BOM role is not clear (issue 8), has an influence on the fact that the scope definition is not clear and not complete (issue 6). This is indicated by following issue 8 in the column (horizontal text) until a cross section is made with issue 6 (vertical text). It is assumed that this is a strong relationship. This is done for all the relationships that are identified in paragraph 6.1. The symbols that are used to indicate relationships are presented in Table 14.

Table 14: Meaning of used symbols in HoQ

Symbol	Meaning
⊖	Strong relationship between issues
○	Moderate relationship between issues
▲	Weak relationship between issues

Explanation of Row/Columns

There are different rows and columns used in the House of Quality and a short description is given here, starting with the columns (left to right) and followed by the rows (that form the foundation of the House).

- Row number refers to the number of the issue (and is therefore not increasing in number)
- Max relationship value in row indicates what the highest value is that is given in that row or column. Often this is 9, indicating that issues are often strongly related to another issue
- Relative weight is calculated by taken the weight/importance of the next column and divide this number by the sum of the weight/importance that is given.
- The weight/importance (from data analysis) are the numbers used to select relevant issues
- Max relationship value in column indicates what the highest value is that is given in that row or column. Often this is 9, indicating that issues are often strongly related to another issue.
- Weight/importance (calculated) uses the relative weight calculated in the row and multiplying it by the strength of the relationship. The number is a sum of the total relationship weights times the relative factor.

Legend	
	Strong Relationship
	Moderate Relationship
	Weak Relationship
	Project classification
	Fit for purpose execution
	Project team
	Front end development
	Additional item

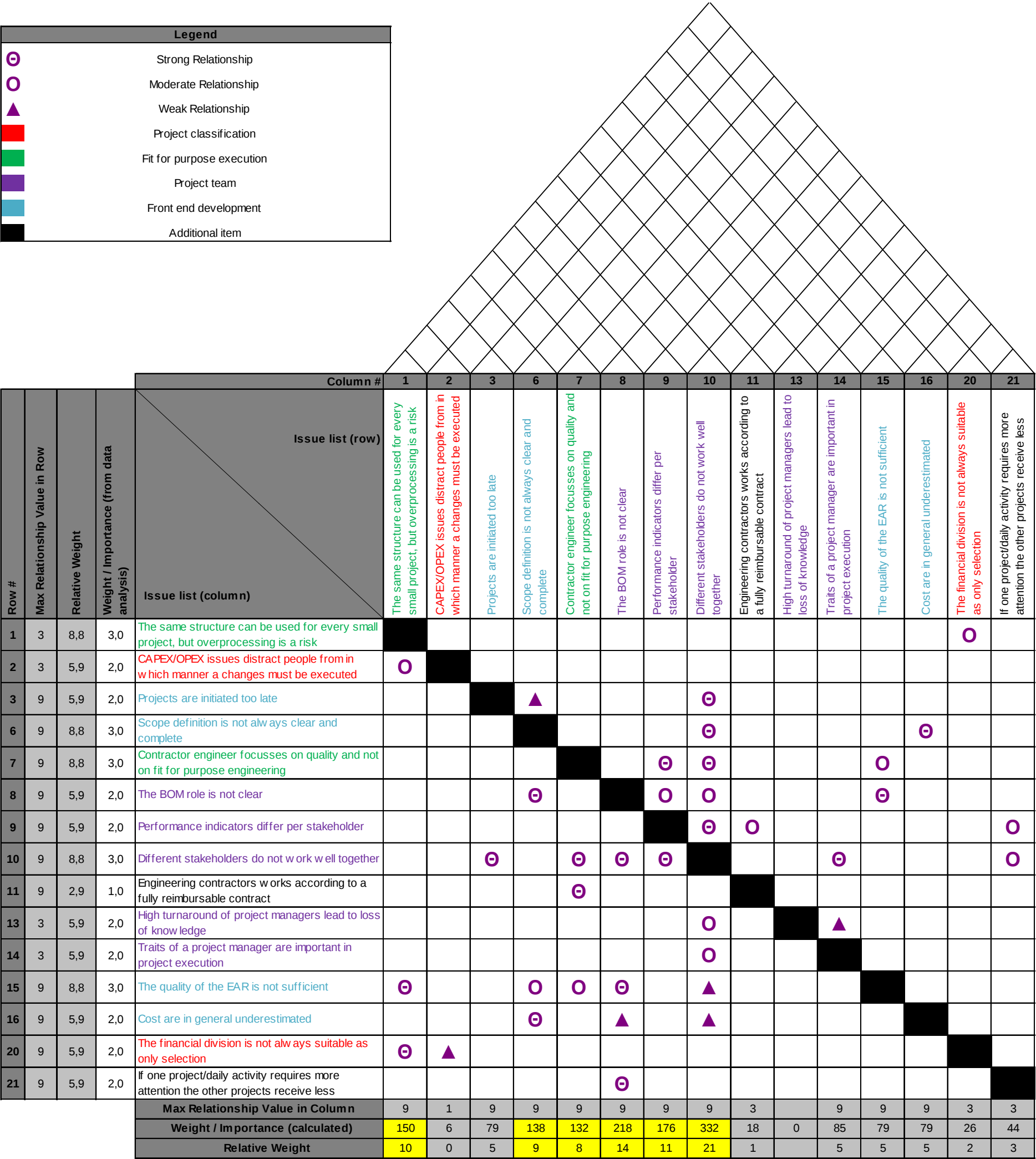


Figure 12: The results of the House of Quality

6.2.3. Results and discussion

The ranking is based on the interpretation of the knowledge gathered during the research and is not validated. The results of the House of Quality are presented in Figure 12. As can be seen not all issues are related to each other but some have more relationships than others. The top six issues that were ranked after using House of Quality are:

1. Different stakeholders do not work well together (project team, issue 10)
2. The BOM role is not clear (project team, issue 8)
3. Performance indicators differ per group (project team, issue 9)
4. The same structure can be used for every small project, but over processing is a risk (fit for purpose execution, issue 1)
5. Scope definition is not always clear and complete (front end development, issue 6)
6. Contractor engineer focusses on quality and not fit for purpose engineering (fit for purpose execution, issue 7)

These issues are selected based on their relative weight and calculated weight/importance. The results are now briefly discussed:

- The first issue exists of several factors. It addresses to the cooperation between different groups concerning project initiation, delivery of input during the development of the project, the influence of the project manager on the project and the cooperation between Shell and the contracting engineering (mainly focusing on different in business model). If cooperation is improved this will not solve all the related issues but reduces their impact in the project execution.
- The second issue involves the definition of the BOM role that is unclear. This has an impact on scope definition, the alignment and cooperation between stakeholders, the quality of the EAR and the fact that the BOM is not a full time BOM for a small project. If the BOM role is clarified more, this will not solve all the related issues but it will enhance fit for purpose execution and project efficiency.
- The third issue considers the different performance indicators per group. This implies that every stakeholder involved in small projects has different performance indicators which might influence the project progress. It also considers the cooperation with the engineering contractor, who works via a fully reimbursable project. This might result in the fact that incentives to work fit for purpose are lower, but there is not sufficient proof found for this.
- The fourth issue that was ranked high is about the project structure that is downscaled from large projects. This is considered to lead to potential over processing which is inefficient. Included in this topic is the work in the done in the Assess phase, which has an impact on the progress of the other phases.
- The fifth issue makes clear that scope should be clear and defined. This is related to the BOM role but also to the costs that are not well estimated in the BOM role. It also shows the scope is impacting the quality of the EAR.

