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An evaluation of the New Product Development process in the context of operational readiness

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Abstract

The successful launch of new products is a key competitive strategy for businesses to drive corporate prosperity as they allow for growth and increased profitability if successfully executed. Innovation processes such as New Product Development, Integrated Product Development and Concurrent Engineering thus form an integral part of businesses staying on top within highly competitive environments. Within this paper the New Product Development process within a specific Company is studied in terms of how it is relates to the operational readiness at the launch of new products. This case study looks into why products are failing to be ready from an operational perspective when the product is being launched through the New Product Development process.

The study concluded that though there are specific improvements that should be addressed within the operational functional area, there were strong indicators that the problems encountered within the operations area is merely a symptom of overall larger problems which relates to how the process is utilised both on a micro and macro level. Further, the process needs to be customised so that it is suitable for the Company's needs and business environment.

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This work is my Master's thesis within Technology and Operations Management.

This work has been both instructive and challenging, allowing me to further develop the skills and knowledge gained through the rest of the Master's program.

For strategical purposes, the thesis has been written anonymously, so I am unable to thank the persons within the Company directly that helped contribute to this with input, insight and challenging views. You know who you are, and thank you.

Further, I would like to thank my supervisor Prof. Jan Frick for his time and guidance during this period, pushing me in the right directions in such a constructive manner.

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Abbreviations

DFM Design for Manufacturability

KPI Key Performance Indicator

MoM Minutes of Meeting

NPD New Product Development

TCE Company data storage system

1. Introduction

The successful launch of new products is a key competitive strategy for businesses to drive corporate prosperity as they allow for growth and increased profitability if successfully executed. With this comes the continued pressure on firms to decrease the time to market of new products in an environment of continually changing customer needs and rapid technology advances set in a globalised market place.

The reasons why new products succeed or fail when introduced into the market is a broadly discussed and reviewed topic. Innovation processes such as New Product Development, Integrated Product Development and Concurrent Engineering have been around for a few decades. They are the result of many years of studies and the review of thousands of companies and how they have successfully (and unsuccessfully) developed and launched new products. Companies have adopted these processes as they are considered to increase the likelihood of product success.

Within this work we will consider the New Product Development (NPD) process within a specific company and evaluate it in terms of its contributions in the context of Operational Readiness. A structured New Product Development is in place and used within the Company, but the results from an operational readiness perspective are unsatisfactory. Therefore, the Question that is to be addressed through this research is '***Why are products being released through the NPD process failing to be ready from an operational point of view?***'

This work is important to the Company as it is driven by a high degree of innovation, within which product development work forms a key part of the strategic goals of the company. The aim of this study is to try identify the underlying causes to the problems encountered and use these results to provide options on the needed improvements in regards to the process in order try help ensure the output from the NPD process is meeting its goals, as it is a key part of the long term success of the company. In regards to the greater knowledge contribution within the area, it serves to consider some of the theoretical work in the area, attempting to practically apply it, and highlights the complexity of doing so in real life terms.

1.1 Background

In this section some brief background information is provided, which is considered relevant for understanding the context and complexity of the problem being explored. The context of the case study is the Company, so a brief introduction is done into the company, its organizational structure and the New Product Development process implemented.

1.1.1 Introduction to Company and background

The Company, a business unit of a larger corporate group (referred to as "the Parent Company" going forward), is a technology solutions provider predominantly positioned within the Oil and gas industry. The Company's focus is on developing the needed technologies and products for reservoir optimization that covers the entire value chain. Increased oil and gas recovery, reduced uncertainty and improved decision making are some of the key objectives that the Company look to help their customers achieve. The Company has an extensive range of products and services it offers, ranging from Downhole applications, Flow metering, Flow Assurance and Mechanical Process applications to Reservoir and Production Management Software.

The focus here is solely within the division of the Company which has manufacturing of goods as part of the core focus. The manufacturing division has multiple locations where employees related to Engineering and Development are located, all following the same procedures and work processes.

For the NPD process the parent Company is only relevant in the sense that it provides the basic NPD model and best practices to be adopted by the Company. Local customization of the model is up to the Company itself to implement.

Organizational Structure. The organizational structure is that of a matrix organization. In regards to the NPD projects, these are run as a hybrid of a Project- and Balanced- matrix, as a project leader is assigned to oversee and lead the project with core team members being assigned from the different relevant functional areas. For some functional areas a responsible person would be assigned, but would not necessarily participate in the day to day activities of the project. The team leader has the primary responsibility and authority, but has a steering group made up of representatives of the functional areas to support the team leader when it

comes to making major project decisions in regards to technical aspects, scope, budget and timeline.

Strategic planning and portfolio management. The Company has a portfolio review process in place which is used to prioritise the ongoing development projects. The details of this process and how it works is outside the scope of this study, so no further details will be discussed. It is merely important to know that it exists, and the NPD projects that are worked on are the result of this planning.

1.1.2 The New Product Development Process

1.1.2.1 What is a New Product Development Process

A New Product Development Process is a phase-gate process for product development. A phase-gate process is a conceptual and operational roadmap in order to promote new or enhanced product ideas from their conceptual idea stage through to a product launch. A phase-gate process divides this effort into distinct phases each separated by a management decision gate. Cross-functional teamwork is essential in order to complete a prescribed set of related cross-functional tasks in each phase prior to obtaining management approval to proceed with the next phase of product development.

Industry research shows (Cooper, 2011) that the companies that are highly successful at launching new products do not do so through sheer luck, but follow a set of consistent, clear and sustainable methods in order to do so. The NPD model as referenced in this study is considered to be such a method.

1.1.2.2 The Company New Product Development Process[1]

The concept of a phase-gate NPD process was first introduced into the Company during 2011, based upon the corporate guidelines in place, and has been evolving ever since. The Corporate NPD model is considered to be a roadmap for all divisions to leverage and customise to what is suitable for the business, not a mandatory set of rules (with the exception of a few areas).

[1] Entire chapter is based on internal Company documentation, November 2016

What will be presented here is the latest format of the process. Though it has been evolving in terms of the details of implementation and requirements, the corner stones have remained the same, which are to have a structured phase-gate process in order to:

- Ensure the right projects are done, through portfolio management.
- Execute the projects properly, through the implementation of a clearly defined and well established process, with clear deliverables and GO/NO-GO decision points at each gate.

One of the goals of the NPD process is to strengthen the development process and to further integrate the entire business from idea through to launch; transforming a customer need into a product.

The NPD process, along with its key building blocks are illustrated in Figure 1 below.

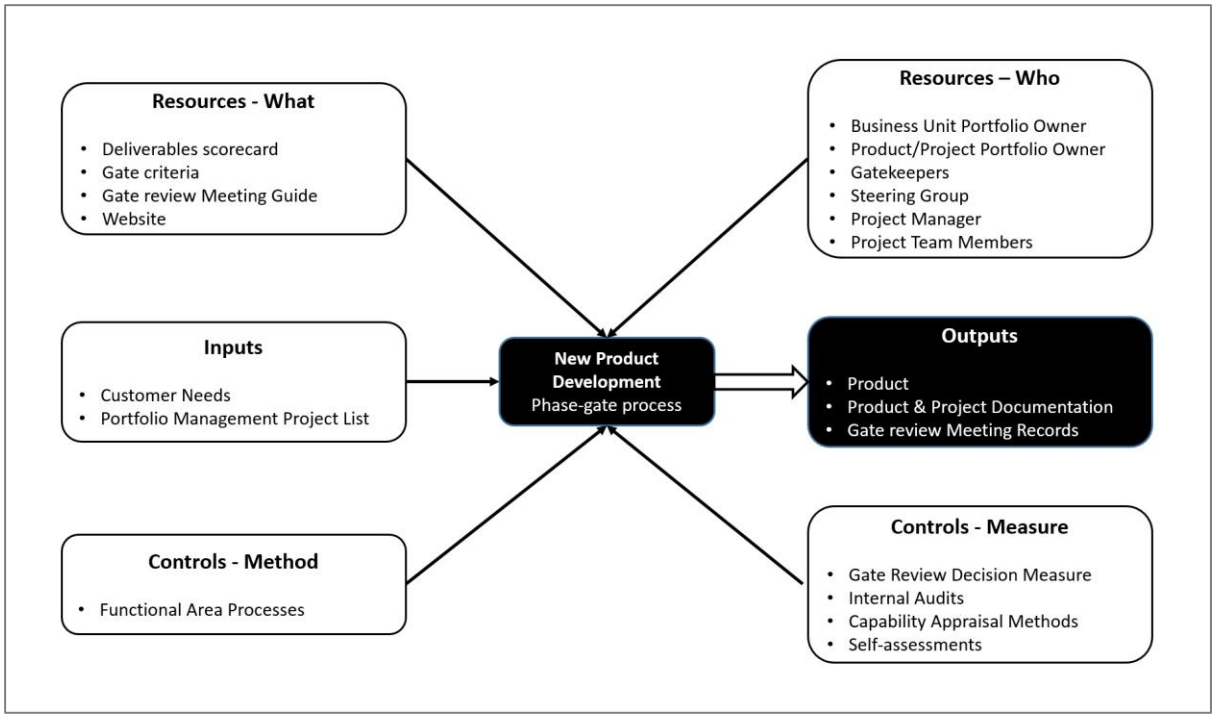

Figure 1. A flow chart illustrating the New Product Development Process. The figure illustrates the basic inputs and what outputs they are transformed into through the NPD process

The NPD Process for the Company is centralised around the phase-gate process which has flowing into it different types of contributing Resources combined with Inputs and Controls to produce the final required output (as illustrated in Figure 1).

Within the phase-gate process itself there are:

- Eight phases, each specifying the deliverables needed to be completed by the different functional areas. (Defined in Deliverables scorecard)
- Documented gate criteria that must be met in order to pass a gate and continue with the next phase of the project

These are supported in the form of gate review meeting guidelines and an interactive website illustrating the phase-gate process, which also links all of the needed criteria and resources in one place.

As can be seen from the illustration in Figure 1, central to the NPD process is the Phase –gate process which is shown in Figure 2 below.

Figure 2. An overview of the Company's phase-gate process. This phase gate funnel is central to the NPD process.

Each of the different phases illustrated above in Figure 2 are now briefly expanded upon.

Phase 0 - Market research

Market research is a continuous process focused on determining what the unmet needs are within the marketplace, including end-user, intermediaries and the experience of the direct customers. Market research generates inputs into Idea Generation, but contains no specific deliverables. It could result in one product or many, and is thus best thought of as the breeding ground for ideas.

Phase 1 - Idea Generation

Idea generation is a continuous process that aims to build an environment for innovation to foster the development of creative solutions to solve relevant customer problems and opportunities. These ideas are then screened for basic feasibility followed by a gate 1 review,

where the gate 1 criteria are used to assess whether the idea aligns with the strategic objectives and whether it does solve unmet customer needs. Based on this; the gate review decision is made.

Phase 2 - Concept Feasibility

The main goals of the concept feasibility phase are to quickly define the product in sufficient detail in order to determine its feasibility from a commercial and technical perspective. Based on this a business plan is developed in order to justify the formation of a cross-functional team and assess the concept's strategic fit within the business. This also forms the basis of the gate 2 decision making criteria.

Phase 3 - Concept Development & Project Planning

Within this phase the product requirements are elaborated on and the rest of the project planned. One of the main outcomes is that a concept design is completed along with demonstrating a proof-of-concept.

Phase 4 - Design and Development

Detailed design, development and system integration are completed within this phase. Furthermore products are built and tested to ensure product requirements and specifications have been met. Suppliers are selected and their production capabilities developed. After gate 4 any changes to the product are handled through Engineering Change Requests.

Phase 5 - Ramp up

During this phase the design is validated in the production environment and field testing carried out as needed. Sales and marketing finalize pricing and product literature and announce the product to the market. Training programs are implemented and supply chain readiness verified. At the end of this phase, the product needs to be fully ready for production.

Phase 6 - Launch and Production Start-up

The product is available to customers, and production is ramped up. This gate review typically only occurs 3 to 6 months after the product is introduced to the market, and is focused on product manufacturability and market acceptance.

Phase 7 - Production

During this phase, the product is being sold to the customer and supported and maintained by the regular business activities. Typically 18 to 24 months after the gate 5 review this gate 7 review is held to further assess market acceptance and product manufacturability.

The outcome of each of these phases is a gate review meeting to verify that all needed requirements and deliverables for that phase has been met prior to proceeding any further.

For gate reviews there are 4 potential outcomes:

1. Continue to the next phase
2. Rework specific activities before proceeding
3. Hold for further considerations at a later date
4. Terminate further development

The outcome agreed in the gate review will determine, if and how the project should proceed.

During each of the phases, different functional areas participate and contribute to the product development within each of their specialised areas. The main functional areas involved within the process are:

- Project Management
- Business Line/Sales
- Supply Chain
- Safety, Health, Envirnment and Quality (SHEQ)
- Engineering and Development
- Trade compliance
- Manufacturing
- Service
- Delivery projects
- Configuration Management

1.2 Aims and Objectives

The Company has a phase-gate NPD process in place and it is reported to be used. Products have been released through the phase-gate process, utilising the gate review method. The expectation at Gate 5; the point of manufacturing ramp-up; is that the product is considered to be ready from an operational perspective.

Let us stop a moment here and define what is meant by operational readiness in the realms of this study. Here operational readiness means, all the processes and procedures for production are in place, tested and functional; the needed suppliers are identified and qualified, and all documentation needed in order to quote, sell and deliver the project are ready and in place. Lessons learnt from different delivery projects indicate that this operational readiness point has consistently not been reached, in spite of the products being delivered in these projects having been released through the NPD process. The consequences of this is broad and far reaching, but also ranging in severity. It can result in extra time and money being spent in order to try ensure commitments are being kept with customers, thus compromising internal project performance.

With this in mind, the Question is put forward: '***Why are products being released through the NPD process failing to be ready from an operational point of view***'?

Two hypothesis are put forward as potential reasons for this:

- H1 - The process is not being followed
- H2 - The process is improperly defined

These hypotheses are further explored and evaluated through data collection and analysis. Based on these results it is then looked into what the potential causes are for any identified problem areas.

The ultimate objective of this thesis is to identify why the process is failing in terms of operational readiness and to propose potential solutions and improvements to the process and the organisational environment within which it functions in order to help drive overall business performance improvements.

1.3 Rationale

The Company is driven by a high degree of innovation, within which product development work forms a key part of the strategic goals of the Company. This study is important to the Company, as ensuring the output from the NPD process is meeting its goals, is a key part of the long term success of the Company. In a broader sense, parts of this thesis could be of value to other companies experiencing similar problems.

The management of the design to manufacturing interface remains a key competitive variable. Included into this is complex organisational structures and job specialisation, which changes this from a design to manufacturing interface to a development to operations interface. Operations in this case covers manufacturing, supply chain, and the executing organisation delivering the final product to client.

Though it is one of the ultimate goals of an innovation process, the degree of success of the products that have been released through the process is not being evaluated here, but only the operational readiness of the product at the point of release. The product functionality and performance is not in question, only how efficiently it can be produced by the organisation at the release point. Products not ready from an operational perspective will result in increased production start-up costs, inefficiencies, frustration within the work force, and potential delays of customer deliveries. All of these result in cost impacts on the product line, which ultimately impact one of the primary goals of the introduction of new products - increased profitability. Helping address the operational readiness of products is here thus seen as an attempt, in the long term, to improve profitability.