- The sixth issue refers to the cooperation with the engineering contractor and is based on interaction with different stakeholders, the business model of the engineering contractor that differs from Shell and it put restrictions on the quality of the EAR

This method shows that it is possible to rank different issues based on limited data and subjective relationships. The ranking is expected based on the findings of the research, only the impact of ranking number 3 (issue 9 – performance indicators) is much higher than expected.

The issues that are ranked highest are based on three themes, only project classification is left out. This might be the case because this theme is partially overlapping with fit for purpose execution, because in the current project approach of Shell Pernis the classification leads to less efficient execution of small projects. The House of Quality also shows that most relevant issues can be found in the theme of project team (while they are connected with issues from three themes except for project classification).

6.3. Suggested improvements

In this chapter recommendations are given to improve the fit for purpose execution of small projects at Shell Pernis. The recommendations are only given for the top six relevant issues as these areas are remarked as the areas where the highest achievements can be obtained:

1. Different stakeholders do not work well together (project team, issue 10)

It has been seen that most of the issues are related to cooperation between stakeholders and therefore it is believed that the focus on formation and responsibilities of a project team will impact also the other issues.

Recommendation 1a)

The project team/BOT is also responsible for a well-managed interaction with the engineering contractor and a clear formulation of the assignment. The formation of a project team that exists of a cross-functional team is important as a cross-functional team is an effective mean for allowing people from diverse areas within an organization to exchange information efficiently or to coordinate a complex problem. A focus on teamwork is important in a cross-functional team. (Stephen P. Robbins, 2010)

The focus at Shell Pernis on the BOT is low in order to avoid over processing, but the BOT formation and the function of this team can be scaled towards the nature of the project. A better focus on the team and team formation is likely to increase the efficacy of a project, as was also shown by earlier research (Bosch-Rekveltdt, 2011). The focus on project team formation is also important as it is remarked that personalities of team members can impact the outcome of the project (Turner, 2007). There should be a fit between the project manager and the team as the project manager has the important role to integrate people and to motivate the team (PMI, 2008). A BOT should minimally exist of a project manager, BOM and representative of the production unit. In this case the project team is different from the BOT, as the BOT is responsible for the business opportunity. The execution of the project is done by the project manager and the (if applicable) project team. This division is important because it ensures that the BOT is not occupied by project management related issues so they can still focus on their daily tasks (except for the project manager whose daily task is to manage projects).

Recommendation 1b)

In order to organize the input of the BOT, a First Contact Meeting must be held to determine the way forward (opportunity roadmap) and to obtain a good problem description. This would create awareness of the type of project that is dealing with (small or medium, and simple or difficult, new method or old method). This way it is ensured that the project management practices and project activities are fit to the nature of the project, which can prevent iterative loops or unexpected events in later stages. If this is done, another meeting must be planned. This meeting can be short for 'simple' projects or longer for the more 'complex' projects¹⁶. During this second meeting it is important to:

- Identify the stakeholders (stakeholder engagement map)
- Identify biggest risks at that moment (risk management plan)¹⁷
- Make an opportunity assurance plan¹⁸

Depending on the size of the project and the amount of stakeholders present, an opportunity framing workshop can be organized simultaneously, but only when no other disciplines are needed for this workshop than required for the risk management plan, opportunity assurance plan and stakeholder engagement map. If the opportunity framing workshop must be organized in a different meeting, it is recommended to plan this between the two proposed meetings because then the stakeholders are identified. The opportunity framing workshop is important to define the scope. Depending on the type of project these steps can be performed in either one, two or three meetings.

A stakeholder engagement plan is important because there are many internal and external stakeholders involved in the execution of a small project. In this multi-actor environment it should be determined whose input is needed and who can block the project. The stakeholder engagement plan forces the project team to think about who to involve and who not, which is relevant for activities such as an opportunity framing workshop. Attention for the interests of the relevant stakeholders is likely to impact the success of a project (Vos, 2008).

At this moment Shell Pernis follows a downscaled interpretation of the ORM in order to avoid over processing. As is mentioned in the issues by the different respondents and especially the issue concerning cooperation between stakeholders, this approach must be revisited. The current risk of potential over processing disables fit for purpose execution of small projects as input is too late delivered, the function and responsibilities within the BOT are not clear and stakeholders do not feel aligned or committed or are not informed in time. Following the suggested processes might cause people to have to spend more time in meetings to prepare the project, but the number of iterative loops in later stages is likely to be reduced and it is likely that the issues mentioned above are (partially) solved by scaling the project approach instead of skipping steps in the project approach.

It should be clear that iterative loops are not per default a problem, because sometimes the project requires an iterative loop (e.g. a repeated risk assessment or revised planning). The iterative loops that must be prevented are the ones that occur because input is provided too late or scope is not well defined (e.g. low predictability of the project).

¹⁶ The characteristics of the projects are given between quotation marks because this classification serves as an example

¹⁷ This is current practice but not in the Assess phase (beginning of Select)

¹⁸ This is current practice but not in the Assess phase (beginning of Select)

Recommendation 1c)

It could be the case that fixed BOT per unit are assembled, to increase the effectiveness of the team because the team gets to know each other. This can also have an effect on the in time initiation of projects, as the team will be much more aware of the coming projects and on-going projects. Also the team members get to know each other and if a change in the BOT occurs the other team members are capable to prevent loss of knowledge.

Recommendation 1d)

At the beginning of this research project it has been decided that the implementation of the project is left out of the research scope. At the end of the research it became clear that these 'back end executioners' have much knowledge about the field and would like to be involved in the front end processes because it will increase the effectiveness of their own work (Heijden, 2012). The reason for this is that they often receive projects that are ready to be executed, that are practically difficult to execute. It is not needed that a meeting with the BOT is set up, but the BOM could at least check the plans to ensure that there will be no costly iterative loops (referring to Figure 7 where changes at the end of a project are more expensive compared to the beginning).

This issue is also indicated to be related with the engineering contractor and the BOM role, but as recommendations for these issues are discussed in the following part this is not discussed in this issue.

It is believed that most of the issues might be solved when there is a bigger focus on team formation and the responsibilities of the team and thereby improving the cooperation between different stakeholders. By improving this issue other issues that are related to this issue are likely also improved. An objection can be that the focus on the BOT requires too many resources, but given the results of this research it is believed that even if a few projects are cancelled; the amount of iterative loops and reduction in rework is likely to be worth the additional effort required in the first phases.

2. The BOM role is not clear (project team, issue 8)

There are several improvements on different levels of implementation:

Recommendation 2a)

The BOM role is described in a document but this document is not well distributed. A distribution of this document to new BOM's and an online training could enhance the knowledge of the BOM about its responsibilities. The online training is offered because Shell uses (obligatory) online trainings often.

Recommendation 2b)

The Assess phase could become a project phase where the project manager is also involved. This would help identifying important issues with the BOM as a project manager is more experienced. The kick off meeting (or early FCM) is important to receive input of different stakeholders about the problem. The BOM becomes aware of the issues outside his discipline. The BOM can still be responsible for the delivery of the PIN and the EAR, but the BOT should be able to challenge the BOM on management of the business opportunity and help with a brainstorm about the possible solutions.

Recommendation 2c)

Another solution is to separate the BOM role from the role that actually writes the deliverables (as done for medium and large projects). This enables an objective view towards the business opportunity

and enables an objective challenge whether the offered solution is the best solution, but is also increases the size of the BOT. It should be remarked that the larger the team, the more important the role of the project manager becomes.

3. Performance indicators differ per group (project team, issue 9)

It is expected that a focus on team formation will ensure that the BOT/project team (and involved stakeholders) have a shared goal, which is important because this will ensure that the different performance indicators of different groups do not hinder the project performance. Because it is not known how much influence this has (because the issue also described the different business models between the engineering contractor and Shell), this should be monitored. If it appears that the different performance indicators play a role, joined performance indicators per project must be made for the involved stakeholders.

It is difficult to change the performance indicators for the internal stakeholders as the current performance measurement system of Shell is based on a year planning.

This issue is also used to describe the interaction with the engineering contractor who works with a different business model compared to Shell. The incentive of the business model of the engineering contractor is to work as many hours as possible, as they are paid by the hour. There are three problems identified:

- If the BOD is outsourced the EAR needs to be detailed. However, the ORM prescribes that the Assess phase should be used as a scouting phase. This is conflicting with the possible outsourcing of the BOD.
- If the BOD is outsourced and the EAR is not detailed, the changes are high that the work that will be returned is not of the expected quality (or not serving the project goal).
- If an assignment is given to the engineering contractor, it must be defined what is included and what is excluded otherwise the engineering contractor will adhere to its business model: delivering quality for a certain amount of hours.

Recommendation 3a)

The cooperation with the engineering contractor can only run smoothly if both parties communicate with each other and ensure that they know each other expectations. When the assignment is given it is important not to sit and wait, but be actively involved to ensure that the problem is well understood. This is likely to prevent iterative loops and rework.

The work of the engineering contractor is monitored using key performance indicators, but this does not solve the problem of the gap between EAR-BOD and the fact that assignments might be not clear. The BOT is responsible for addressing both issues.

4. The same structure can be used for every small project, but over processing is a risk (fit for purpose execution, issue 1)

A formal project structure is important because people fulfill within Shell special roles. However, this formal structure can be adapted to the type of project that is dealing with. Therefore it is important to offer a decision tree that shows what kind of project is being dealt with.

Recommendation 4a)

If a problem or opportunity is identified (and requires a change according to the Management of Change (or MoC) procedure) projects are now divided based on the expenditure size. It is proposed to make one form for initiation (project and plant change) and independent of which classification it is, a route is selected based on the number of alternatives considered and the complexity of the project. This must be indicated by the initiator and decided by a small team of experienced people (such as the DRB-1 including the plant change and project team lead). A schematic picture of the proposed routes is found in Figure 13. It is recommended that even if it appears that one solution is the best, a short screening phase is done to examine whether it is the best solution. This screening phase can be lighter than the Assess phase without the deliverable of an EAR, but with the involvement of relevant disciplines.

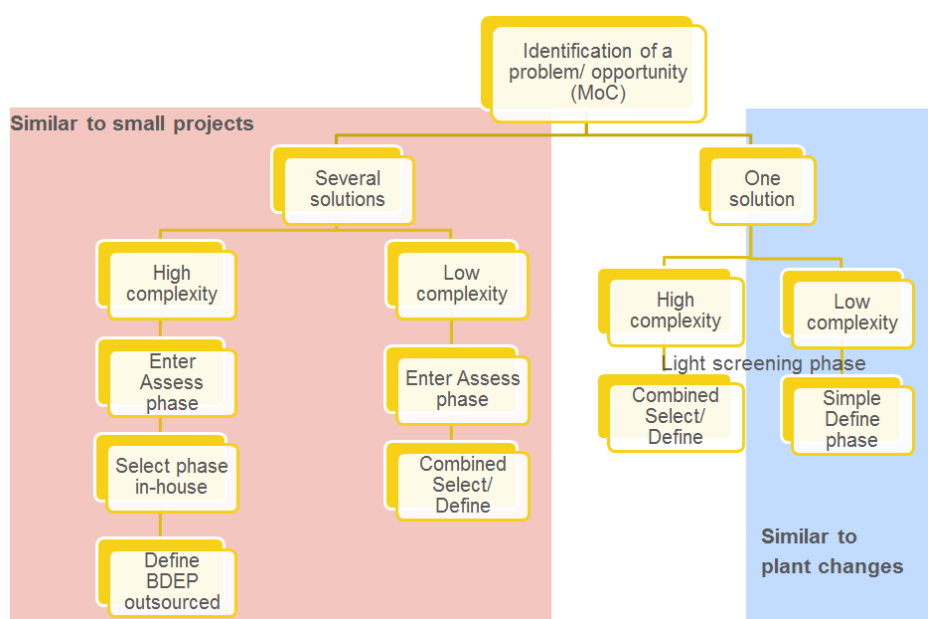


Figure 13: Proposed method to initiate and define project structure¹⁹

The advantage of this structure is that the initiator can no longer find ways around the OPEX/CAPEX classification (as far as that was possible). The route of the change (plant change or project) is also no longer determined by the financial classification.

The format of the PIN must be changed in such a way that the problem formulation receives a lot of attention so that the initiator is forced to accurately describe what the problem is. During this

¹⁹ A workshop was organized with two European Shell refineries and it appeared that one of the refineries had no classification between plant changes and small projects but used the same structure for every change (for changes < 3 USD million)

identification step other stakeholders must be involved in order to ensure that the described problem is also the problem that needs to be solved. The PIN also leaves room for a proper scope definition.

There are two possibilities after the problem formulation:

- If it is clear that the possible solution is already known, a project manager should review the PIN to make the scope complete as possible. This involves the work around the change such as painting, construction, demolishing or building of complexes. Often it is seen that this is not taken into account by a PIN author. If the PIN is reviewed by a project manager, more accurate cost estimations can be given (by PIN author or cost estimation department). Reviewing the PIN increases the load of the PIN and of the project manager a little, but ensures that the problem definition is clear and creates alignment and commitment to solve the problem between the stakeholders.
- If it is unclear what the solution is, the author needs to indicate this and still come up with the best solution possible in order to give a cost estimation that enables project portfolio planning. By indicating that the best solution is not known yet, the different actors involved in project initiation still have the freedom to decide later what way to proceed. It also ensures that the organization (production units, BOT, DRB, project portfolio) is aware of the fact that there might be changes in the solution and thus cost estimate.