1.4 Definition of terms

Term	Definition
A visible, documented process	A process that is described clearly and people know where to find the details on it and who has the relevant responsibilities for the different aspects of it.
Case	An instance of an object of study.
Coding (e.g. H1.2.3.)	These codes refer to Figure 5 in the paper to ensure discussion points can easily be back-referenced and put into perspective of the bigger picture. These numbers are generated from a numbering logic and have no other significance than being able to relate the reference to the overall picture easily.
Cross-functional collaboration	Actively working together and sharing information across functional areas while working towards a common goal.
Design for Manufacturability	Efforts by design and manufacturing to improve product-process fit, and the degree of simultaneous work.
Gates	Defined Go/Kill gates. Sessions where projects are reviewed and it is decided whether or not they should continue.
Gate criteria	Defined go/No-go criteria at gates, in the form of a checklist.
Gate deliverables/ NPD Deliverables	A set of predefined documents or actions which need to be completed prior to a gate review and in order to move onto the next phase of the project.
Operational readiness	Having all the processes and procedures for production in place, tested and functional. Having the needed suppliers identified and qualified. Having all documentation needed in order to quote, sell and deliver the project in place.
Phases	Clearly defined stages within which work is to be done.
SIPOC analysis	Supplier, Input, Process, Output Customer Analysis.
Study	A research project in which a practise-oriented objective is formulated and achieved.
The Company	The Company currently being studied and evaluated.

The Company President	The title might not be a direct representation, but it is intended to represent the highest level of management, held by a singular person. Also referred to as CEO, Managing director, etc. As the exact title periodically changes, it represents the highest level in the hierarchy.
The Parent Company	The larger company/Corporate group of which The Company is part.

1.5 Limitations and Constraints

The scope of this evaluation is focused on the implementation of the NPD process within the Company only. It does not evaluate any other sister companies. The Company follows guidelines from the Parent Company, so within this work the Parent Company guidelines are assumed to be in accordance with industry best practices. The validity of this assumption was also considered during the literature review, and there were no immediate indicators that this assumption is wholly incorrect.

The sample projects that are evaluated as part of this work are only from within the Company itself, and is not a reflection or evaluation of the overall Parent Company process, or that of any other sister divisions. The ultimate focus of this work is to help ensure that the products released are meeting requirements from an Operational perspective, and thus when considering detailed aspects of the deliverables within the process, the focus has been limited to functional areas that form part of the Company's core Operations department, not all functional areas. As the functional areas' work is closely inter-related, this detailed focus has in some areas resulted in a more detailed assessment of some other functional areas, but only as a consequence, not as the main focus.

Another point to note is that the success of the projects or products under discussion are beyond the scope of this work. A product might not be 100% ready from an operational perspective, but this results in extra internal costs and man power being utilised to ensure customer expectations are met, it does not necessarily compromise customer results. The consequences of these expediting actions are beyond the scope of this work.

1.6 Division of Chapters

The chapter structure for this thesis is as follows:

Chapter 2 A review of the literature shaping the concepts and questions within this thesis is given. It lays the foundations for the theoretical concepts discussed later in the thesis.

Chapter 3 Discusses and explains the research methodology used and why it is considered valid and applicable for this case.

Chapter 4 In this chapter the overall research structure is laid out and elaborated on including data selection and collection in order to address the hypotheses and the overarching research question. The chapter is divided into different sections, starting with a breakdown of the actual research structure used in this work, followed by the different stages of analyses, and finally ending in a data combination and exploration section, which combines all of the results together for clearer overall picture.

Chapter 5 Discussion section. Results from chapter 4 are summarised, discussed and validated through the combination of theory and data.

Chapter 6 Conclusions are drawn and presented based on the earlier work.

Chapter 7 In the context of a practice-oriented case study, recommendations are made towards the company for future improvements and areas for evaluation.

2. Literature and theory development

Below follows a review of the literature which has shaped the reasoning behind this thesis. Product development and some of the models surrounding it are at the heart of the matter. This is a very broad literary topic and thus the focus here is narrowed to the New Product Development and similar models such as integrated product development and concurrent engineering. The specific focus is on how these are structured in relation to the intended outcome of the final product released being truly ready for manufacture – operationally ready.

Parts of this thesis relate to the broader theoretical concepts that are not specifically related to product development, but to the areas forming the structure within which these development models are to function, such as organisational structure and culture, which make it more complex than just a process to be implemented.

Literature in the domain of Design for manufacturability and Organizational theory were evaluated in order to provide broader insight into the topic.

2.1 Product Development Models

As discussed by Rosenthal and Tatikonda (Susman, 1992) there are two key strategic capabilities needed by a company in order to support the competitive strategy. These are Cross-functional integration and an efficient and effective NPD process.

The concept of a systematic idea-to-launch process was initially proposed by Cooper in his first edition of 'Winning at New products' (Cooper, 2011). The model was conceived by observing the successes and failures of development projects undertaken by numerous companies. This later led to the coining of the term – *Stage-Gate* ®, considered to be one of the most widely used methods for taking an idea from concept to market launch. Cooper's work in this area is considered to be some of the most pertinent as it is based on in depth studies of companies and their practices, and is continually updated based on bench-marking studies performed. The New Product development Stage-Gate® process is laid out as a playbook to help overcome some of common reasons found for product failures.

New Product Development is an overarching concept ranging from how to come up with the big new ideas, picking the right projects at the right time and driving them successfully to market. The focus within this thesis is not on the Portfolio Management segment, but is

related to the project execution part of the process. The Mantra as laid out by Cooper (Cooper, 2011) is that it is about “Doing the right projects and Doing projects right”. The focus here is thus on “Doing projects right”. There might be instances where “Doing the right project” is touched upon but that will only be in the context of how decisions related to this might affect the quality of the actual project execution.

Integrated Product Development is a similar concept, the focus being on the different functional areas working together from an early stage. Andreasen and Hein (Andreasen & Hein, 2000) speak in slightly broader terms in that there are three main tasks to be carried out; Marketing/Sales, Development/Design and Production.

Concurrent Design/ Engineering (also referred to as Simultaneous Engineering) aims to address three main areas: people, process, and technology. It revolves around the integration of business methods, people and technology. It also highlights that it involves major organizational changes because it is dependent on cross-functional teamwork rather than the traditional hierarchical organization. As discussed by John Stark (based on the Institute for Defence Analysis (IDA) in its December 1988 report- 'The Role of Concurrent Engineering in Weapons System Acquisition') (Stark, 1998), implementation of this concept requires major organizational and cultural change, which though it features in the more prescriptive methods such as Stage-Gate ® models, at first glance it does not appear as a central concept, but more of a supporting feature.

Though the terminology and some of the focus areas might be slightly different between these different models, the basic underlying message and concepts are the same. For product development to function in an optimised state, the activity needs to be integrated throughout the company, and not be worked on within different silos. The early work done is as important as the core product development activities.

From a literally perspective, there are numerous reasons listed as to why the project execution part of product development fails. Most authors approach this topic from the perspective of why New Products fail (Cooper, 2011), (Andreasen & Hein, 2000). These various reasons why Products fail are however a mixture of drivers from the portfolio management side of things (looking for example at the reason why projects are started, and the quality of input based on which they are started); and drivers from the execution side of things.

Based on Cooper's studies (Cooper, 2011) of successful and unsuccessful product releases, the main reasons listed as to why New Products fail, is discussed both from a project perspective and an organizational perspective. Considering both these and what are considered to be critical success factors, a plethora of potential contributors for NPD failures are apparent. Below are listed the potential reasons considered directly relevant within the scope of this work:

- Quality of execution, simply explained as tasks that are not done, or are not done well enough. Missing steps and activities.
- Unstable project specifications or scope creep.
- Dysfunctional project teams, lack of integration across departments.
- A lack of a systematic portfolio review, resulting in too many projects, and of the wrong mix being worked on.
- Lack of competencies, skills and knowledge.
- Not utilising the core competancies within the company.
- Not having the right organisational structure in place.
- Lack of top management support.
- Not having the right resources in place, or enough of them.
- Not having a multi-stage structured New Product development process in place.
- Lack of spiral development (Predominantly straight lines).
- An over emphasis on speed of execution, at the cost of project success.
- Poor organizational design and leadership.
- Unreliable data.
- Missed timelines.

Cooper raises a few important points, referred to as the "Dark side to accelerated Product Development" (Cooper, 2011). The emphasis being that there should be a balance between accelerating the product development, and what is reasonably achievable timelines. If shortcuts are taken, this could lead to errors of commission and omission, with the ultimate consequence of either delays to the project or even product failure. Such product failures have the potential for longer terms consequences in that the customer has lost confidence, increased service and warranty costs, all leading to loss of reputation and potentially affecting the company sales of other products to the same customer. If the early stages of the

development is gone through too fast, the back end result could be a product that does not meet customer demands.

2.2 DFM literature

It is accepted that incremental improvements in functional efficiencies are not enough to drive the needed improvements in cost, quality and lead-time required in order to stay competitive. The product development models as discussed earlier are all methods of introducing new products into the market place in a disciplined and strategically focused way. A key component facilitating this work is also referred to as Design for Manufacturability/ Design for Assembly. Literature in this area (Susman, 1992)talks about the need to focus on the relationship change between the traditional design and manufacturing functions. This relationship can be considered a component needed for driving the successful deployment of the NPD process, but in terms of ensuring operational readiness, as is the focus point of this paper, it is one of the most important aspects. Susman (Susman, 1992) discusses what are referred to as organizational issues that influence and can be influenced by design for manufacturability.

New product development is a complex organizational effort, regardless of the complexity of the product being developed. This can be seen from the high number failures in new product development. Often tasks within a phase or across multiple phases are unintentionally skipped or inadequately executed.

One of the key focus areas thus becomes how to effectively co-ordinate efforts due to the increase in simultaneous work. Cross-functional co-ordination mechanisms or the use of specific tools and practices need to be in place to facilitate this. Organizational theory discusses different types of co-ordination mechanisms, which are useful checks to measure the NPD process up against, as cross-functional collaboration is a key feature to the success of the NPD process. Here we will use co-ordination mechanisms as discussed by Mintzberg (Mintzberg, 1979). These are as follows:

- Mutual adjustment
- Direct supervision
- Standardisation of work processes
- Standardisation of output

- Standardisation of skills & knowledge
- Standardisation of norms

These aspects of co-ordination mechanisms will be further considered during the evaluation of the process.

The concept of co-ordination mechanisms should not be confused with creating overly heavy bureaucratic processes. In their study on balancing the firmness and flexibility within innovation processes, Tatikonda and Rosenthal concluded that the project execution success was positively associated with formality, project management autonomy and resource flexibility (Tatikonda & Rosenthal, 2000). There is thus a balance to be struck between the more formal methods while still allowing for the flexibility needed for these innovation processes.

It was attempted to find similar studies as to the one being conducted here, but the literature found was mostly related to general product development models, design for manufacturability, project execution and organisational theory. The problems encountered are not necessarily new, but the focus here is on the specific problem within the context of this specific company, so the general literature only proved to provide insight on the general level, whereas the study focusses on how this applies in this specific environment.

3. Research design and methodology

3.1 Selection of the research method

The research design and methodology is an integral part of the this work, as it lays the foundations and framework for how the work was to be done, the data gathered, analysed and curated, prior to the final work being produced. Hence effort was put into identifying the most appropriate research method and then to design the study for the particular case at hand.

For the chosen study topic, experiment was not considered feasible within the timeline available. In addition, only a small number of instances are available for analysis and it is not possible to manipulate instances, thus making a pure survey based research strategy less suitable.

In the end, a combination of Action-research and single case study methods were chosen to perform this study. This approach allowed for combining the benefits of the more prescriptive case study techniques and the flexibility that action-research allows; as the parameters of the central problem are reasonable clearly defined, but the real root cause and potential solutions were uncertain.

Case Study research methods were determined to be appropriate, having used the classification methods as laid out by Yin (Yin, 2014) . This is based on the primary focus of this paper from the onset being that of an explanatory nature pursuing answers to questions having an operational link instead of frequencies or incidence. Further the questions being asked were of a ‘why’ and ‘how’ nature, focusing on contemporary events; and the researcher had no control over behavioural events.

Taking it a step further and considering that the business environment of the case, and taking into account the work of Dul and Hak (Dul & Hak, 2008), more specifically, a practice-orientated comparative case study was the most appropriate technique. The definition of practice -oriented research from (Dul & Hak, 2008) is used here, which is: “Practice-oriented research is aimed at contributing to the knowledge of specific practitioners for a specific practice, where practice is the real life situation for which a practitioner has either formal or an informal responsibility for”. Practice oriented study uses theories, but the primary objective is not to contribute to the development of those theories, but rather to use them in practice, as is common within business research.

The benefits of using this method is its ability to deal with a full variety of evidence; such as observations, interviews, artefacts and documents. The study by Jans and Dittrich (Dul & Hak, 2008) on publications within popular industry scientific journals indicated that in the field of Operations Management case studies were a reasonably common method, and based on the percentage of case study publications in relation to overall it could be thought of as an accepted research method in this field. Jans And Dittrich (Dul & Hak, 2008) also point out that based on the papers they studied that the most common malady for case studies is that they suffer from lack of scientific rigour. Other typical concerns in regards to the use of case study research is the lack of systematic procedures and interpretation of ambiguous evidence to influence findings and conclusions.

Action-Research is a method that pursues action and research outcomes at the same time. It is a qualitative method that requires participation in the process being studied; is spiral in nature and requires critical reflection throughout. The degree of participation can vary. A key part of this model is using Kemmis & McTaggart's model (Kemmis & McTaggart, 1988) of Plan-Act-Observe-Reflect, in a cyclic loop until a satisfactory conclusion point is reached. The importance of being responsive to the evidence is naturally incorporated through the participation and cycles, and thus change naturally propagated. Some of the more traditional methods inhibits this effective change. Pitfalls of this method, are typically unclear goals and methods, and the difficulty in keeping distant and neutral.

Incorporating an adapted version of this technique along with case study research methods; as has been done in this research; allows for flexibility and the ability to respond to the emerging needs of the situation while following the research structures of the case study methodology.

3.2 Research Design

It is attempted in this work to counteract the short-comings highlighted in the previous section by following a methodology based on those as laid out by Yin (Yin, 2014), Dul and Hak (Dul & Hak, 2008) and Runeson and Höst (Runeson & Höst, 2008). They address how to plan, design, collect, analyse and share data within a case study in such a way as to counteract the most common short-comings of the method.

To help with the rigour of this case study, a case study protocol was developed based on the guidelines provided by Yin (Yin, 2014) and as developed by Bereton et.al. (Bereton, et al.,

2008) It is proposed by these authors that the use of a protocol will help provide an underpinning methodology that can potentially help improve the overall reliability and validity of the conclusions, as the protocol helps lay out the data collection and analysis procedures thereby logically linking the data, the interpretations and the conclusions. See Appendix A for the outline of the case study protocol.

Quantative data involves numbers and classes and is analysed using statistics. The quantative data available for this study is limited due to the population size available for the different data sets, so has only been used for frequency of occurrence and percentages. Qualitative data involves descriptions, diagrams, pictures etc., and can thus help provide a richer and deeper understanding. The data collected in this empirical study will be predominantly qualitative, though quantative data was explored where feasible. A "mixed methods" approach (Robson, 2002) , often provides a better understanding of the phenomenon. (Seaman, 1999)

3.3 Data Collection Methods

Data collection techniques for a case study are not considered to be any different than it would be for any other study. Data collection methods and techniques were thus selected based on the data types available and with the underlying principle of 'multiple sources of evidence' and data triangulation. Further, principles of measurement and quality criteria were applied to try ensure reliability and validity.

As part of the data collection process, triangulation of data was sought after. This triangulation is important as it helps increase the precision of the study which is important for a case study which has richer and broader data sources, but is allot less precise than quantative data. There are different types of triangulation that can be used (Stake 1995):

- Data source triangulation – Achieved through the use of more than one data source, or using the same data source at different points in time.
- Observer triangulation – Using more than 1 observer as part of the case study.
- Methodological triangulation – The combination of different types of data collection methods.
- Theory triangulation – Using the combination of alternative theories or perspectives.

Different methods of triangulation will be demonstrated and used within this work.

Typically there are six types of data sources identified (Yin, 2014):

- Documentation
- Archival records
- Physical Artefacts
- Interviews
- Participant-Observation
- Direct Observations

Within this study, physical artefacts were not relevant, and participant-observation technique ruled out due to the limited amount of time available. A mixture of the other types of data sources were used throughout. The data collection plan (Appendix B) includes more details on the specific data sources used.

3.3.1 Interview design

Different data sources and levels of sources were used, as illustrated in Appendix B, but in addition in order to gain a deeper understanding of the various aspects and complexities within the process, interviews were conducted (first degree information). This provides the benefit of the perspective of those involved in the projects on various levels, and thereby "unfold the meaning of peoples experiences" as stated by Kvale (Kvale, 1996).

Qualitative methods build on two underlying principles, that of human experience and human interpretation. Human interpretation (Hermeneutics) is about interpretation and understanding. What is contained in project documentation represents how people interpreted the situation at that point in time. Within an interview situation, it would be the interviewee's interpretation of the question that will drive their understanding and response. The experiences of each of the interviewees and the interviewer will also in turn influence the understanding and the areas of exploration. By conducting the interviews, new knowledge will be gained by both parties.

Interviews are a good source of data for this case study as it will be able to provide important insights, and provide references for potential additional sources of evidence. The design of interview questions were thus considered carefully throughout to ensure they are put worth in

a friendly, unbiased and non-threatening manner, to try ensure the responses received contain as much information as possible, and the most realistic point of view. An example of this is posing "How" questions instead of "Why" questions, as pointed out by Becker (Becker, 1998). A "Why" question creates a natural defensiveness on the side of the informant. For the interviews themselves, a few focus areas were considered upfront in order to try get the best possible data from these interviews. Reflexivity was another phenomenon that attention was paid to. In the context of an interview, reflexivity occurs when the Interviewer's perspective unknowingly influence the interviewee's responses, and in turn the interviewee's responses the interviewer's line of inquiry. An awareness of this phenomenon during an interview can help limit its affects.

Ethical guidelines as laid out by Yin (Yin, 2014) were followed in the setting up of interviews, during the conduct of interviews and finally in regards to how the data was handled afterwards.

4. Data Analysis

In this section, the methods from the previous section have been practically applied in order to select, collect and analyse the relevant data. The chapter is divided into different sections, starting with a breakdown of the actual research structure used in this work, followed by the different stages of analyses and finally ending in a data combination and exploration section, which combines all of the results together for a clearer overall picture.

4.1 Research structure

Based on the case study question, two primary Hypotheses were put forward. To address these, progressive stages of data analysis were entered into, based on the chosen research method and the overall design. The case study protocol was used throughout, along with the Data Collection plan. Within the data collection plan a series of other documents are referenced[2] each of which includes specific data collection and analysis methods for that data set along with the recorded results. Below is a brief description of the progressive phases of analysis, which are also illustrated in Figure 3 below.

Data Selection - Characteristics to measure. Here it was considered what characteristics we would be comparing the data to. Answering the questions – "What constitutes a properly defined process for NPD?" and "What characterises the process being followed?"

Data Evaluation:

- **Stage 1 – Process Evaluations.** Based on the measurement characteristics identified for the process definition from the literature above, it was looked at what data was available in order to assess each of these characteristics (**Data Collection**). **Data sources** were identified in parallel with identifying **data analysis** methods, while focusing on having multiple sources available.
- **Stage 2 – Project Evaluations.** This stage used the same steps as stage 1 above, but focusing on the evaluation of executed projects.
- **Stage 3 – Preliminary data combination and validation.** The data from the two previous discrete stages are combined to give some initial **high-level observations**.

[2] These referenced documents are not contained within the thesis, but available for review upon request.

Based on these high-level observations and the insights gained though stages 1 and 2; **interviews** were conducted to further explore the high-level observations and identify any additional potential indicators. The **data** and insights gained through the interviews were then **summarised**.

Data Combination and Exploration. **Data** from stages 1 to 3 are **combined** and then discussed in terms of **potential underlying causes**. These potential causes were then correlated to see what the most common underlying reasons are in order to propose high impact focus areas for future improvements on the process. Providing these potential focus areas is one of the value-adding activities associated with this thesis.

Moving forward within the thesis, reference codes will periodically be included within the text (e.g. H1.2.3.) These codes refer to Figure 5 in the paper to ensure it can easily be back-referenced and put into perspective of the bigger picture. These numbers are generated from a numbering logic stemming from the two hypotheses H1 & H2, but have no other significance than being able to relate the reference to the overall picture easily.

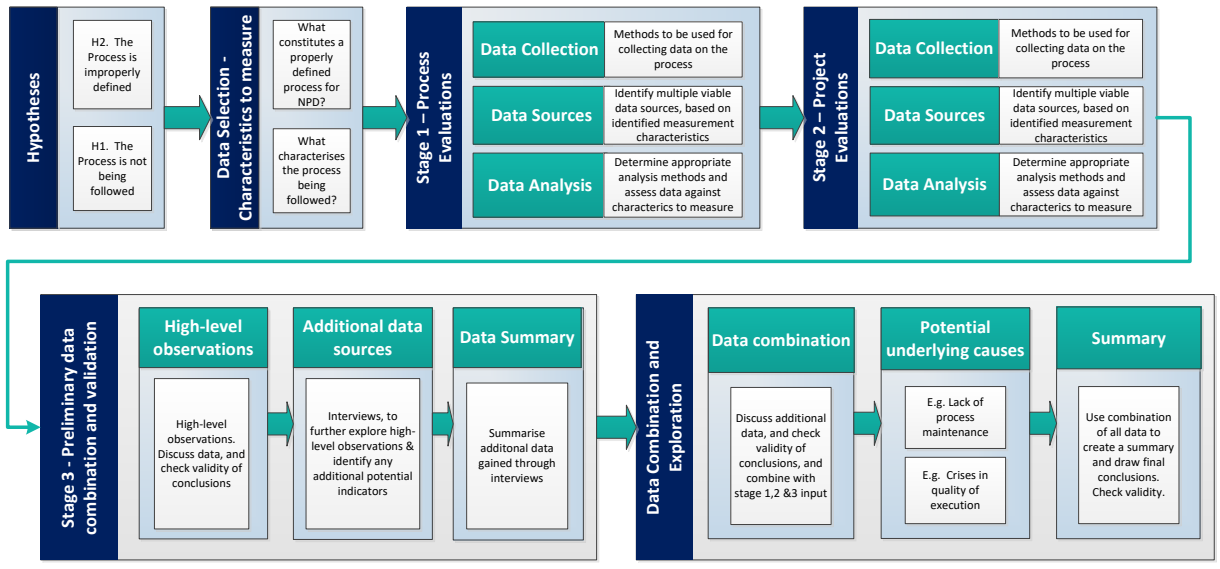

Figure 3. An illustration of the data gathering and analyses phases that were gone through

4.2 Data Selection – Characteristics to measure

With the hypotheses in mind, a preliminary data selection process was gone through.

Considering the hypothesis ***H1-The NPD process is not being followed;*** it is deliberated what the key activities within the phase-gate process are that allows it to function and help drive the intended results. Based on this, adherence to these elements can be considered as a first pass assessment activity. Centred on the results from this first pass assessment, incremental cycles of more detailed analysis are entered into as needed.

Utilising the characteristics of an operational phase-gate system as laid out by Cooper (Cooper, 2011), and results from APQC best practices in innovation studies (Cooper, et al., 2004) the key elements for process adherence were derived. The key elements considered here for data selection are thus:

a. Completion of gate deliverables at the time of the gate review
b. Adaptation and scaling of the process
c. Designated gatekeepers making clear, informed decisions using process-defined criteria
d. Cross-functional collaboration

For ***H2-The actual process implemented is improperly defined;*** a similar approach is taken as above, in that it is first considered what the characteristics of the process are towards which the implemented process will be measured. Here these are:

a. Phases - Clearly defined stages
b. Gates - Defined Go/Kill gates
c. Gate deliverables - Deliverables defined for each gate
d. Gate criteria - Defined go/No-go criteria at gates
e. An adaptable and scalable process
f. Gatekeepers designated for each gate
g. A visible, documented process
h. Activities defined for each stage
i. A process manager in place
j. An enabling process for the project team
k. Cross-functional work clearly defined within the process

Items ‘a’ through to ‘e’ from the list above are covered within the Parent Company process, so the assessment will be whether *the Company is aligned with the Parent Company best practices(H2.3),* and whether the process details within the operational areas are as they should be.

Point ‘f’ from H2 is evaluated at the same time as point ‘c’ from H1.

Point ‘g’ through to ‘i’, will be evaluated together under the statement – *Activities defined for each stage within a visible and documented process*. A visible and documented process should include designated gatekeepers and having a process manager in place.

Point ‘j’ from the list above is not possible to measure or investigate directly, but it is considered to be facilitated by having all of the rest of the characteristics met. In other words, by having a clearly defined process, with a process manager in place and activities defined, the process would be considered to be more likely to be an enabling process for the project team. The opposite side of the coin is a process, partly, defined with unclear activities, where the project team are unsure of the expectations, and end up having to spend time on figuring out what the process needs instead of focusing their efforts on producing value producing efforts- Thus not an enabling process.

Point ‘k’ from H2 is looked into at the same time as point ‘d’ from H1 under the statement - *Cross-functional collaboration as an integrated part of the process.*

To summarise, the evaluations that will be done are as follows:

- Completion of gate deliverables at the time of the gate reviews (H1.1.)
- Adaptation and scaling of the process (H1.2.)
- Designated gatekeepers making clear and informed decisions using process defined criteria (H1.3. & H2.2.)
- Cross-functional collaboration as an intergraded part of the process (H1.4. & H2.1.)
- Alignment of Company process against the Parent Company process (H2.3.)
- Activities defined for each stage within a visible, documented process (H2.4.)

4.3 Stage 1 – Process Data Evaluations

4.3.1 Data Collection on the Implemented Process

In order to try evaluate the Hypothesis that the implemented process is improperly defined (H2), data on the company process was gathered in successive phases of elaboration in order to try determine at what level there might be a problem, if any. This is illustrated in Figure 4 below, and further elaborated on directly underneath.

Figure 4. An illustration of the successive phases of elaboration when studying the process

Data on high-level process description

The Company NPD process is described in chapter one. This process is based on the Parent Company recommended practice, which provides the basic outline that each subsidiary should follow, but also contains a series of mandatory deliverables that need to be completed in order to align with overarching company policies and strategies. The assumption is that the Parent Company process is in accordance with best practices and thus it is not being evaluated here whether that process is as it should be. What is being evaluated here is whether the implemented process for the Company is properly defined and thus able to facilitate the successful execution of development projects.

In order to get a proper understanding of how the Company process compares to the recommended Parent company process a detailed comparison of the process and deliverables for each was done in order to determine whether the recommended NPD process has been implemented. The key areas considered during this evaluation are discussed further in section 4.3.2.2. This exercise also proved to provide additional insight into the Company implementation and interpretation of the process, which was a good baseline when evaluating the already executed projects.

A brief description of the data collection and comparison procedure:

- Firstly, information on each of the processes were taken from their respective web-applications, which as a tool for the process, should be the most up-to-date source of what the requirements are. This includes information on the different phases, functional areas, gate deliverables and gate evaluation criteria for each of the processes.
- Next, all deliverables for each process were compared on a phase-by-phase basis for each functional area. This is in order to determine which deliverables the Company has adopted from the Parent Company, and which were considered to not be applicable. In addition to this there could also be deliverables introduced by the Company on top of the Parent Company specified deliverables.
- Following the above two steps, for each phase, a comparison was done across the different functional areas to determine whether there are any deliverables which overlap or are duplicated. This was done for both the Parent Company- and Company- processes.

The reason for the final criteria above is that an overlap or duplication of deliverables can be an indication of improperly specified deliverables and a contributor to unclear responsibilities. Unclear responsibilities in turn can to some degree be considered a potential reason for the process not being adhered to.

Department procedural level

Following the above higher level evaluation of the entire process, a more detailed evaluation was entered into, looking at the procedures in place both at the top level, but also on a functional area level. Some basic parameters that were looked at were as simple as whether procedures exist, whether they are up to date and if cross-functional collaboration is covered. See the data collection plan in Appendix B for further details.

Detailed process analysis for operations

The details of the process and deliverables specified within the Operations department was looked into even further detail, as this is part of the specific focus for this case study. Data was collected as illustrated in data collection plan in Appendix B, which includes the high level process procedures and detailed department procedures. Based on this a SIPOC analysis was done and all referenced templates and guidelines reviewed.

4.3.2 Data Analysis on the Implemented Process

By assessing the data available and considering the methods discussed in chapter 3, different assessment techniques were identified. Based on these the needed data was collected and the analysis work done as shown in the data collection plan (Appendix B). The data evaluation results below are presented in terms of the relevant measurement criteria identified to evaluate each of the hypotheses.

4.3.2.1 Alignment of Company process with Parent Company process (H2.3)

A comparison of the existing Company process and recommended Parent Company process is done in order to assess the below measurement characteristics (earlier defined in chapter 4.2.).

a. Phases - Clearly defined stages
b. Gates - Defined Go/Kill gates
c. Gate deliverables - Deliverables defined for each gate
d. Gate criteria - Defined go/No-go criteria at gates
e. An adaptable and scalable process

We start by considering what the requirement for adherence to the Parent Company process is. Aside from a few mandatory deliverables, the Parent Company requirement is not that the process is adopted to the letter, as it recognises that there are variations. Instead along with the NPD funnel, there is a NPD Process Model, which includes a goal for each functional area and gate, accompanied by a recommended specific practice, each of which should result in the gate deliverables. For example, for the Product Planning functional area, in phase 1 the goal is to define a business case for the product to ensure adequate value proposition and proper market positioning for the product. In order to meet this goal, Specific Practice 1.1. –

Develop Product Business case should be implemented in a suitable format, which would result in different required deliverables as a result of implementing this practice (Competitive Product review and Business case). The deliverables might be different for different business Units, but the Specific practices and goals should still be in place in a form suitable for the business unit.

When the comparison was done between the processes, it started at the top level framework and systematically went down into more detail, up to the point of the actual gate deliverables.