After the initiation the project is based on its complexity. Complexity is remarked as the best project classification that has been identified so far because it takes into account the number of elements that are found in a project, the newness of the problem/proposed solution, the uncertainties that are still present and the amount of stakeholders that are involved.

The complexity of a project is judged using the TOE framework as proposed by M.G.C. Bosch-Rekveltdt and introduced in paragraph 4.1. The reduction of uncertainty in goals and method can be done by taking into account “lessons learned”. “Lessons learned” is already a topic in the current process, but in the Select phase. This might be too late as a large amount of the work has already been done (e.g. assessing different options). The BOT is responsible for this classification which can be checked by the area project manager or project team lead. The advantage of this model is that it also shows the biggest risk areas and it leads to insights which project management steps are really required, which steps can be scaled and eventually which steps can be left out of the process, as described with the adaptive project management approaches introduced in paragraph 4.2.

The assessment of the project complexity (recommendation 4) will help identifying the biggest risks but the further the project progresses the more information becomes available which can provide new insights. The assessment of project complexity can be repeated at every stage because the environment is dynamic which can change the complexity in amount but also in area (Bosch-Rekveltdt, 2011).

This structure focuses to keep the Assess phase a real assess phase and therefore the EAR format should also be changed to help the BOM/BOT to look wide enough and to work towards the best option available. For projects that are determined to be of high complexity the next phase should be to complete an in-house BOD. If the project is of low complexity, the EAR will function as a pre-BOD and a

combined Select/Define is carried out (possible outsourced). This must be made clear in advance to ensure that the EAR is of the level that is sufficient for the development of the next phase.

It should be monitored how the cost estimates will develop when the Assess is really reduced to a scouting phase. It might be that cost estimates become not accurate enough which ensures large deviations in the next phase. This is not expected because it is likely that the complete problem and scope definition will positively impact the cost estimation.

In this recommendation it has been explicitly not been chosen to provide only one structure because it does not give room for adaptive approaches as the suggested project routes provide.

5. Scope definition is not always clear and complete (front end development, issue 6)

The scope definition is not always clear and complete and this might be caused by the fact that the stage gate process described in the ORM is not completely followed. This has as the effect that there is not a logical sequence of activities and that the right information is not available at the right time. Steps are skipped in order to ensure fit for purpose execution, but this results in the fact that expectations are not known (such as the BOM role, who is responsible for scope development) and that stakeholders are not aligned, because no internal agreement has been reached over problem and scope definition. It should be also taken into account that the scope is a 'translation' of the business objectives. If the project team is not aware of this required translation, then it might be that defined project scope does not 'serve' the business objective.

This will impact the project in later stages as rework might occur, especially when the project is partially outsourced. The recommendations for this problem have already been given:

- Focus on team formation and the minimal ORM requirements
- Assess phase becomes a project phase to ensure complete scope.

6. Contractor engineer focusses on quality and not fit for purpose engineering (issue 7)

Most of this issue was already described in issue 9 about the performance indicators (bullet number 3). As was stated before the engineering contractor focusses on quality as that is their business model. Quality is of importance because it ensures that designs comply with the law. Although there is an alliance between Shell Pernis and the engineering contractor, it remains important to be specific in needs. The engineering contractor should also contact Shell in case of anything is not clear. According to the respondents this happens too little, but this could not be verified.

7. Conclusion and recommendations

This chapter is used to present the conclusions and recommendations of the research at Shell Pernis. The research questions will be answered and discussed. The first paragraph will provide the conclusions of this research (7.1). Then paragraph 7.2 reflects on the research method, discussing the research limitations and to provide recommendations for further research.

7.1. Conclusions

The goal of this thesis is to investigate and contribute to the knowledge on project management for small projects and to propose recommendations to increase fit for purpose execution of small projects at Shell Pernis. These goals were fulfilled successfully.

Within Shell Pernis small projects are defined as projects with a capital expenditure between USD 50,000 and USD 3 million. The project management practice that is used to execute these types of project is called the Opportunity Realization Manual (ORM), which are practices originally written for projects with an expenditure over USD 100 million. The ORM is downscaled in order to apply the manual fit for purpose for small projects, which refers to the fact that with sufficient and efficient effort, good results are obtained. This financial difference between small and large projects is not the only difference, as with a larger project also the size of the project teams, the strategic impact, the duration and the risks involved are larger.

It became apparent during this research that a financial classification between projects alone disables fit for purpose execution of projects. The reason for this is that the financial classification determines which mandatory steps must be taken to execute the project. Projects can be expensive because the piece of equipment that is required is expensive, but this not necessarily implies that implementation is difficult. It is better to classify projects based on type of project.

With the increasing complexity of the environment and the project, it is important to first assess the project before the right project management approach is selected, this is referred to as 'adaptive project management'. It is recommended to use complexity to classify projects, as this takes into account several aspects of a project that are of great influence on the project management approach that is chosen. Judging a project on complexity takes into account the newness of the project, the experience of the organization and project team and the number of elements that need to be addressed in the project. This would enhance fit for purpose execution, as the project characteristics are determined upfront, leading to a better application of the project management processes because the characteristic of the project determines the intensity of the processes needed.

There are several issues identified in the development and execution of small projects at Shell Pernis. The most important issues that were identified and ranked using the House of Quality analysis are re-written to more general issues:

1. Difficult cooperation between stakeholders (project team, issue 10)
2. Unclear tasks and responsibilities of team members (project team, issue 8)
3. Different performance indicators per stakeholder group (project team, issue 9)
4. The usage of the same project structure for every project (fit for purpose execution, issue 1)
5. The lack of a good and complete scope definition (front end development, issue 6)
6. The business model of the engineering contractor and the communication with Shell (fit for purpose execution, issue 7)

These issues were systematically identified based on surveys, in-depth interviews and project data. These issues can be solved by improving processes in the front end development.

The cooperation between stakeholders and the unclear task and responsibilities can be improved by an in-depth focus on project team formation (or in the case of Pernis, the Business Opportunity Team). The team is responsible for good scope definition and this can be done by providing a good problem definition and involving the relevant stakeholders to provide input. The team is responsible for the challenge that the scope is complete. An efficient project team that is committed to the project is also likely to impact the cooperation with the engineering contractor, as the project team might focus more on results. It is the task of the BOT to ensure that the assignment towards the engineering contractor is clear to prevent unnecessary cost and/or rework.

Changes can be initiated via one route (at the moment there are two different initiation methods) and the route can be scaled towards the nature of the project. There should no longer be a difference between plant changes and small projects based on financial classification, but this will be determined after the change is initiated. The structure is needed to provide (new) order in a large organization as Shell Pernis. The issue identified the need of a more fit for purpose structure. This structure resembles the old structure, but this time scaled to the complexity of the project.

Shell Pernis has translated the ORM to an own approach. The ORM is downscaled in order to avoid over processing. Shell Pernis has not only scaled the activities, it has also skipped some activities, which are assumed to be the reason for less efficient project execution and contributing to the identified issues. It is believed therefore that project management projects cannot be skipped, but must be scaled towards project characteristics. The ORM prescribes the use of a stakeholder engagement plan, an opportunity framing workshop, opportunity roadmap, opportunity assurance plan and a risk management plan.

The scope development in the Assess phase is not yet part of a project (but part of the initiative phase). Because there is little focus on the involvement of other disciplines and management of the business opportunity, these Assess phases are often not contributing to fit for purpose front end development. It is therefore recommended make the Assess phase part of a project, which also ensure the involvement of a project manager that is able to keep overview without going into too much details (as occurs now) and to improve the development of the scope. By making the Assess phase part of the project, several activities that are now done in Select phase are carried out earlier. This will improve the scope development and ensures that the Assess phase is used as a scouting phase, whereas the trend is now seen that the Assess phase becomes a Select phase without the activities that are normally done in the Select phase, which affects fit for purpose execution.

The main question of this research can now be answered. The minimal requirements (based on the research carried out at Shell Pernis) that must be used in order to be fit for purpose for small projects are:

- Project assurance (project assurance plan)
- Scheduling (opportunity roadmap)
- Contracting and procurement (focus on cooperation)
- Opportunity framing for proper scope development (including lessons learned)
- Stakeholder management
- Project team formation
- Risk management

These activities must be scaled to the nature of the project. This list is not exhaustive, but addresses the needs that are identified in the top six issues.

The four themes that are identified in this research show that fit for purpose is reached by a focus on project team, a proper project classification in order to enable adaptive project management practices to be scaled and by focus on the stage gate process called front end development.

The risk in 'doing' small projects is that processes are soon seem to be 'too much' and therefore the steps are skipped. However, by skipping these steps the development of the project is not following a logical and sequential way anymore. It is therefore important to realize that project management processes should be scaled and not skipped. This enables fit for purpose execution of small projects; ensuring that the project management practice is adapted towards the nature of the project.

7.2. Research limitations and recommendations

This research provided a method to measure issues within a company and to provide recommendations based on the issues found. These recommendations contribute to the development of the minimal requirements to achieve fit for purpose execution for small projects, but the list presented in this research is far from complete. In order to complete the list, further research is needed in this area. This could be done by using this method as a stepping stone to discover issues at other companies.

The method that was used in this research started with exploratory interviews to map the problem. This type of exploratory research was necessary as there was little literature available. The exploratory research led to themes which provide the structure of the research. For further research it is recommended to check whether these themes are the main themes or that other themes are also relevant but not mentioned by the respondents chosen in this research.

The choice to use surveys in one respondent group and interviews for the other was made to determine the use of surveys in such a research. The information that was gathered in the interviews was more in detail as the respondents had the time to answer the questions carefully and more in-depth. Statements could be explained directly and questions could be elaborated. A survey could still be used to gather more general information, such as themes in this research, but it is not a valuable tool for gathering in-depth information as the amount of information that is written down is limited compared to the knowledge of the survey respondent. In-depth interviews allow for accessing and challenging that knowledge much more. Surveys could further be used to verify information found and to validate the possible relationships that were used in the House of Quality.

Although the House of Quality has, to my knowledge, never been used for ranking interview data, it turned out to be a helpful tool due to the similar application it has in product and process engineering. Subjective relationships may be used to quickly identify and rank issues as long as only the top ranked issues are important. This enables focusing on the most important issues that are likely to have a high impact when they are improved compared to other issues.

The project data was used to support issue that were found but could not be used to determine additional issues as the project database of Shell Pernis was not complete. This makes the research mostly empirical as the bulk of the information was found via primary data (interviews and surveys). In order to verify the research the findings can be tested against the respondents and to validate whether the suggested improvements contribute to fit for purpose execution.

The issues that are formulated are based on the first in-depth interviews that were held. This creates a bias as bulk of the issues that are identified from respondents from the Refinery Turnarounds and Projects. If other interviews would have been used to identify the issues, they will have the same meaning but probably use different wordings. The impact of this is likely to be legible.

The respondents chosen in the interview group are chosen based on their key function and expertise. It was attempted to make the respondent groups of the same size, but this was not possible because some stakeholder groups are smaller compared to others. The judgment whether an issue was valid or not was done on the amount of groups that indicated this issue, but also on the number of respondents. This might lead to a biased view as one respondent group was twice as large as another, but at the same time the amount of data given per respondent in a respondent group may also differ (e.g. a project manager may provide much more data than a refinery technologist). In this research such issues are not accounted for but in further research it is important that the respondent groups are of similar size or provide similar amounts of data, depending on the approach.

The different groups are mainly involved with the front end development of a project as it was seen that during the front end most of the project is defined. This led to the exclusion of stakeholders of the 'back end' of the project (the executioners). It is expected that it does not influence the results, but it can be said that this assumption to exclude the 'back end' stakeholders is not valid as they can have a great influence on the front end development, if they are involved in this process. The effect of involving additional stakeholders in the development of the process cannot be estimated. It can make the process more cumbersome because more people are involved or it can make the front end development better because the 'field' experts are involved. As this possible relationship was not included in the scope it was not taken into account during this research, but in further research it might deserve some attention.

Another point for further research is the topic of project classification. In this research it has been recommended to classify projects based on complexity instead of financial dimensions. Providing a method to measure and predict complexity of a project (within Shell Pernis) could be a topic for further research.

The study did not describe how a small project should be executed, but identified aspects that are most likely to be important in all small projects, although this case was limited to Shell Pernis. The generalization of this is not verified but is very interesting for further research. It might even be the case that these findings are in general applicable to large projects, but this was not within the scope of this study and could be a topic for further research. This thesis is a stepping stone for further research and its methods, with some adjustments, seem a suitable starting point for such research.

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Appendix I. Exploratory interviews

The information was obtained by interviewing a small respondent group in a very open interview to gather knowledge about possible problems occurring with the execution of small projects. For these interviews the following persons were interviewed: Two Capital Team Leads, the Project Leader Plant Changes, the Chemicals & Base Oil Technology Manager (who is the initiator of this research) and the CAPEX coordinator. The information starts with a general overview of the Shell Pernis site and ends with a description of project management. On average Shell has 150/200 projects running simultaneously in Pernis.

The exploratory interviews led to the themes. A summary is given of all the exploratory interviews in one list and the themes are marked in colors to show how they were identified. Everything that is not colored is considered to be information.