The phases and gates of the NPD. When using the latest version of the Company NPD process, it is clear that both processes have the same phases and gates, and thus are functioning off the same basic framework.

The functional areas. The Functional areas in each of the processes are not identical.

The variations are summarised as follows:

- ***The same in name but not in practice*** **-** Some functional areas are the same in name, but when looking at the details within the functional area, it should be noted that they are not an accurate reflection of actual company functions and personnel performing the work. There are also functional areas listed that no longer exist.
- ***Additional functional areas added in by the Company beyond what is in the Parent Company process***
- ***There are functional areas existing in the Parent Company process that does not exist in the Company process***

Based on this, it appears that when it comes to the functional areas being used, for some areas the functional areas are adopted directly (even though the mentioned functional area does not do the work) and in some cases new functional areas are introduced even though the work is done by an already existing functional areas. At a first glance this could be considered to be semantics, but this is the backbone of the process; a complicated process that requires continuous interaction and individual performance in order to ensure successful execution. For this to work, it is fundamental that the process is clearly defined, along with where the different responsibilities lie, so that everybody knows when they should do what and which activities leads from theirs; similar to a symphony orchestra if we are to try draw an accessible comparison.

The gate deliverables. When looking at the recommended deliverables, and what has been adopted by the Company, a detailed comparison was performed, comparing functional area to functional area, while compensating for functional naming discrepancies. Below are some key points noted from this comparison, the statements could apply to multiple deliverables or just singular ones, but all were considered important to highlight, because as a whole they provide a reflection of the condition of the deliverables:

- Not all suggested deliverables have been adopted. In some cases the decision and reason why is documented and clear, and in some cases no information is available.
- Deliverables that were planned to be implemented, never were.
- Deliverables have been added in addition to recommended ones.
- For one functional area there is no overlap between what was prescribed and what was adopted.
- Some listed deliverables are not unique for a project, but are standard company procedures that are always followed.
- Ownership of deliverables are not consistent from gate to gate.
- For some gates, the same deliverable has multiple owners.

Further when reviewing the Company documents from the different available sources, and putting it into to context of the known and observed changes within the company, it is clear that the process has not and is not being kept up to date.

- Overarching process description documents are partly outdated, as have not been kept up to date as the process has evolved
- Additional functional areas have been introduced in terms of deliverables, but these are not necessarily aligned with company structure and thus are covered by existing functions

Gate criteria. Gate criteria exist within the process, and is the same as recommended by the Parent Company. These have not been adjusted to the Company needs. Process documentation indicates that these should be used during the gate review. There is however no clear Go/No-go indication coming from this.

An adaptable and scalable process. The process is set up to allow for scaling.

4.3.2.2 Activities defined for each stage within a visible and documented process (H2.4)

Within this section the goal was to assess whether the process meets the following criteria:

a. A visible, documented process
b. Activities defined for each stage
c. A process manager in place

This was done through the review of key process procedures and a detailed review of the Operations' related process descriptions.

Review of key process procedures

Following the evaluation of the high level process description in the previous chapter; other relevant department procedures were evaluated in order to assess whether a visible and documented process is in place and that activities are defined for each stage.

Activities are considered to be distinct from deliverables. The deliverables are the outcome of activities. Note, it is not necessarily needed for a specific procedure to exist if the activities in the process description incorporated into the NPD model holds sufficient detail. There are however a few key functional areas that are involved in the process at a very detailed level, and thus incorporating the NPD requirements and activities into a department procedure would be the best way to control the process. Of the ten functional areas, there are at least three functional areas; that based on their level of involvement in projects; and what is included in the high-level process, you would expect additional details on the process on a department level. However only one was found to have an up-to-date procedure incorporating the NPD activities into their day to day work.

Cross-functional collaboration was also assessed while reviewing the process and procedures. This is however a difficult topic to measure and evaluate as there are many ways of interacting and achieving this which is related to personal relationships, informal flows of information and so forth. Using some of Mintzberg's co-ordination mechanisms (mentioned earlier); standardisation of – output and – work processes, it can be assessed directly whether the available procedures and processes demonstrate these characteristics.

It was found that the high-level process is visible and documented, albeit outdated and with some overlaps between functional areas. However, o a functional area level it is not currently

done in a sufficient manner. Activities are only defined for limited functional areas and there are only limited indicators of cross-functional work.

A detailed assessment of Operations related process description

The specific focus of this work is in regards to operational readiness, so it is of interest to do a more detailed evaluation of the NPD process as it specifically pertains to 'Operations' deliverables. Here we will look specifically at the 'Manufacturing' and 'Delivery projects' functional areas. In order to get a proper understanding of the quality and condition of the prescribed process for these two functional areas a SIPOC (Supplier, Input, Process, Output, and Customer) analysis was done, using what is currently described in the NPD process and in any previous process analysis. In summary when looking at the process summary using the SIPOC tool, the following is apparent:

- What inputs and who are providing them in order for the Manufacturing deliverables to be completed is only specified for a few deliverables.
- Who will be utilising the output (deliverables) from Manufacturing is not specified.
- The process to be used to convert input to outputs is not specified at all.
- Templates are not available for all listed deliverables.
- For some deliverables only a few lines of descriptive text is provided, so what is really expected from the deliverable is not clear, and open to interpretation from person to person.
- In some cases blatantly incorrect outputs have been listed in the process description.

From further detailed reviews of the supporting documentation, it also became clear that the timing of the deliverables in relation to the rest of the process does not make sense for some of the deliverables. In some cases, the level of detail that is asked for is too high compared to what is actually possible at that phase of the project. On the other hand there are deliverables required too late in the process compared to the phase the project would be in. For example, manufacturing instructions being created as an output from the ramp-up phase which includes a pilot build, i.e. how do you do a pilot build without manufacturing instructions?

Based on this the observation is made that the process for this functional area is improperly defined. It was also noted that no specific department procedure exists describing the work to be done in regards to the NPD process.

4.4 Stage 2 – Project Data Evaluation

4.4.1 Data Collection on projects to be evaluated

As part of the analysis work there was a need to study results from actual projects that have been run through the NPD process. To avoid introducing sampling bias, projects were selected for evaluation based on some pre-set criteria. The selection process was taken in phases because though projects might meet the basic selection criteria, other factors might not make these projects feasible to include into this case study.

Project identification criteria:

- Projects that have passed through a gate 5 or higher gate review.
- Projects that have been through at least one customer related sales project, since being handed over to operations.

The above is considered the primary selection criteria, as once the above criteria has been met, the product has been handed over to operations and data becomes available on the success of the released product and project in terms of operational readiness.

Based on the projects identified using the above identification criteria, a first pass screening of these projects was done in order to determine whether all of the needed project data was readily available. Projects without the needed data readily available, were excluded due to the time constraints of the case study.

Using the above identification criteria in conjunction with the project screening, four projects were identified for detailed evaluation of which one was excluded due to data availability.

The three projects selected offer a good range in project type variability, ranging from an ‘existing product upgrade’ to a ‘new to the world’ solution. Below is a short description of each of the projects that will be evaluated as part of this study.

Reference	Degree of Innovation	Comments
Project A	New to the world	High degree of complexity. Never been done before, new manufacturing techniques to be defined. Some base components being re-used from previous products, but only to a minor extent.
Project B	New to the company, competing market technology	Mid-level complexity. Established technology, but new for the company in term of commercialising.
Project C	Existing product upgrade	Low-level complexity. Only electronics being changed, no mechanical design changes to the rest of the product

Table 1. An overview and description of the projects selected for more in depth evaluation.

The spread of project types as indicated above is considered to be a positive for this case study, as there can be considered to be a degree of correlation between the 'newness' of the technology and the number of manufacturing and operational issues that might be encountered at manufacturing start-up. If only projects of the same type were to be included into the study there is a risk of a skewed view as to the potential findings.

4.4.2 Data Analysis on the Projects

Based on the earlier described classification process, three projects were identified as feasible for analysis in relation to this study.

Using the methods discussed in chapter 3.3, different measurement criteria were identified, and the data needed in order to assess these determined (see data collection plan in Appendix B for more details). Based on this, data analysis was done which is further elaborated on below. The data evaluation results are presented in terms of the relevant measurement criteria identified to evaluate each of the hypotheses.

4.4.2.1 Completion of gate deliverables at the time of the gate reviews (H1.1)

Completion rates of gate deliverables

In order to assess whether gate deliverables are being completed as required at the time of the gate reviews; for each of the projects a series of 'degree of completion' values were calculated.

$$Degree\ of\ completion = \frac{\#\ of\ completed\ deliverables}{\#\ of\ applicable\ deliverables}\%$$

The following measures were looked at:

- *Degree of completion of the gate deliverables* for all functional areas. This simply tells us whether the functional areas had completed the required deliverables as defined in the process, and to what degree, i.e. what percentage of deliverables were completed compared to what should have been.
- *Degree of completion of gate deliverables* for the 'Manufacturing' functional area. This is intended to show us to what degree Operations specific functional areas are following the process compared to the rest of the company.

The results for all three projects are presented as an average across all gates, in Table 2 below.

	Project A		Project B		Project C	
	All functional areas	Manufacturing functional area	All functional areas	Manufacturing functional area	All functional areas	Manufacturing functional area
Degree of completion of the gate deliverables	55%	0%	84%	90%	92%	87%
Degree of customisation	82%	88%	83%	75%	70%	85%

Table 2. Results for the three projects assessed in terms of degree of completion and customisation of deliverables. Calculated as an average value across all gate reviews held for each project.

Based on this it is clear, that for most gates the deliverables are not completed at the time of the gate review. This table also shows that this behaviour is spread across all projects evaluated and not just limited to one or two.

4.4.2.2 Adaptation and scaling of the process (H1.2)

Customisation of deliverables is expected, as no two projects are identical. The process is intended to be scalable, and should thus allow for some degree of customization of the specific deliverables applicable for each gate.

A percentage of customisation was calculated as a first pass, and then an actual comparison of the specific deliverables being customised out. What this could potentially indicate is whether there are deliverables that are consistently customised out. If so, it would be a potential indicator that even though this deliverable is part of the process, the people using the process do not consider it to contribute any value, or that the approach to the customisation is flawed or done by the wrong persons.

Customisation of gate deliverables

Degree of customisation applied at each gate; for the overall process and for the 'Manufacturing' functional area.

$$Degree\ of\ customisation = \frac{\#\ of\ deliverables\ indicated\ as\ relevant}{Total\ \#\ of\ gate\ deliverables}$$

The results for all three projects are presented as an average across all gates, in Table 2 above.

There was an indication that deliverables were being customised, but not always appropriately, or by the right persons, as deliverables which should have been applicable were customised out by persons other than the functional area responsible. There was not enough data available to draw conclusions on deliverables repeatedly customised out.

Below in Table 3, the results are presented as an overall average for all three projects and across all gates. Manufacturing has performed marginally worse than the rest of the functional areas.

	All functional areas	**'Manufacturing' functional area**
Degree of completion of the gate deliverables	77%	59%
Degree of customisation of the gate deliverables	78%	83%

Table 3. Overall average for all three projects assessed in terms of degree of completion and customisation of deliverables across all gate reviews held

4.4.2.3 Designated gatekeepers making clear and informed decisions using process defined criteria (H1.3 & H2.2)

In order to assess this criteria, a series of questions were posed, which are discussed in detail below. After the relevant questions have been explored an overall conclusion is drawn on whether this criteria is met.

Are there designated gate-keepers for the gates?

Designated gate-keepers were assigned when the process was first introduced, but based on the process data reviewed, this overview has not been maintained. From observational data, it is not clear who the designated gate-keepers are and what specifically their responsibilities are. Project documentation indicates who has voted for the project to continue, but it is unclear whether these are the designated gate-keepers.

Are decisions clear and clearly documented for all gates?

There is a lack of consistent documentation from project to project. In some cases results from gate reviews were not recorded at all. Where documentation exists, the decisions are clearly recorded.

Do the decisions align with the status of the gate deliverables?

No, projects with incomplete deliverables are consistently let through gates. Out of a total of 12 gate reviews that had been passed, only 3 had all relevant deliverables completed. If we were to convert that into a compliance %, only 25% of projects meet the requirement of having completed all deliverables at the point of a gate review.

Are gate criteria used to facilitate decision making?

Process documentation indicates that the gate criteria should be used during the gate review. Of a total of 14 gate reviews held, there is only documented evidence of the gate criteria having been considered for 4 of these reviews. The outcome of the use of the gate criteria in those cases could not be seen to have any influence on the final decision of passing those projects through the gate review. From observations made through participation in the process; it was clear that some senior managers were not aware that the gate criteria existed. For some of the projects these criteria were used as a pre-gate verification checklist, but not as part of the gate review itself.

In summary, there is an indication that:

- The designated gatekeepers are not clear to all project participants.
- The documentation on the gate decisions are not consistent and not always kept up to date.
- Projects are let through gates when the basic gate criteria are not met.
- Process-defined criteria such as defined gate criteria and completion of deliverables, do not appear to have an influence on the decisions being made.

4.4.2.4 Cross-functional collaboration as an integrated part of the process (H1.4 & H2.1)

Cross-functional collaboration is a key characteristic to be looked at when considering whether we are following the process, but also in terms of process definition.

From a process definition perspective it is assessed how this is covered from a procedural perspective. From a process adherence perspective it is assessed how this is functioning within the projects.

The assessments done include:

- Detailed reviews of the process procedures to try identify if and how this collaboration aspect is facilitated.
- Project schedules were looked at to consider how we plan for the cross-functional work.
- Observational data was used to look at how deadlines are communicated.

Based on the above points, it was observed that there is limited to no mention of cross-functional collaboration within procedures. Schedules evaluated, similarly had little to no sequencing catering for cross-functional inputs. Scheduling activities were also very much focused only on core engineering work. In many cases, all functional areas were given the same deadline, for just ahead of the gate review, without considering inter-relations between the functions.

The spread of how resources use hours throughout the projects was briefly assessed to try determine if this can provide additional insight into the evaluation of cross-functional work and when non-engineering resources are doing work in relation to the gate reviews. The data did not have a sufficient level of detail to be able to draw any conclusions on, so have been omitted here.

4.5 Stage 3 – Preliminary date combination and validation

There are no pre-defined criteria to measure in this phase and the data chosen to be collected are wholly dependent on the results from the previous stages.

As presented in section 4.1, based on the results of Stage 1 and 2 and the knowledge from the literature, some initial high level observations are made. Based on these the interview questions were designed in order to gain additional insight into potential underlying causes, and corroborate other information sources where feasible.

Figure 5 below illustrates how the Hypotheses relate to the measurement criteria, and in turn to the data collected, the data analysed and the initial high-level observations. Though Stage 1 and 2 are treated as distinct stages, they have some criteria overlapping which supports the high-level observations both from a project – and process- analysis perspective, as illustrated below.