- Project classification
- Fit for purpose execution
- Project team
- Front end development

Shell's project structure

Shell has set up a governance and assurance system that must ensure that all projects are following the same standards and are well executed. The Opportunity Realization Manual (ORM) is the manual that prescribes the execution of projects. Shell has divided their project structure into five phases and the responsibility over the several phases is divided. The first two phases (called Identify and Assess) are called an 'initiative', and a Business Opportunity Manager (BOM) is responsible for the progress and the 'opportunity'. The third until fifth phase (respectively Select, Define and Execute) is the responsibility of a project manager and the initiative is in these phases called a project. A no-change policy for the project scope is enforced from the start of the Define stage; because changes lead to rework, which is considered to be inefficient.

It is a stage-gate decision process and after Assess it is important to question whether all the opportunities are well addressed, if there is still enough time and if all the resources are still available. If this is the case and the initiative receives permission it is turned into a project.

Good scoping leads to a successful project (with no scope changes at the end). A good project is a project where the contingencies decrease the further a project is developed. Cost and planning for a project should be realistic and project overhead should be realistic compared to the hardware costs.

Planning and cost estimation is carried out using standard schedules and cost estimations. On average the duration of a project with a certain amount of budget will on average be between half a year and two years. It is hard to check whether these estimates are reasonable or too conservative.

Management of change

Every change (e.g. plant change or project) is executed following the procedure of management of change. A change is an activity that can be temporary or permanently added to a system. It includes changes on machinery, processes, operating and utility systems. Changes must be controlled because a change can introduce new dangers as the change is implemented in a complex, integrated system. Every change

should be judged on its impact on safety, health, environment, product quality and reliability of the system.

Small projects

Projects are extra work to improve the current situation. The difference between a small project and a large project is the dedication towards the project. A small project is often carried out besides the daily job and as long as the project runs smoothly, there are no problems encountered. As soon as the project development is becoming more difficult and requires more attention, other items get less attention.

Plant changes

Within Shell project management, a special type of small projects exists. Plant changes are small changes that are classified as operational expenditures. Plant changes are generally considered to be more efficient compared to small projects because they are faster executed with less overhead, because the changes are easier, the lines of communications with the production unit (client) are shorter and there are less people involved. Plant changes are executed without the involvement of a project manager so the production unit is responsible for these types of changes. Every change below USD 50,000 is considered to be a plant change. The changes slightly above USD 50,000 could be executed as a plant change, but by default this is a project. These capital projects could be executed as a plant change if the projects are not too complex. Doing so is called taking the COFFEE route. The project manager and plant change engineer then decide who bears the responsibility for the project.

Pernis specific

The organization structure of the Shell Pernis site is divided in eight main pillars, which have to cooperate to run the site smoothly. The three pillars that are most involved in projects are:

- Refinery Production with nine production units of which two are chemistry and seven are refinery
- Refinery Technology with several groups that assure the technological progress and safety of the site
- Refinery Projects and Turnarounds that are responsible for the plant changes, projects and turnarounds

There are many ideas at the site but since resources and budget are limited, the business drivers must be very clear in the initiative phases (Identify and Assess). Another issue is that often projects are initiated too late and that the costs are underestimated in the Identify phase. The question is if the project is still a viable idea if all costs are taken into account. The next step is to further fine-tuning of the process, looking into the manner projects are initiated and executed (efficiency). Pernis uses two deliverables in the first two phases; the Project Initiation Note (PIN) and the End of Assess Report (EAR), which are used to define the scope properly. The PIN requires a rough cost estimate by the author, while the EAR requires many details that are often not part of the expertise of the author, which causes delays when deadlines should be met. Delays also occur when the EAR is send out for comments. The EAR is a derivative of the deliverable in the next phase (called Basis of Design, BOD), but there seems to be no relationship between the quality of the EAR and the length of the BOD phase.

A part of efficiency can exist by offering a project uniform structure, so it is clear for everyone what value drivers and processes are chosen for a particular project. Structure is also needed at a large production location as Pernis. There is a site committee at Pernis that determines which phases could be potentially

skipped or combined. The project manager can choose which value processes are needed to execute the project safely and successfully.

On site there are cost-driven projects (preferred) and schedule-driven project (consumes too many resources). There are many small projects on site, which seems to result in fragmentation of work. The engineering work in the project phases (Select, Define and Execute) is carried out by a contracting party. Delays often occur because people do not realize the project structure prescribed in the ORM. Often a project is too late initiated (resulting in a schedule driven project) or deadlines are not met, which can cause problems in resource scheduling.

Lastly, Pernis exists of nine different production units which all have their own history. This is also of influence how projects are executed, as the work processes, operation and maintenance are differently organized.

Project management

Project management is a structured approach to execute a project but costs a lot of money. Sometimes phases are put together to save costs. The project managers of the Refinery Projects and Turn Around organization often differ in traits and have a different level of experience and knowledge. This can also be of influence how projects are executed. The success criteria for a project are: Health, Safety, Security and Environment (HSSE), quality, time and cost.

The ORM has no strict guidelines what to in- or exclude for small projects. This has as an effect that different production locations of Shell have different approaches how to handle projects. This is summarized below but is not a part of the exploratory research, it is only to show that there are differences and that there is freedom how to deal with small changes.

Other Shell locations

Not only Shell Pernis struggles with the efficient execution of small projects, the other European locations, Moerdijk and Rhineland, also acknowledge the difficulties of efficient execution of small projects. During this research a workshop was organized to exchange best practices and a short summary of the approaches of Moerdijk and Rhineland is given in this paragraph. This illustrates the differences between the implementations of the ORM.

Shell Moerdijk

Moerdijk and Pernis are very similar in their practices, but Moerdijk does not require the writing of an EAR. For single discipline, small projects, a plant change management of change is used. Moerdijk is improving the current database for plant changes using a software program called Cintellate. Moerdijk functions as global pilot for this Electronic-Management of Change.

Rhineland

Shell Rhineland does not make a difference between plant changes or small projects and uses the same process for both. Every project starts with a first contact meeting, in which a fit for purpose approach is agreed upon (decide which value improvement practices are in or out). Rhineland executes projects often without the involvement of external contractors, while Shell outsources almost every project. Because plant changes and small projects are 'the same', a production unit is always involved in execution and responsible for the success.

Appendix II. **ORM**

This appendix is used to describe the stage gate decision process in more detail and to describe the governance processes.

- Identify: the opportunity is identified and divergent thinking is needed to understand the opportunity. The opportunity is identified and written down in a Project Initiation Note (PIN – Pernis specific²⁰). A site committee called “DRB-1²¹” decides whether the PIN can enter the following phase (Assess). If a PIN is endorsed to the following phase this is called ‘flow’ and when the initiative is held back this is referred to as freeze. The DRB-1 exists of members of the Site Leadership Team (SLT), Refinery Technology (RT) and the Refinery Project department (RTP). The composition of members in the DRB-1 does not change. Around 80% of the PIN’s receive a flow status. The opportunity is now referred to as an initiative (thus not yet as a project). A very rough cost estimate is made in the PIN by the author to provide an initial cost estimation. This cost estimate is also used to determine the VIR of a project, which is one of the criteria for validity of the opportunity.