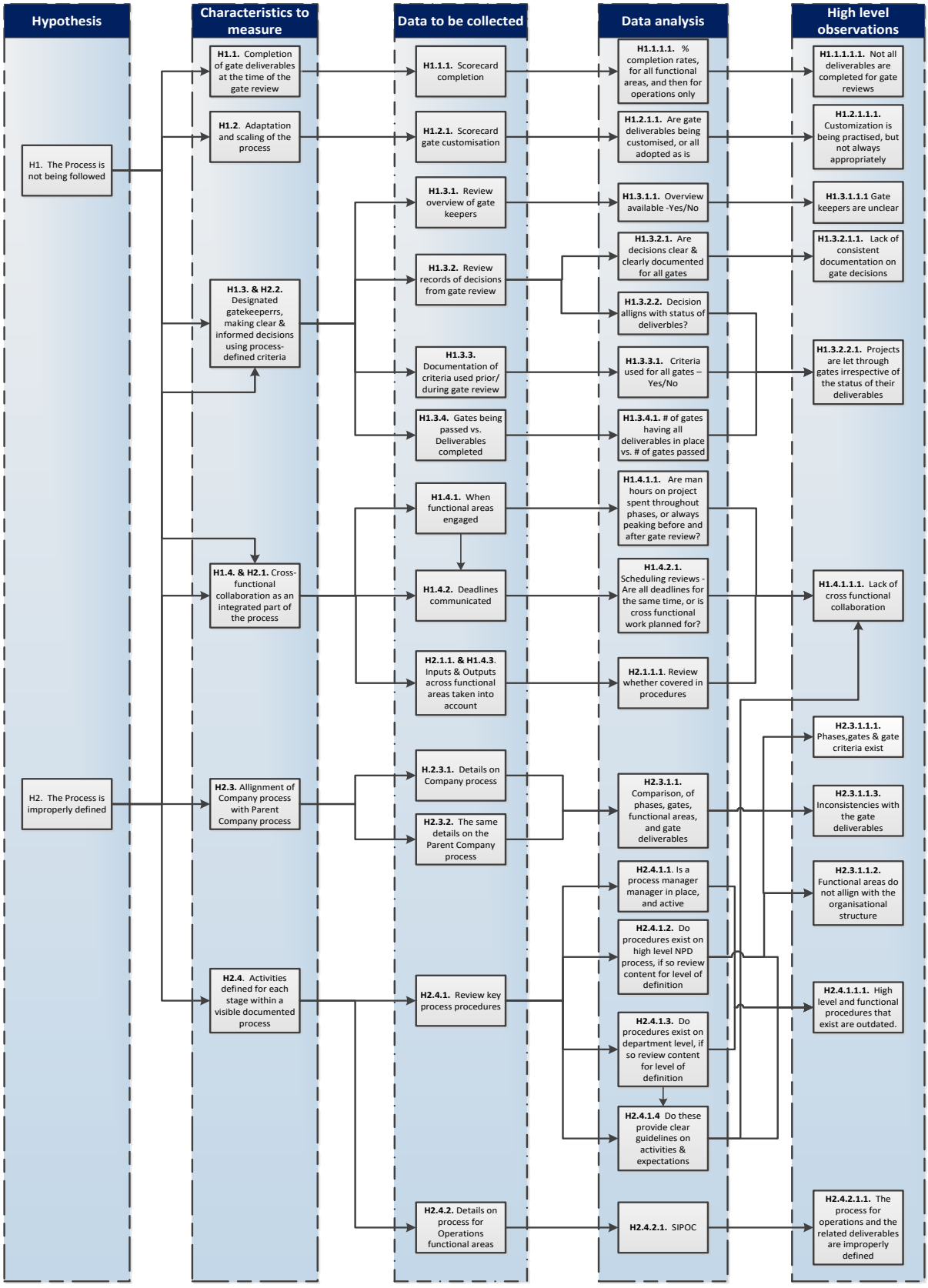

Figure 5. Overview of information flow and logic linking from hypothesis through to high-level observations

4.5.1 Interviews

Based on the initial stages where the hypotheses were evaluated and the subsequent step where the potential high-level causes of the identified problem areas were further delved into, an interviewing stage was entered into. This stage brings the opportunity to get opinions and interpretations from people exposed to and directly working with the process. This provides a rich source of information to either corroborate some of the findings from the other data sources, but also to potentially highlight other unknown causal factors not apparent from the documentation and other data sources. The insights gained here are included into the next section where potential underlying causes are explored and presented. The interviews were set up in a semi-structured format, with the questions being planned, but not necessarily asked in a set sequence, as it was chosen to let the development of the conversation direct the sequencing.

Interviewee selection. The requirements used during the selection of the interviewees were that they are actively involved in NPD projects, as opposed to only having been involved in historical projects. This is to ensure that the current status of the process is reflected as opposed to historical views only, the latter being less relevant when considering potential improvements. Interviewees were selected from different functional areas, but also from different levels within the organizational structure, thereby bringing in horizontal and vertical differentiation.

It should be noted that the organisation is small so there is no opportunity to build up statistically significant data by interviewing numerous persons from within the same function.

The detailed answers to the interviews conducted are contained in Appendix C. Here the answers will be presented in a condensed format combining all of the interviewees' input to highlight what information and views they provide.

Question 1 & 2 - Experience

These questions in the interview were to validate the experience and the relevance of the experience of the interviewees to the NPD process.

The subjects that were interviewed, all had extensive experience within the Company, in different positions and had been in the Company since the NPD process was introduced. All actively work with the process, either as functional area leads, or as contributors.

Based on this they are considered to have relevant knowledge and insight to the process.

Question 3 – Purpose of the process & common shared vision

These questions were intended to assess if there is a relatively common shared vision between the different interviewees in terms of the purpose of the process, but also as to whether they consider this to be a commonly shared vision among peers.

There were no starkly contrasting views in regards to the purpose of the process, but neither was there one truly common underlying purpose discussed. Commonality was shown in the area of the process being for the entire business, and it helping to focus the efforts on products for which it has been established that there is a market. Further, the final product quality and ensuring the company is ready to execute, were repeat topics.

In regards to a commonly shared vision, most seem to consider that within their immediate groups that there is a commonly shared vision, but it was suggested that within the larger groups that there might not be.

Question 4 – Process definition and adherence

The questions in this section were to gauge whether in general the interviewees thought that the process was properly defined and followed.

From a **process definition** perspective, the high-level process was generally considered to be well defined, though one respondent did indicate that even at that level things could still be improved further.

On a functional level description, there was consensus that not all of the needed tools, templates and guidelines were in place, and that for the areas they were, they either required improvements or major updates.

In regards to deliverable definition, two respondents indicated that the activities that are required are not clear, and that some deliverables were “badly defined”.

Within the operations functional area, the actual timing of some of the deliverables in regards to the rest of the process was questioned.

How process information is stored and where it can be found was in general considered to be clear, but there were indications that the prescribed practices were not necessarily followed, as they were time consuming, non-value-adding and not followed up on. This was a suggested area for improvement.

From a **process adherence** perspective, 4 out of 5 interviewees thought that the process was not being followed as intended. It was suggested by 2 respondents that the degree of success of the project and process adherence relies on the persons involved, their experience within the company and motivations. It was further suggested that there is a variation not only between person but also Business Lines and locations within the company.

Those that considered the process not to be followed suggested the following potential underlying reasons:

- Variations in business lines
- Senior leadership
- Project leadership
- Lack of training – On the process, the tools and the understanding of the process
- Inadequate procedures and templates
- Availability and prioritisation of resources
- How project planning is done
- Time constraints
- Project management & leadership focus during project execution
- Not using the process for the right purposes
- Belief in the value that the process can bring
- Product being sold and delivered prior to the NPD project being completed

One respondent indicated that overall, a maturing process is most likely required throughout the organisation in terms of how the process is used and followed.

Question 5 - Cross-functional collaboration

These questions were included to try assess whether the interviewees considered cross-functional work to be well described within the existing process and procedures.

Based on the responses, it can be said that most indicated that this is an area that can be improved on, as cross-functional work is partially covered but it is not necessarily always clear who will be using the deliverables. It was also suggested that some of the deliverables being created are not being used as they could be.

One respondent indicated that the inputs were clear to those needing them and those providing them from a cross-functional perspective.

No co-ordination structures are known of, and degree of co-ordination wholly up to the individuals. Within the projects, it depends on the project leader, as some are better than others at this aspect.

Question 6 – Value-adding activities

These questions were structured to try assess to what degree the NPD development work is integrated into 'everyday' activities, or whether they are treated as additional separate tasks. In addition it was used to gauge whether respondents consider all deliverables are value adding, or whether some are just being completed for the sake of being completed because it is on the scorecard.

There was a mixture of responses, ranging from the NPD process activities being the same as for everyday work to it being fully separated. Based on the range of positions of the respondents, this is considered to be neither a positive nor a negative, but just a state of being.

In regards to deliverables being value adding, all respondents agreed that there are deliverables currently within the process on which resources are spending time, for the sole purpose of completing the deliverable in regards to the scorecard, as nobody else was using them, and they gained little to no value from creating them.

Question 7 - Process maintenance & continuous improvement

These questions were included to gauge whether the respondents considered that the process needed to be improved and provide some insight into which specific areas they were concerned with. In addition it was to determine if any known updates were planned for, to see whether; regardless off the process ownership definitions, functional areas were pro-actively working on improvements that were not known of beforehand based on previous enquiries into the process.

There was unanimous agreement that process improvements were needed. There was only one active ongoing improvement initiative known of and it was limited to a specific department. Areas suggested for potential improvements within the process:

- Resource allocation and how resources are committed.
- A clearer definition of the activities within the process, and the requirements governing those activities.
- How the responsibility for validating and customising deliverables are done in relation to those responsible for creating the deliverables (the functional area lead vs. the functional area responsible for the project).
- The persons involved in the gate reviews – Suggestion that maybe at least 1 objective participant is needed to ask the questions those that are not as heavily vested in the project success will not.
- Cross-functional collaboration across departments and how implemented within the process.
- Better description of deliverables.
- Better templates.
- Creation of missing templates.
- An overall review of the process to validate whether all deliverables included are actually needed.

Question 8 – Project Execution

Based on the project evaluations done, there were indicators that projects were falling short on the mark of meeting project goals. Based on this the question was asked to try get some insight as to what the potential reasons are for project execution sometimes falling short of

the mark. The question was posed on the assumption that the projects were not meeting the goals they set out to meet. This assumption was not commented on or corrected, indicating that none of the respondents strongly disagreed with this view. No documented Key Performance Indicators (KPIs) could be found in regards to the process or projects, so the question was asked to the respondents to determine if there were some in place that were not directly documented in the process.

In regards to potential reasons for not meeting project goals the following were put forward:

- Resource availability, in general but also specifically in the form of dedicated resources, and prioritization of work for resources with split responsibilities. This point was highlighted by ALL respondents.
- How planning is done for projects – Creating accurate schedules and understanding the critical path from day 1. Allowing for development through the inclusion of cycles in design.
- Scoping of projects – In two forms - scope creep, and knowingly omitting some scope that it will not be possible to produce the product without including.
- Lack of understanding of the technical requirements and what they translate to.
- Selling the product prior to the design being frozen.
- Technical difficulties during the project.
- Sub-supplier issues (considered minor only).

Only 1 respondent was aware of KPIs being used in regards to the process/projects. This respondent is responsible for reporting to senior leadership on this, thus indicating that though there is a KPI being reported, it is not something that is being used within the process on performance management basis in any known way, beyond it potentially driving decisions made by senior leaders.

Question 9 to 13 – Gate reviews and decision making

These questions were included with the intention of getting a better understanding of the gate reviews, the decisions made, and whether the results of the decisions taken are understood. Here is also specifically trying to assess whether it is clear to people working on the projects whom the actual gate decision makers are.

Based on the results, nobody was 100% sure of all of the gate decision makers. The respondents that worked within management positons, appeared to know who the basic members are, but on the details and when exact responsibilities came into play, everything was not clear. The respondents that were not within management positions did not appear to have clear knowledge of who these decision makers are.

The gate decision making criteria mentioned by respondents were as follows:

- Gate criteria checklist (only 2 out of 5 respondents referred to this).
- Gate review meeting presentation (2 out of 5 respondents).
- Completion of deliverables (All respondents mentioned this, but one questioned whether this is actually true, as so many projects which have not completed their deliverables pass gates).

It was also mentioned, that depending on what a project manager chooses to focus on, and how they present on the day will most likely have an influence on the decision made.

Further, it was agreed by the respondents that the decision made only covered the work up to the gate, and that there was no further commitments or outputs coming from the gate review meetings (e.g. no commitment to the next gate, or agreement on deliverables for the next gate). It was suggested that resource and budget commitments are covered through other processes.

It was further suggested that the gate-keepers might benefit from some training and clearer guidelines in terms of what criteria should be evaluated, and what their responsibilities are in terms of the gate review process and decision made.

Question 14 - Process ownership

The focus of these questions were on process ownership and clarity on responsibility. Respondents were asked who they thought owned the process - whether it was with a single person, or down to the functional area leads in order to try gauge whether communication on this has been clear through the organisational changes, and whether there is a clear split between the single process owners and what the functional area leads are responsible for. Further, it was asked who validates the quality and completeness of the deliverables ahead of

the gate review, due to some indicators of sub-par quality on deliverables after the earlier evaluation of the selected project.

Based on the variation of responses, it is not clear to all who the overall process owner is, and how the process owner responsibilities balances with that of the functional area leads. Except for core engineering documents for which there is an established review process (from before the NPD process), there are limited review processes in place to ensure consistent quality on the deliverables.

Question 15 - Training

Training in the process is highlighted within the literature (Cooper, 2011) *as a key part of the foundational building blocks for NPD. Questions were thus asked to see what training had been performed, and whether refresher training gets done as the process gets adapted.*

Most respondents referred to a single 1 hour session that had 'once' been held, as a general introduction to the process. No specific functional area training was mentioned. No refresher training done.

Question 16 – Design for manufacturability

For respondents working within operations a few extra specific questions were asked relevant to training and design for manufacturability. As operations readiness is part of the specific focus of this work, this was considered relevant.

Based on the responses, the following points should be noted:

- No specific Design for Manufacturability or Design for Assembly training or guidelines provided.
- Very little expectations and guidelines provided in regards to the process. The individuals are to prioritise the NPD work themselves in addition to everyday work.
- There are no existing guidelines for review and release of manufacturing deliverables.
- There are no sign-offs required from manufacturing for design reviews.

4.6 Data combination and exploration

The data collection and analysis stages for both the process and how it is practised provides a series of building blocks to help put together the overall model of the problem. This exploration of potential underlying causes is done based on potential drivers seen during the analysis stages, utilising the theory on the process, interview data and through the observations made through participation in the process. In this section it is attempted to bring all of these pieces together in order to get a better and more in depth understanding.

A cause and effect (Ishikawe diagram) method was used in order to try determine what the potential underlying causes are in relation to the high-level observations from the initial stages, where the hypotheses were explored. See Figure 6 further below which illustrates an example of the cause and effect method used to evaluate one of the high-level observations. This was done for each of the high-level observations(from Figure 5), then coded and summarised (as per Table 4) and transferred into a mind map to try visualise what the most common underlying factors and links are. See Figure 7 at the end of this chapter. The coding referred to, is used consistently from the hypotheses through to the high level observations (Figure 4 through to Figure 7).

It is noted that the findings from the process evaluations overlaps in some areas directly with the findings from the detailed project evaluations. This makes sense, in that if the process is not defined properly in regards to certain features, this deficiency is then manifested during the project execution. The inadequacies of the process could in these cases also be considered a causal factor.

Chapter structure. This chapter is divided into subsections based on the earlier identified measurement characteristics (Figure 5). Within each subsection the relevant high-level observations are highlighted and each of the potential causes linked to a high-level finding is briefly discussed to explain what is meant by it and examples are provided where it makes sense. There is a high degree of inter-relation between some of the causes, which will then be cross referenced to the section where already discussed.

4.6.1 Completion of gate deliverables at the time of the gate review (H1.1)

A clear observation from the analysis of the sample projects is that when the gate reviews were held, not all deliverables were completed. For the projects evaluated, on average only 77% of the deliverables were completed when going into a gate review. For Operations this number was even lower at 59%.

Input from the interviews indicate that 4 out of 5 respondents thought that the process is currently not being followed.

The Figure 6 below illustrates what the potential underlying causes can be and these are then discussed in more detail further below.

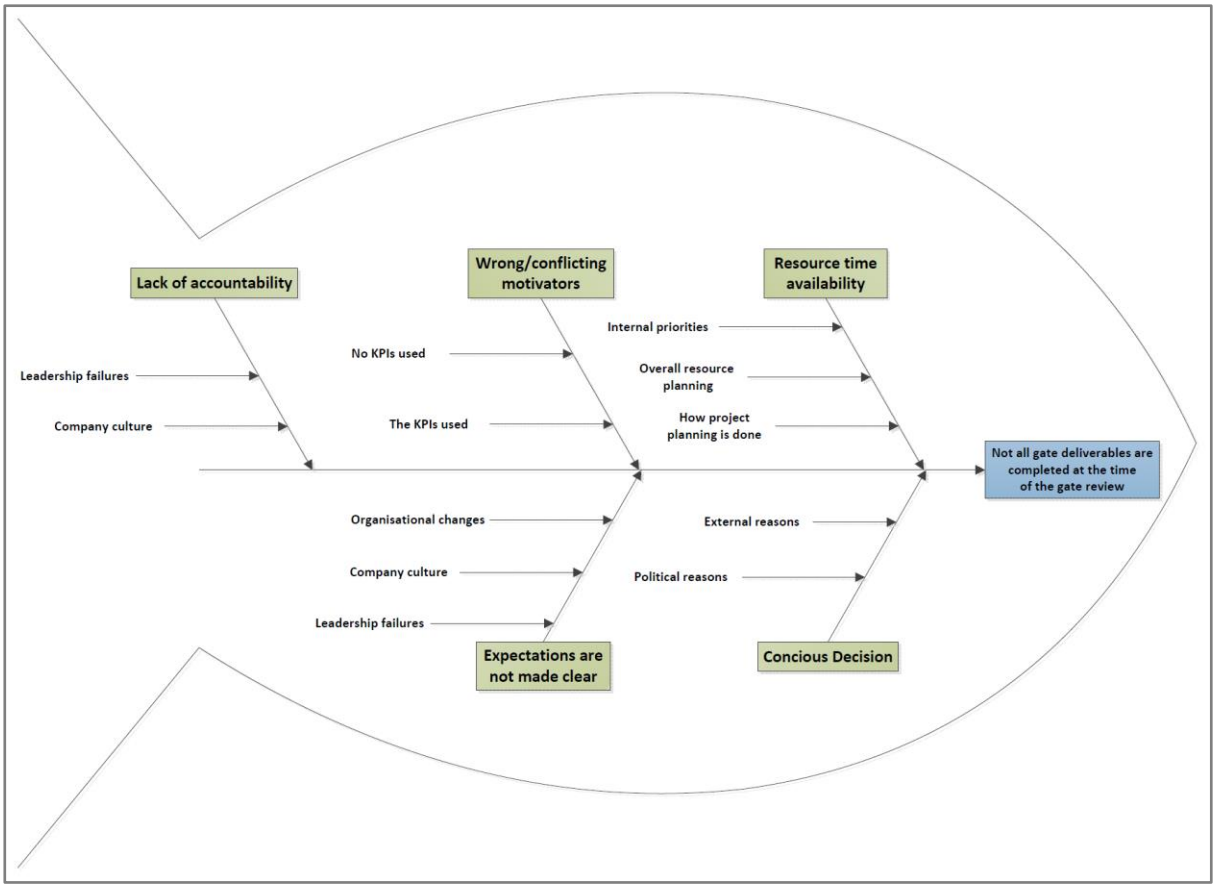

Figure 6. A cause and effect diagram. This diagram explores the potential causes related to the high-level observation that 'Not all gate deliverables are completed at the time of the gate review'.

The potential reasons for **not all gate deliverables being completed at the time of the gate review (H1.1.1.1.1)** are as follows:

a) Resource time availability

This cause takes into consideration that resources might not always have the time available to work on the project and complete their activities in the timeline required. Here it is considered that there are multiple reasons for such a scenario to occur:

- ***Internal priorities*** – The resource is assigned to the project, but also other projects and tasks, which when the time demand steps in the other tasks are prioritised above the development work. A typical example seen of this would be for Manufacturing Engineering resources, where they support customer related projects being produced in the factory, so when a call on priorities is to be made, the customer timeline driven projects always wins out.
- ***How project planning is done*** – Often the resources needed to complete gate deliverables are only requested right before the gate review is due, not leaving sufficient time to complete tasks. It is considered that perhaps this is related to how the projects are planned and managed. If all functional areas are not planned for within every phase, from the beginning, then the aforementioned scenario will occur. For resources with split responsibilities this is of particular importance because due to such short notice assignment, tough priority decisions have to be made in relation to everyday priorities, whereas if these tasks were assigned and planned in advance the impact of the everyday emergencies can be mitigated.

  Planning/scheduling was mentioned throughout *interviews* as an area of improvement, and considered an underlying cause for many other problem areas. Lack of cyclic planning for development work, poor managing and prioritisation of the critical path were specifically highlighted.
- ***Overall resource planning*** – When projects are initiated, the overall project pool and resource availability in relation to the needs of the project should be evaluated, incorporating all of the latest project schedules. Not only the needs for the project and those specific resources. The overall load on existing resources should be accounted for. Planning for unknown variables should also be considered into this. If this planning is not done, this could lead to potential issues in regards to time availability of the resources.

b) Wrong/conflicting motivators

How we measure performance is an integral part of how employees are motivated, and what is communicated to them as being a critical aspect of their work. If these motivators focus on the wrong areas, or are only limited to certain areas, they will negatively impact the low-level decision making in order to satisfy these whilst compromising potentially equal or more important areas. This can contribute to the erosion of the effectiveness and buy-in towards the process.

- ***The KPIs used*** - The only Key Performance Indicator (KPI) that is known of, is On-time Completion of gate 3, 4 and 5. It should be considered what message that sends to the people working on the projects, and what impacts it might have on decision making for the participants. To take an obtuse view on it, this could indicate that it is only about completing the tasks on time, not about the quality of work, or meeting budget and timeline requirements. This will be in natural conflict with what individual groups see as important. For example, core engineering resources might be more focused on the quality and effectiveness of their design, and though they will strive to meet deadlines, does not necessarily consider that to be as important, thus the process becomes more noise on the side, but is not believed to bring any value to the table.
- ***No KPIs used*** – Conversely based on the *interviews*, the aforementioned KPI was not known to many. Lack of KPIs can have the opposite effect, as part of the drive of meeting the KPI goals is removed. The message is then, we have this process, but we will not monitor how well we perform in order to try continuously improve.

c) Lack of accountability

There are many sociological studies on the topic of types of accountability, but here we consider the guiding terms from the RACI (Responsible, Accountable, Consulted, Informed) concept (Project Management Institute, 2013). This is a frequently used tool in project management, within which Accountability indicates who or which group is ultimately answerable for the correct and thorough completion of a deliverable or task. This does not necessarily represent the person doing the work, as the accountable person can delegate the work to those responsible.

The reasons that there could be a lack of accountability are considered as follows:

- ***Leadership failures*** – Lack of accountability is raised as a potential issue, as based on the continued push for going through gates without having completed deliverables, and having done them thoroughly, it does not appear that any accounting is done in terms of the failure to meet the requirements. This ultimately lands in the hands of the leadership roles.
- ***Company Culture*** – Resonating on from leadership failures discussed above, by not doing this accounting, it is almost as if it is deemed acceptable to not complete what is required. This in turn undermines the work of those that do strive to account for their work. It is expected that this would have some form of knock-on effect on Company culture and the surrounding implementation of the process, as the culture forms around what is repeatedly done and deemed acceptable by those around you and the leaders.

d) Expectations are not made clear

This ties in closely to the topic of accountability, both in terms of what is labelled **Company culture** and **leadership failures**, but also what managers communicate to the employees working on the NPD projects. Is the expectation set clearly that this work should be completed on time and to what standard, or is there a subtext of – "It does not really matter, and other work is more important". Is there diligent follow-ups and driving for completion results independently of the project itself?

Interview responses indicate that for some functional areas there are no specific expectations or priorities set, it is up to each individual to prioritise as they see fit.

There is one additional sub-factor to be considered here:

- ***Organisational change*** **-** When restructuring occurs in companies, as is a frequent occurrence in the current climate within the Oil and Gas industry, you find people in positions with responsibilities which they have not had exposure to before, such as working on or having resources working on NPD projects. If specific steps are not taken to ensure proper training or introductions on the topic, areas of strength in the process can crumble, and areas of existing weakness become worse. For example, not completing deliverables within the required timeline can become considered

acceptable behaviour and thus steps are not taken to ensure work is completed when agreed, and we end up back on the topic of accountability.

Interviews indicated that a lack of buy-in is still existing and that there has been no refresher training or in some cases training at all of employees in regards to the process. This will further exaggerate the organisational change contributors.

e) Conscious decision

A conscious decision taken by senior managers that the project has to go for a gate review at a specific point regardless of the status of the deliverables and what the project considers feasible.

This topic is subdivided into two potential motivations behind such behaviour:

- ***Political reasons*** – Internal politics come into play and a manager wants to demonstrate progress or engage the gate stakeholders on a specific topic of discussion, but uses the project as a tool for this. This is contrary to the intention of the process, but alas is still seen to happen.
- ***External reasons*** – The product that is the outcome of the project has already been sold, and regardless of the status of the gate deliverables the project has to proceed in order to meet those contractual needs. This falls into the category of going through the motions because the process is what you have to do, and what the project should be seen to do, so that we can say we follow the process, even though this behaviour is totally contrary to the purpose of the process.

A large proportion of the contributors above fall under the umbrella of a Crises in Quality of Execution', as discussed by Cooper (Cooper, 2011) as one of the primary failings with the implementation and use of the NPD process.

4.6.2 Adaptation and scaling of the process (H1.2)

As no two projects are equal, the NPD process should allow for some degree of scaling and customisation of deliverables. It is clear from all the projects assessed that some degree of customisation of the deliverables are done, but not always appropriately or by the relevant functional areas. Based on some of the deliverables which were customised out, the purpose of those deliverables were clearly not understood, and the customisation made without consulting the responsible functional areas. On the grounds of this, the high level observation is made that **Customization is being practised but not always appropriately (H1.2.1.1.1)**, and the following factors are thus considered potential causes:

a) **Lack of understanding of the process and its intent.** This refers to the very basic understanding of the purpose of the process, the benefits it is intended to bring, why the involvement of the different functional areas are important and what they drive, why the different deliverables are important and finally why all functional areas are needed. Ultimately why parallel development work is chosen above series.

b) Lack of cross-functional engagement. Functional areas that are meant to be involved are simply not engaged in the decision making process.

c) Lack of clarity on where the responsibilities lie in regards to the process

This factor has a potential sub-factor related to ***the lack of maintenance on the process***, as observed from the evaluation of the process description, in that functional areas and functional area leads are not kept up to date.

All these above potential causes are in turn linked to Process Training, or more precisely the lack of process training. ***Process training*** in turn is linked to ***Process Ownership***, as ensuring that people are properly trained and have understood the process as it is intended to be used should come from the process owner.

Interviews indicate that there is some level of understanding the purpose of the process, but that it is not fully consistent across the board. The consequence of the lack of process understanding and intent; is in some cases at least likely to be one of multiple contributors when individuals are put into a decision making environment, such as customisation of deliverables.

4.6.3 Designated gatekeepers making clear and informed decisions using process-defined criteria (H1.3 & H2.2)

From the evaluations done on the documentation of the process, the projects and observational data, it is clear that:

- The designated gatekeepers are not clear to all involved.
- The documentation on the gate decisions are not consistent and not always kept up to date.
- Projects are let through gates when the basic gate criteria are not met.
- Process-defined criteria such as defined gate criteria and completion of deliverables, do not appear to have an influence on the decisions being taken.

In addition to this, data from the *interviews* indicate that it is not clear to all respondents who the decision makers are. For those that agreed on who the core team should be, when more specific questions were asked on responsibilities and roles, there were a few points that became unclear. This confirms the preliminary conclusions from the data evaluation that it is not clear to people working on the projects who the designated gate-keepers are. 4 out of 5 interviewees did not think that the gate review criteria were being used, or that it was clear how they should be used.

These aspects are all discussed and explored in further detail below, in terms of what the potential underlying causes could be.

Gate-keepers are unclear (H1.3.1.1.1)

This is attributed to ***lack of process maintenance,*** evidenced from the evaluations done on the process itself, and the guiding documents where these gatekeepers and decision makers are meant to be listed. This in turn is linked to ***Lack of process ownership***, all of which results in additional uncertainty in regards to responsibilities with respect to the process. Communication during organisational restructuring and how it can contribute or erode the clarity of responsibilities is closely linked to this topic. It is considered difficult to follow a process properly if it has known deficiencies or outdated information. These known shortcomings will naturally put the rest of the information it contains in doubt, unless there is

clear and specific communication on the deviations or it is clearly communicated who has these responsibilities as this at least provides a go-to person.

When Process ownership is discussed, it considers two levels, the high-level overall process ownership (by an individual) and the process ownership on a functional area level. When a lack of process ownership is referred to, it is attributed to both levels. The high-level overall ownership is here considered to be the single person that holds responsibility for the overall clarity in vision of intent and interpretation of the process, and the process being up to date. It does not necessarily indicate that this is the person doing the work of maintenance, as that is a task that can be delegated, depending on how the responsibility is delegated to the functional area leads. For example, the overall process owner ensures that the functional area leads co-ordinate their efforts and have a common way of interpreting and applying Parent Company guidelines. The functional area leads in turn ensure that their functional area deliverables are up to date and aligned with these guidelines. Training should be taken care of in a concerted effort by both parties.

The lack of clear process ownership being a problem area was further confirmed by the *interview data*, which indicated that not all respondents knew who the process owner was, or what the split of the responsibilities are between the overall owner and the functional area leads.

Lack of consistent documentation on gate decisions (H1.3.2.1.1)

Where the documentation exists, the decisions made and by whom are clear. There are however a few instances where the documentation is not available. From the process, the requirements within the procedures, in this regard, are clear.

Lack of consistent documentation might be considered a minor issue, if the end result is not affected. Here however it is only considered to be a symptom of a much larger problem and thus explored further in terms of potential reasons for it.

Most *interviewees* indicated that how to handle the documentation was clear within procedures, but it was suggested that these guidelines might not always be followed and that there is no validation, so there could be large variations from project to project.