Sometimes an opportunity framing workshop (OFW) is held to identify and frame the problem and possible solutions. The ORM describes the Identify phase as a phase in which the description of the technical challenge must be given as well as the understanding of economic and financial dimensions. The strategic and portfolio fit should be present, including commercial challenges and potential.

- Assess: this phase is used to diverge in solutions and consider the feasible options, including the ‘big ticket items’ which enables a first good cost estimate. The deliverable in this phase is called an end of assess report (EAR). An EAR is a requirement that is specific to Shell Pernis. The opportunity is still called an initiative. During this phase the project is judged based on feasibility, necessity and priority, although the ORM prescribes these actions in Select. If the EAR receives flow status in the DRB-1 meeting, the initiative turns into a project. From that moment a project manager is involved in the process.

The ORM describes the Assess phase as a phase that requires a description of a range of options including pros, cons and feasibility. This phase is used as a scouting study.

- Select: in Select the optimal concepts of the Assess phase are worked out and the best option is chosen (convergent stage) for Define. The final document in this stage is called Basis Of Design (BOD). The technical specifications must be specified in order to make a 30% cost²² estimate.
- Define: preparation to lock into an investment/divestment decision (Final Investment Decision, FID – 10% cost estimate²³), and the final document is referred to as a Basic Design Engineering Package (BDEP).

²⁰ The site Pernis used to have many projects which made it difficult to manage a project portfolio. The PIN must serve as a start of the project funnel – it provides a screening of necessary projects

²¹ Decision Review Board - 1

²² The actual cost do not deviate 30% above or below the cost estimate

- Execute: the opportunity is implemented. This involves detailed engineering as well as procurement and construction.
- Operate: the opportunity delivers the value. Commissioning and startup are also part of this phase.

Governance at Shell includes the steer, supervision, support and assurance of a project. Each project has a common governance structure (shown in Figure 14):

- Business Opportunity Manager (BOM) is accountable to the Decision Executive (DE). The BOM is responsible for full integration of all the technical, economical (and financial), commercial, organizational and stakeholders and other political elements of the opportunity (TECOP). If a project manager is responsible for the TECOP aspects of a project, the project manager functions as BOM. The BOM leads together with the project manager the Business Opportunity Team (BOT).
- Decision Executive (DE): accountable individual in Shell with the appropriate organizational approval authority for the opportunity.
- Decision Review Board (DRB): supports the DE in his/her decision making and is chaired by the DE.
- Line of Sight: chain of accountable individuals from the business opportunity team via the BOM and DE to the individual in the Shell organization who holds the appropriate delegated organizational approval authority for the opportunity. This is not used at Pernis for small projects.
- Mandate: agreed up-front between the BOM and the DE that gives the BOM instructions but also the room and authority to manage the delivery of the opportunity. The mandate sets out the objectives and boundary conditions for the opportunity, as well as the key assumptions.

The roles of the DE and the BOM should always be found in two different persons. The DE delegates the daily management of the opportunity to the BOM. The BOM is responsible for ensuring that the opportunity is framed and planned and that the activities of the opportunity team are managed and delivered effectively. The DRB will advise the DE to enable good quality decision making. There are key decision gates coinciding with the phase boundaries at which the decision executive (DE) with support of the DRB-1 can decide to stop, hold, recycle or proceed with the opportunity.

Shell's assurance process is set up as follows:

- A project team is called a business opportunity team (BOT) and the composition of this team must be well planned, promote clear responsibilities and accountabilities. It shall exist of an appropriate mix of expertise, such as technical, financial, commercial, HSSE (Health, Safety, Security and Environment) and other disciplines relevant to the opportunity.
- The Business Opportunity Manager (BOM) is responsible for overall management and delivery of the opportunity. The project manager is responsible for implementation/integration of the BOT, from an appropriate early stage.
- The Decision Executive (DE) is responsible for providing guidance, supervision and support for the BOM. The DE chairs the decision review board (DRB).

²³ The actual cost do not deviate 10% above or below the cost estimate

- The DRB has the relevant expertise to support the DE in his/her decision making. The DRB should be appropriately scaled for the opportunity and contain only the relevant business and functional representation required to support the opportunity.

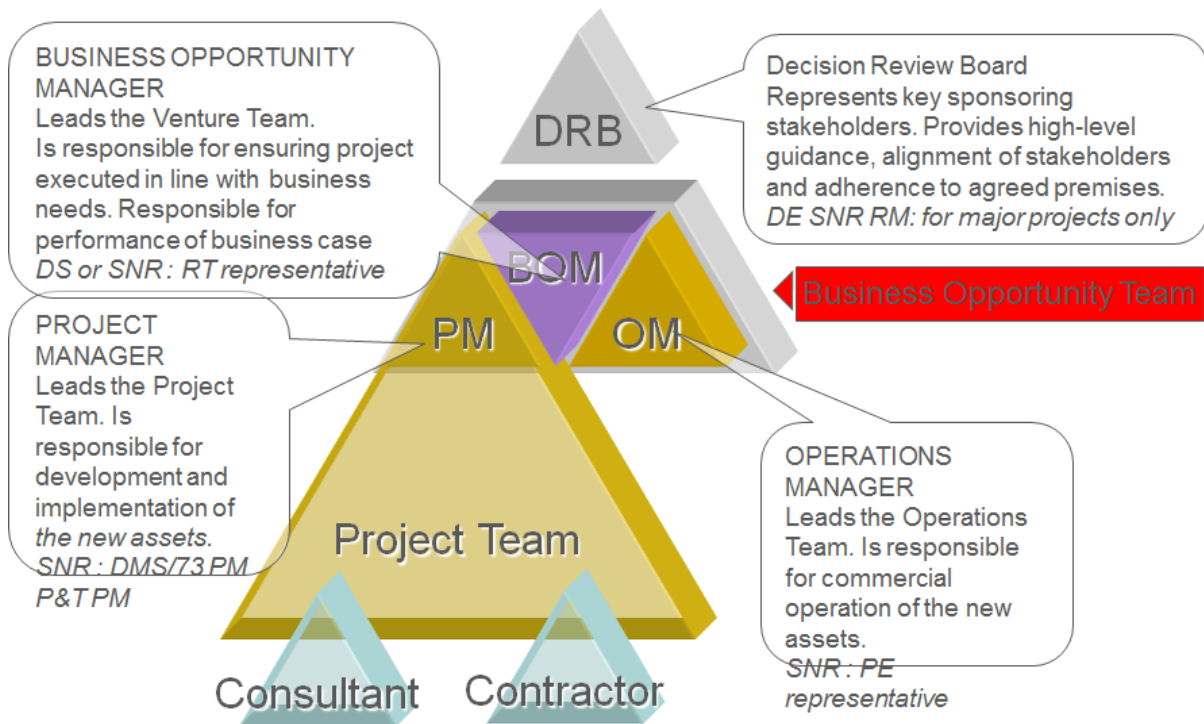


Figure 14: Governance structure at Shell

Appendix III. **COFFEE route**

The Pernis project organization looks for improvement in the project structure to lower the costs and execution time needed for small projects. A project-plant change route was initiated, referred to as the COFFEE route which is taking into account project complexity.