The potential reasons for the aforementioned problem are as follows:

a) **Lack of training on the process** – This is a two-fold issue, as it is linked to lack of training for new employees and refresher training for existing employees. For new employees it is important so that they can understand the intent of the process and the Company philosophy and the overall expectations towards an employee participating in the process. Laying these foundations correctly from the start is a key point for long term improvements. For employees already using the process, refresher training is needed in order to remind them of the importance of their role within the process and keep re-enforcing the intent, the philosophy and the expectations, which are all part of building the Company culture you want surrounding such a process. Lack of training is directly attributed to the ***lack of process ownership,*** and the consequences of this previously discussed.

   Interview data indicated that limited to no training had been done, and certainly no refresher training had been offered. For the most part, employees are left to figure it out for themselves.

b) **Little to no quality control on deliverables.** For the specific deliverables listed on the scorecard, that are not core engineering documents (for which there are set review and release procedures that ensure their quality), there appears to be very few follow-ups on the deliverables and the quality of them beyond that they are being checked off as completed at the gate review. It relies predominantly on the individuals participating in the project, and their individual judgement to produce what they think is sufficient. This is also further confirmed by *interview* data.

c) **Lack of accountability.** As discussed in section 4.6.1.

d) **Quality of execution.** This is a very fundamental problem which can simply be defined as failing to complete the required work either within the timeframe required or to the level of quality required.

e) **Outdated procedures causing uncertainty on all content.** From the process evaluations it is clear that some of the procedures are outdated. If there are known errors within a procedure it will bring into doubt the accuracy and relevance of the rest of the content, unless there is specific communication to the persons using the procedures that bridge over the errors. There is no evidence of such bridging information. In the case of one department procedure, due to re-organisation the centralised oversight function was removed, so it is highly doubtful that bridging instructions would have been provided.

Projects are let through gates irrespective of the status of their deliverables (H1.3.2.2.1)

From the projects evaluated, the documentation indicates that projects pass gate reviews even though the fundamental gate review criteria are not met. The fundamental criteria at the gate reviews are that the gate deliverables are all completed, and that the project meets the requirements as laid out in the gate criteria checklist.

Potential reasons for why these decisions are taken are explored below:

a) **Gate criteria checklist** not adjusted to the Company needs. The Parent Company Gate criteria checklist was adopted directly with no adjustments. It thus has some very generic questions being asked that are not always clear as to what is meant by them. Its potential effectiveness is thus undermined. It is also noted that for some projects there is no evidence of these gate criteria having been evaluated, either ahead of, or at the gate review.

b) **Gate criteria do not** directly and wholly **facilitate decision making** within the gate review. It is effectively just another checklist. There are no specific must meet criteria identified; which if not satisfied; the project should not go through the gate. Often the question on whether the gate criteria have been met is not even raised.

c) **Lack of process understanding** manifests itself here but with some slightly different lower level contributors.

   - ***Implications of the decisions are not clear***, in the sense that the gate reviews only seem to be looking at what has been done and not what will be done. In other words by the decision makers signing off on the gate, they are agreeing to specific resources being available for a certain specified period, which is not the case in practice.

     This underlying cause was further validated through the *interview data*, where respondents indicated that as far as they were aware gate decisions did not include any sign-off or agreement on work to come, but was only focused on the work that had been done prior to the gate.

   - This also ties in closely with the topic of ***unclear responsibilities*** discussed earlier, because if the decision makers have not pre-aligned with the resource owners, and the overall portfolio needs there is no way of knowing whether the resources are actually available for the work to be done.

d) **Leadership failures** can be considered a potential factor, as passing projects that do not meet the basic criteria is also about not being willing to, or able to make the tough decisions irrespective of what pressures are from the rest of the review group.
e) **Political and external** motivators as discussed in section 4.6.1.
f) **Decision making methods** are wholly subjective. Decisions appear to be made purely on the grounds of the opinion and the motivations of each individual. There is no form of objective 'scorecard' being used during the gate reviews summarising what critical criteria are met or not.

For this point, where projects are let through the gate when all deliverables are not completed, the overall knock-on effect on people's perception and buy-in of the process should also be considered. They see that one of the cornerstones of the process is not reinforced, which then raises the question of, what is the point of completing all deliverables? There could be functional areas that put in allot of effort to ensure they meet their deadlines, but see that it does not appear to matter, thereby eventually losing the buy-in from the areas where you do have it. An overall erosion of the Company culture and the effectiveness of the process is the end consequence. This is also seen from some of the *interview* data, where it is questioned whether the deliverables are actually part of the decision making criteria and indications that the usual level of effort will not be put into some deliverables due to their purpose being unclear and the content thought to be unused.

4.6.4 Cross-functional collaboration as an integrated part of the process (H1.4 & H2.1)

Cross-functional collaboration is an important part of simultaneous/ integrated product development processes, because you have multiple functional areas working at the same time towards a common goal. Information sharing and communication become even more important as the different areas need to ensure they are progressing their own work but also providing other functional areas with the information they need to continue with their part. It is no easy task as it is about sharing the right level of information at the right time, and the different functional areas being able to trust what they receive. The goal is to try do work in parallel with as little rework as possible, because as soon as you go down the road of parallel work across functional areas there is always a risk of rework.

The potential reasons for cross-functional collaboration not functioning in the optimum way are numerous and have been studied in detail by others within various areas. Here we discuss what the most pertinent potential causes are that are relevant within the Company, based on findings from the projects and process studied.

From the evaluations done on the documentation of the process, the projects and observational data, it is clear that cross-functional collaboration is not always planned for. *Interview* and observational data indicate that non-engineering resources are frequently only engaged just prior to the gate review in order to complete their deliverables. Alternatively they are engaged at the beginning of the phase, told what deliverables they need to produce and then asked if they are completed a few weeks prior to the gate review.

The project schedules looked at, do not account for cross-functional input and outputs, or non-engineering activities. There are no existing project scheduling templates or guidelines that address this cross-functional planning. Neither are there established co-ordination mechanisms for this work. In addition, Department procedures and guidelines only briefly touch upon cross-functional work, if at all.

These aspects are all indicative of an overall **Lack of cross-functional collaboration (H1.4.1.1.1)** and are discussed and explored in further detail below, in terms of what the potential underlying causes could be.

It is thus considered that the lack of cross-functional collaboration is driven by:

a) **Lack of process understanding**. As discussed in section 4.6.2. . Lack of process understanding is also linked back to a ***lack of process training*** and in turn ***lack of process ownership.***

b) **Dysfunctional project teams.** Though a project team exists, it is not functioning as it should and working together. This will result in a lack of cross-functional collaboration, which is evident from interview data that indicates resources are not receiving the information needed to perform and are engaged at different levels depending on who is involved.

c) **Functional silos.** If functional silos are present, cross-functional collaboration will suffer. Functional silos refers to functional areas only considering the work that they need to do within their area and not considering what input is available from other areas, or what other areas utilise their work.

d) **Not integrated into department procedures.** This ties closely to the co-ordination mechanisms discussed in earlier chapters, but also the existence of functional silos. Standardisation of work processes forms a fundamental part of helping with that co-ordination, so if it is not present, or only in a very limited context, one known method of helping with cross-functional collaboration is removed, and chances of success in this area reduced. The lack of cross-functional considerations within department procedures can also be considered symptomatic of functional silos still being present.

e) **Project Leadership.** The project leadership role should be there to help drive and ensure cross-functional collaboration within a project. The leader has a high degree of influence on the understanding and implementation of the process by the project group. If it is not present, or the leader does not understand the importance of the work by the other functional areas, project problems will quickly highlight this. *Interview* & observational data indicates that in some cases the request of cross-functional resources is only done a few weeks ahead of a gate review. Other specific problems stemming from project leadership practices that were mentioned: Lack of involvement and regular follow up, lack of information, lack of co-ordination of activities, lack of pre-planning (as everything is done at the last minute).

A strong project leader with a clear understanding of the process and its intent can also go a long way to help compensate for some of the short-comings in the process. This is however not what should be relied on, as people are different and you have no guarantee when new Project Managers start that you would get the same level of understanding and drive as with existing ones. The counterpart of the argument is also that if you do not have this style of leadership, the overall quality and ability to meet the wanted outcomes will quickly erode.

f) **Poor planning.** Part of ensuring that the right functional areas are engaged at the right time is down to project planning. Poor planning will contribute to the erosion of cross-functional collaboration. Planning and scheduling came up as problem areas across the different *interviews*.

4.6.5 Alignment of Company process with Parent Company process (H2.3)

From the results in section 4.3.2.1, the following main problem areas were identified:

- Functional areas do not align with the organisational structure.
- Inconsistencies with the gate deliverables.

Each of these are explored further in the below section in order to try determine the underlying causes.

Functional areas do not align with the organisational structure (H2.3.1.1.2)

This is wholly attributed to the **Lack of process maintenance.** As the organizational structure has changed the process has not been maintained in order to keep it aligned with these changes. This is directly attributed to the ***Lack of process Ownership*** from an individual perspective for the overall process, but also from the functional area leaders. It should however be kept in mind that the functional areas were never properly aligned from the beginning, which might be a contributor towards the lack of updates. Ultimately this lack of alignment results in unclear responsibilities, similarly to what was discussed in section 4.6.2.

Inconsistencies with the gate deliverables (H2.3.1.1.3)

In addition to the problems identified in section 4.3.2, within the *interviews* it was indicated by all participants that there are deliverables which are thought to add no value to the process or the end product. With this in mind, how the gate deliverables are defined are considered to have the below underlying causes:

a) **Lack of understanding of the process and its intent,** as discussed throughout previous sections. Here, however it is more related to the functional area leads than the project participants. As this understanding is even more critical when the process is being designed or adopted.
b) **Lack of process ownership**, as discussed previously and specifically pertaining to a single person that holds responsibility for the process being up to date, and the overall clarity in vision of intent and interpretation of the process. Here it is relevant for how gate deliverables are interpreted and responsibilities across functional areas managed. Guidelines on what should be a gate deliverable and what is covered by department

procedures and quality assurance processes are needed. Essentially an overall Company philosophy should be established and communicated.

c) **Lack of process maintenance**, as discussed in previous sections. As time progresses, there are natural changes that come into the company, which should be ensured are reflected in the process. The process should not be stagnant (Cooper, 2011), but evolve along with the business and its needs.

d) **Lack of cross-functional collaboration**. This problem was evident in how the projects were executed, but is also present in how the process has been implemented, which can be seen in the department procedures and lack of alignment across functional areas, with duplication of deliverables as an example. Deliverables being required which are not actually used by other functional areas is another contributing factor.

4.6.6 Activities defined for each stage within a visible, documented process (H2.4)

From a process perspective, having a visible, documented process with activities defined for each stage is an important framework to have in place in order for the process to function in as efficient and consistent way as possible. Based on the reviews done earlier and the *interview* data, the following high level observations are made:

- High level and functional procedures that exist are outdated.
- The process for operations related deliverables are improperly defined

Interviews indicate that there are problems with the definition of the process in more than just the Operations functional area, but those will not specifically be addressed within this paper.

The potential causes of these high level observations are explored in detail below.

High level and functional procedures that exist are outdated (H2.4.1.1.1)

In regards to the potential reasons that the guidelines and procedures are outdated, it is easy to jump to the conclusion of - Lack of process maintenance. This is however too an obvious answer, and we should ask ourselves the reason for it. Below are a few of the contributing factors that should be considered:

a) **Organizational structure** – Some functional areas changed from a centralised oversight structure, to a multiple owner structure. This structure can contribute to the centralised procedures becoming dated, as nobody has the direct responsibility for these procedures and guidelines, because if everybody has the responsibility for the same things, in effect nobody does. This is also relevant when lack of process ownership is considered below. An interesting aspect that arose from the *interviews*, is that the dedicated oversight function for the process was removed as a conscious prioritisation decision, as based on down-sizing, having a dedicated resource for this could no longer be validated. Re-distribution of the relevant responsibilities however did not happen in such a way that would allow for this work to stay up to date.

b) **Time availability** – Not enough time available to complete the work. With limited resources, there is always a lack of available time, so unless this work is ***prioritised*** at some point in time, it will continue to be outdated.

c) **Lack of Process Ownership** – This is both on an overall process ownership level, but also on the functional area ownership. A key characteristic of the process as proposed by Cooper (Cooper, 2011) in order for it to function properly is that it should have a process manager in place that can actively drive improvements, provide implementation guidelines and training as needed. The owners of the process hold the responsibility to ensure the procedures and guidelines are updated, whether this be a task done by themselves or delegated, they are ultimately accountable. There is a fine balance that needs to be struck here between the functional areas taking responsibility for their deliverables, and the overall process owner ensuring alignment across the functional areas, so that there is consistency in how we apply the process. The exact split in this regard is most likely not clear at present. This lack of responsibility for ownership in itself can be attributed to its own causal factors, such as:

    a. **Priorities on paper are different to what is being practised**. In other words, lip-service is paid to the importance of NPD, but when the actual prioritising of work is being done, this is not followed through on.

    b. **Impact of no clear ownership responsibilities not understood**. The consequence chain as a result of the ownership responsibilities not being clearly understood; such as released products not being ready for manufacturing; is not apparent.

c. **No buy-in to the process.** If the process is perceived as something that has to be done, but the buy-in does not follow, the level of focus on the related activities will always suffer when priorities have to be made. This can potentially be due to how the process was originally implemented and that the value of the process was not being seen. This underlying cause was specifically mentioned by at least 2 *interviewees.*

The process for operations and the related deliverables are improperly defined (H2.4.2.1.1)

The potential reasons behind why the process definition is not properly in place for operations are many and discussed in more detail below:

a) **The knowledge, skills and competency** in the area of process design. Due to some very basic process descriptors being missing, the ability of the persons responsible should be considered and whether they had the proper background or level of competency to understand the work they were doing or the consequence of it.
b) **Lack of understanding of the process and its intent**, as discussed in section 4.6.2. . The level of 'buy-in' of the functional area lead into the process, can also be considered as part of this causal factor, as the extent of adoption and ease of implementation will to some extent be driven by this, regardless of the formal company requirements.
c) **Functional silos** still present. The separation between the functional areas is thought to still be present and a potential causal factor based on the limited to no focus or mention of cross-functional inputs or outputs. This is further corroborated when looking at the details of some of the required deliverables, which overlap heavily with what is being produced in other functional areas for the same purpose.
d) **Crises in quality** in regards to process definition, as there has been a failure to complete the required work either within the timeframe required or to the level of quality required.
e) **Time availability** as discussed in the above section on outdated procedures, is also relevant here. If the resource did not have sufficient time available to develop the process at the initiation phase, then the state of the current process could be explained. However due to the timeframe, the casual factor of crises in quality looks to outweigh this.