In this route, an initiative is executed as a plant change but with capital expenditures. The COFFEE route provides the opportunity for fit-for-purpose execution of opportunities, irrespective of the classification. It is based on a complexity classification of opportunities, but still taking into account the ORM principles in terms of governance and assurance processes and addresses to the issues that are identified with the change.

The COFFEE route focuses on type of funding, needed front end development and the implementation of a project. If a project involves for example single discipline, replacement-in-kind and no anticipated issues, the project could be executed as a plant change with the production unit largely managing the opportunity, but a project manager is still involved. This would lead to lean front end development and less execution lead-time and cost.

Figure 15 shows the application of the COFFEE model. Each opportunity is classified as follows:

- Basic (B) (Plant change engineer responsible)
Simple implementation and replacement-in-kind
- Regular (R) (Project responsible)
Normal implementation and new/critical/additional functionality
- Premium (P)
Complex implementation and new/additional functionality – time critical, TA-dependent, interference with other activities

	OC Opex Plantchange	OP Opex	TA TA-capex	TR TA – Capex Replacement-In-kind	CS Capex Small	CM Capex Medium	CL Capex Large
Budget	PU-budget (Pernis)	PU-budget (Pernis)	TA-budget (Manufacturing)	TA-budget (Manufacturing)	Small Proj. Budg (Manufacturing)	Capex budget (Manufacturing)	Capex budget (Manufacturing)
Accountable Opportunity	BOM	BOM	BOM	BOM	BOM	BOM	BOM
Accountable Budget	B=PCE R=proj. mgr	B=RMS R=proj. mgr	B=TA -mgr R/P=proj. mgr	B=TA -mgr R/P=proj. mgr	B=PCE R/P = Proj. Mgr	Proj. mgr	Proj. mgr
Responsible Front End Development	B=PCE R=proj. mgr P=proj. mgr	B=RMS R=proj. mgr P=proj. mgr	B=TA -mgr R=proj. mgr P=proj. mgr	B=TA -mgr R=proj. mgr P=proj. mgr	B=PCE R=proj. mgr P=proj. mgr	B=RMS R=proj. mgr P=proj. mgr	B=RMS R=proj. mgr P=proj. mgr
Responsible Execute	B=PCE R=proj. mgr P=proj. mgr	B=RMS R=proj. mgr P=proj. mgr	B=TA -mgr R=proj. mgr P=proj. mgr	B=TA -mgr R=proj. mgr P=proj. mgr	B=RMS R=proj. mgr P=proj. mgr	B=RMS R=proj. mgr P=proj. mgr	B=RMS R=proj. mgr P=proj. mgr
MOC Based on Front End Development type	B=plantchange R=project P=project	B=plantchange R=project P=project	B=TA R=project P=project	B=TA R=project P=project	B=plantchange R=project P=project	B=plantchange R=project P=project	B=plantchange R=project P=project
BOM Business Opportunity Manager	Production Specialist	Production Specialist	Production Specialist	Production Specialist	Unit Technologist	Long Term Technologist	DME/23 (Henk Jansma)
DE Decision Executive	PU manager	PU manager	Manager Projects & TA	Manager Projects & TA	Head of projects	Manager Projects & TA	B= GM R= GM P= RVP
Requirements	FID=PU mgr FIDdeliverables -workpackage -10% est. Admin - ??	FID=PU mgr FIDdeliverables -workpackage -10% est. Admin - ??	FID = ?? FIDdeliverables - TA IP -10% est. -R/P – ffp deliverables Admin – TOST	FID = ?? FIDdeliverables - TA IP -10% est. -R/P – ffp deliverables Admin – TOST	AMP endorsemnt FID = GM FIDdeliverables - PAR4 report -10% est. RTP assurance on all projects (eg cost control by RTP) Admin – MAC	AMP endorsemnt FID=TMPIC FIDdeliverables - IP Admin - MAC RTP assurance on all projects (eg cost control by RTP)	AMP endorsemnt FID=MIC FIDdeliverables - IP Admin – MAC RTP assurance on all projects (eg cost control by RTP)

Figure 15: Pernis project management governance – red boxes refer to COFFEE model, PCE = plant change engineer, TA mgr = TA project manage, BOM = Business Opportunity Manager, RMS = refinery Maintenance service, proj. mgr = project manager

Figure 15 shows the classification for projects. There are different types of projects (plant changes, operational expenditures, turn around capital projects and capital projects) and depending on the level of the project (basic, regular or complex) a project should be treated differently as shown in the figure. The COFFEE route proposes different structure for OPEX Plant changes and CAPEX small projects. If a CAPEX small project is executed on the basic level, the plant change engineer is responsible instead of a project manager. But if the small CAPEX project is a regular or complex project, these responsibilities belong to the project manager. The structure for basic small CAPEX projects is similar to those of plant changes. Execution is often done by the maintenance department of Shell.

Appendix IV. CAPEX/OPEX classification

The differences between CAPEX (capital expenditures) and OPEX (operational expenditures) are listed below:

- CAPEX: all costs directly incurred in the acquisition of, or addition, extension, major renewal or replacement to a fixed asset. A fixed asset comprises assets that are acquired or constructed with a view to being employed in, or contributing to, the business operations of the entity on a continuing basis (more than a year).

Examples of CAPEX are the purchase of a completed asset or equipment specifically acquired for use in the construction of a major project. If the expenditure is above USD 50.000 or the greater and expected life is higher than one year, all work is classified as capital expenditure. If this is not the case; it is classified as operational expenditure.

The CAPEX budget is not allocated per production unit but is allocated per site, whereas OPEX is part of the production unit's budget.

- OPEX: expenditure incurred directly or indirectly in operating, maintaining, repairing or altering existing fixed assets (without enhancing the formal asset value). Examples of OPEX are assets lives of less than one year, temporary facilities which will be abandoned upon completion of the operation, day to day costs of operating an asset including maintenance. Examples of operational expenditures are: opening, cleaning, inspection and demolishing an existing tank and the replacement of tank lining/coating (without a change).

- TA refers to turn around, which is a planned major shutdown, involving a complete process unit shutdown initiated by main inspection and cyclical overhaul of equipment with an interval greater than one year. A turnaround should be scheduled and planned well in advance and serves the purpose of significant unit mechanical repair. (Sliwakowski, 2012)

TA CAPEX: all expenditure incurred for executing and preparing the execution of accepted TA scope items, done during a TA event window except for:

- Spend incurred on an item that is an improvement, functionality or material change, etc. of an asset (except for improvements of non-capitalisable assets)
 - Spend per item of scope of more than \$3m value
- REVEX: expenditure incurred on a capital project that classifies as OPEX spend on site level (thus not part of the production unit OPEX budget). Examples are if purchases are made before the Final Investment Proposal and wages of people involved before construction.