Code	High level observations	Potential causes	Code	Potential sub-causes	Code
H1.1.1.1.	Not all gate deliverables are completed at the time of the gate review	Resource time availability	10	How project planning is done Overall resource planning Internal priorities	11 18
		Wrong/conflicting motivators	17	The KPIs used No KPIs used	
		Lack of accountability	8	Company culture Leadership failures	4 13
		Expectations are not made clear	19	Organisational changes Company culture Leadership failures	5 4 13
		Conscious decision	20	External motivators Political reasons	14 15
H1.2.1.1.	Customization being practiced, but not always appropriately	Lack of understanding of the process & its intent	1	Lack of training on the process→Lack of process Ownership	7→3
		Lack of cross-functional engagement	6		
		Lack of clarity on where the responsibilities lie in regards to the process	12	Lack of process maintenance→Lack of process Ownership	2→3
H1.3.1.1.	Gate keepers are unclear	Lack of process maintenance	2	Lack of process ownership	3
H1.3.2.1.	Lack of consistent documentation on gate decisions	Lack of training on the process	7	Lack of process ownership	3
		Little to no quality control on deliverables	16		
		Lack of accountability	8	Company culture Leadership failures	4 13
		Quality of execution	16		
		Outdated procedures resulting in uncertainty on all content		Lack of process maintenance→Lack of process Ownership	2→3
H1.3.2.2.	Projects are let through gates irrespective of the status of their deliverables	Gate criteria checklist not adjusted to the Company needs	21		
		Gate criteria does not directly and wholly facilitate decision making	22		
		Lack of understanding of the process & its intent	1	Implications/consequences of decisions not clear	23
		Leadership failures	13		
		External motivators	14		
		Political motivators	15		
		Lack of objective decision making criteria	24		
H1.4.1.1.	Lack of Cross functional collaboration	Lack of understanding of the process & its intent	1	Lack of process taining→Lack of active process ownership	7→3
		Dysfunctional teams	25		
		Functional silos	9		
		Cross-functional collaboration not integrated into department procedures	6		
		Poor project leadership	13		
		Poor planning	11		
H2.3.1.1.	Functional areas not consistent & do not align to organisational structure	Lack of process maintenance	2	Lack of process ownership	3
H2.3.1.1.	Inconsistencies with the gate deliverables	Lack of an understanding of the process & its intent	1		
		Lack of process maintenance	2		
		Lack of process ownership	3		
		Lack of cross-functional collaboration	6		
H2.4.1.1.	High level and functional procedures that exist are outdated	Organisational structure	5		
		Resource time availability	10		
		Lack of process ownership	3	Priorities on paper different to what being practised Impact of no clear ownership responsibilities not understood. No buy-in to the process	27 12 28
H2.4.2.1.	The process for operations and the related deliverables are improperly defined	Lack of knowledge, skills, competency	26		
		Lack of an understanding of the process & its intent	1		
		Functional silos	9		
		Crises in quality of execution	16		
		Resource time availability	10		

Table 4. Summary of high-level observations in relation to potential underlying causes. The 2nd and 3rd 'code' columns are randomly generated codes to be used within the frequency analysis in the next section. The → symbol indicates an additional sub-cause.

4.6.7 A summary of the potential underlying causes

Utilising the data gathered while exploring the two hypotheses, the potential underlying causes of the problems were explored. These were summarised in Table 4, showing how the high-level observations made while exploring the hypothesis are related to potential underlying causes. There are many potential underlying causes, so in order to try focus these, the data from Table 4 was converted into Table 5 and used to produce a frequency plot as indicated below. By determining the most frequently re-occurring causes, it is an indication of which area, if addressed, could potentially have the most immediate and widespread benefits. It should be kept in mind that most of the underlying factors are interlinked to some extent, so by improving one area you can start seeing benefits across the board. This does however not mean that the less frequent items should not be addressed, or addressed later, this merely serves as an indication of where the highest degree of benefit could be gotten from, due to potential knock-on effects.

For example, if using the frequency plot from Figure 7 below, and addressing point 3 OR point 2, and back-tracking through all related points, you could potentially be addressing or improving on 9 out of 10 of the high-level observations. Only observation H1.1.1.1.1 would remain (directly) unaffected. So, based on that, the proposition could be that process maintenance should be addressed, along with how project planning is done, as that would have a high-spread effect. This also correlates well with the identified problem areas within the literature.

Code	Potential causes	Frequency
1	Lack of understanding of the process & its intent	5
2	Lack of process maintenance	5
3	Lack of process ownership	8
4	Company culture	3
5	Organisational structure/changes	2
6	Lack of cross-functional collaboration	3
7	Lack of training	3
8	Lack of accountability	2
9	Functional silos	2
10	Resource time availability	3
11	How project planning is done	2
12	Unclear responsibilities	2
13	Leadership failures	5
14	External motivators	2
15	Political motivators	2
16	Quality	3
17	Wrong/conflicting motivators	1
18	Internal priorities	1
19	Expectations are not made clear	1
20	Conscious decision	1
21	Gate criteria checklist not adjusted to the Company needs	1
22	Gate criteria does not directly and wholly facilitate decision making	1
23	Implications/consequences of decisions not clear	1
24	Lack of objective decision making criteria	1
25	Dysfunctional teams	1
26	Lack of knowledge, skills, competency	1
27	Priorities on paper different to what being practised	1
28	No buy-in to the process	1

Table 5. Summary of all identified underlying causes. These are derived from Chapter 4.6.7 and also serve as the key to Figure 7 below.

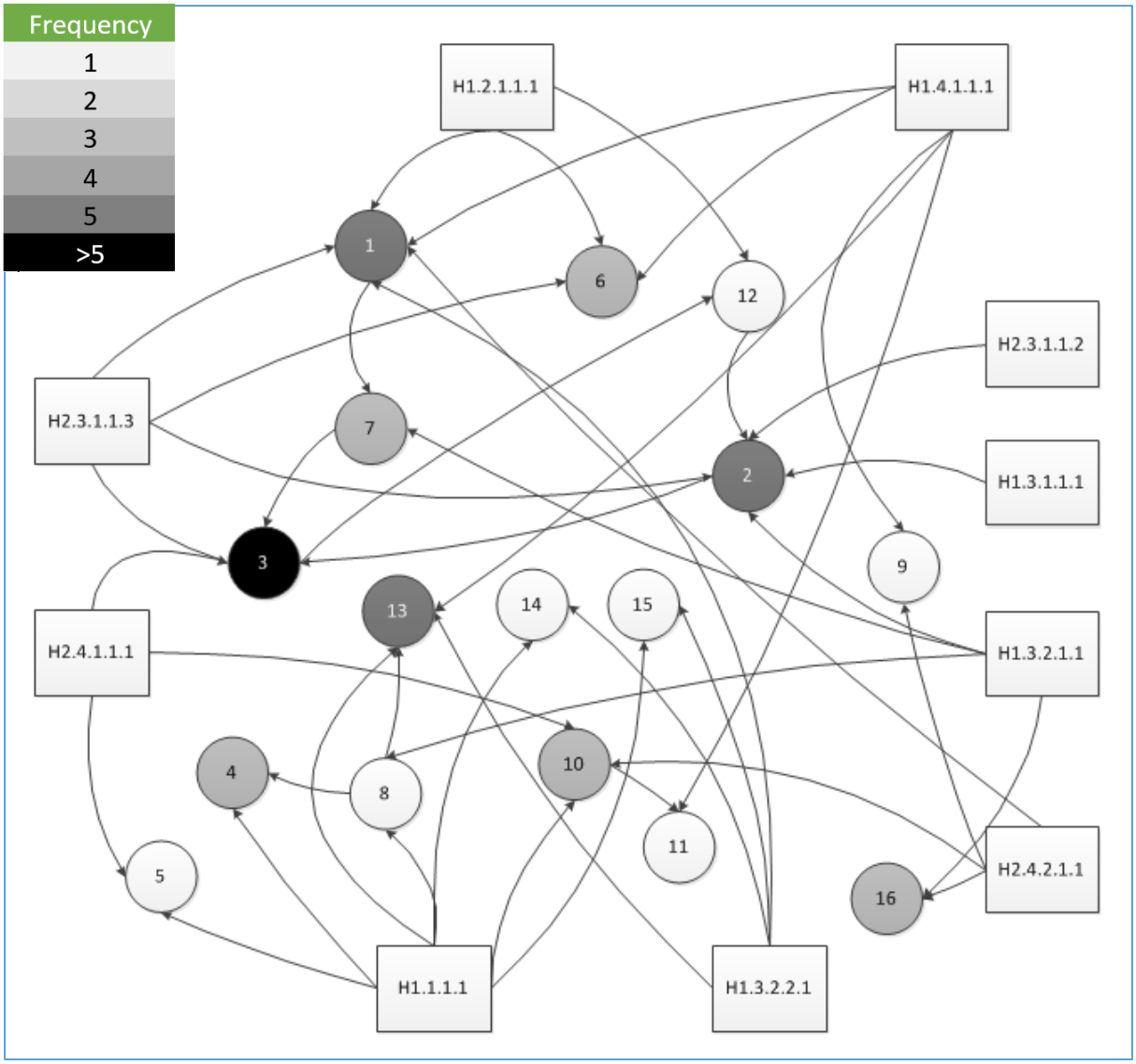

Figure 7. Mapping of most pre-valiant underlying causes. The codes within the rectangles (e.g. H1.2.2.2.1) relate to Figure 4. The codes within the circles are randomly assigned unique identifiers linked to Table 5.

There was a high degree of confirmation of the underlying causes mentioned during the interviews when comparing to what was identified through the data assessment utilising theory on the subject. There are however two underlying causes that are unique from the interviews & observational data, which would not have been identified otherwise:

- Scoping of a project in such a way as to exclude work needed for integration and operations related activities.
- Not using the process as intended – Selling the product prior to development work being completed.

Scoping of projects often comes up within literature as a reason for products failing. This is normally in the context of unstable product specifications and project scope creep. It typically does not touch upon the purposeful limitation of scope, in order to proceed with product development and release. Here it occurred for projects where it is not an entirely new product being designed, but an add-on functionality. Some of these projects were scoped in such a way as to limit it purely to the new technology, but without taking into account the integration of the new technology into the system in a complete manner. Here it is considered to have a few potential underlying causes:

- Limiting the scope to be able to proceed with the project due to limited resources.
- Limiting the scope, in order to reach a 'release' point earlier. The push is to try be able to say the product is ready for sales, as it is tested and qualified in regards to its scope, but in essence is not integrated and will not meet Operational readiness goals.
- To make the development project more 'clear-cut' and easier.

All of these points are ways to work around the process, which is further indicative of a lack of buy-in in the process, as it is clearly not considered a way to help accelerate the development work in such a scenario. The nature of these decisions reaffirm the problem of functional silos being present, as this approach benefits one department at the cost of another.

Process model incorrectly applied. This refers to the instances where the product has been sold prior to the product having been released through the NPD process. For such cases, effectively the project is going through the motions, as there is no option which would allow the product to not pass a gate. Yes, parts of the NPD process would still be useful from an engineering perspective to help ensure that the final product released is of a certain quality. The decision making basis for such a project is however no longer following the original principles where it is attempted to increase your investment (continue with the project) as you decrease your risk (go through the gates). You are effectively back in the gambling seat of betting it all at the beginning with most of the uncertainty still in play. Further, the overall project decision making will be different as it will be purely time-driven, and some decisions that might have been 're-design' under other conditions become a move forward and work with it, all ultimately potentially compromising the end product in terms of manufacturability and cost.

Based on the above points raised and in conjunction with the evaluations done on the hypotheses, it should be considered whether the process as it is currently defined is suitable for the business environment that large parts of the Company operate within, which is more driven by low volume, high value products and direct customer specifications, as opposed to consumer driven, high volume industries.

5. Discussion

The main question asked at the beginning of this research was 'Why are products being released through the NPD process failing to be ready from an operational point of view?'

Based on this two hypotheses were put forward as potential reasons:

- H1 – The process is not being followed
- H2 - The process is improperly defined

These hypotheses were then further explored and evaluated through the data collection and analysis phases. Based on those results it was then looked into what the potential causes are for the identified failures.

This chapter will be structured in such a way as to firstly address the two hypotheses put forward and then to address the primary research question.

5.1 Methodological considerations

It has been attempted to ensure the quality, validity and reliability of the study throughout by employing the techniques discussed in Chapter 3. For validity we consider the four logical tests put forward by Yin (Yin, 2014):

- Construct validity – Achieved through the use of multiple sources of evidence, and an established chain of evidence through the research techniques.
- Internal validity – Logic models linking the question, through to the high-level observations and potential underlying cause is demonstrated through the analysis methods as illustrated in Figure 5.
- External validity – The findings within the study align well with the existing literature.
- Reliability – Demonstrated through the use of a case study protocol and the Data collection plan.

There are a few points to highlight that should be kept in mind as they could be pertinent to the quality of the data collected and analysis done. These are not specific observations, but provided as context for the conditions of the study.

- The researcher had little to no experience in doing case studies or in the design of interviews. This could be a disadvantage for the overall quality of the data collected and reliability of the conclusions drawn.

- There were time and resource constraints in regards to this research, so in some cases it was decided to not gather further data, in order to stay within these boundaries.
- The researcher works closely with the topic at hand and as such would have some pre-existing notions and opinions that could skew the data interpretation.
- A large portion of the analysis work was done based on analysis of documentation. Documentation and records can be misinterpreted, as they were not necessarily written with the researcher as the target audience.

With these concerns in mind, efforts were however taken to establish robust working methods to compensate for some of these disadvantages.

Interview data was used to help confirm some of the information gained from documentation. A relatively small number of interviews were conducted, and are thus not of statistical significance, but only provide the opportunity to gain additional insight. It is also important that it is considered whether the right people were interviewed. The people interviewed as part of this research were chosen based on them currently actively participating in NPD projects; but they were not necessarily involved in the projects which were evaluated. The respondents each had numerous years of experience within the company and involvement with the NPD process. A certain amount of planning went into the interviews, but it should be considered that various biases can still exist within the information gathered, both in the form of interviewer and respondent induced biases. The interview environment can also play a role, as interviewer and interviewee both work at the same Company.

As the number of cases studied were limited, they cannot provide results that can be generalised, but can be used to provide insight and an increased understanding.

Primarily the results from this study can be used to initiate improvements in terms of the process within the Company itself, and cannot be generalised. Some of the findings correspond well to existing theory, and as such serves to confirm those views further.

5.2 The process is not being followed (H1)

At the outset it was hypothesised that one of the reasons why the products are failing to be ready from an operational point is view is because the process that is in place is not being followed.

In order to explore this hypothesis, projects were selected to evaluate as to whether they do actually follow the process. The projects to be evaluated were selected based on pre-set criteria and prior to looking at the available data to ensure that no biases were bought into the evaluation.

To evaluate these projects, measurement criteria were identified that were considered relevant for assessing whether the projects follow the process as it is intended. These measurement criteria were identified based on the literature studied. Based on these measurement criteria, the available data was identified. In order to increase the reliability of the results, multiple data sources were pursued.

- Data source triangulation was achieved through the use of more than one data source.
- Interviews were held and the opinions of active participants in the process gathered through a series of questions asked on the topic. Multiple interviews were held allowing for observer triangulation as more than 1 observer was used.
- In addition to this, through the use of active-participation the researcher was able to participate in some of the processes and gather direct observational data.
- Based on the above, it could also be argued that Methodological triangulation is achieved through the combination of different types of data collection methods, thereby further strengthening the reliability of the data.

Based on the results from the evaluations described above, it is concluded that the **hypothesis is proven to be true.** The process as it is currently implemented is not followed in its totality.

One potential downside of evaluating projects in addition to the process is that the information gained on the process is relevant to the process as it is currently, and not to what it was when these projects went through the process. Any process improvements that might have been introduced over time would then not be reflected in the projects studied. However, as the projects evaluated span many years, and the same problems repeat throughout, the effect of this time-lap is thus thought to be minimal.

5.3 The process is improperly defined (H2)

At the outset it was hypothesised that the other potential reason why the products are failing to be ready from an operational point of view is due to the process that is in place being improperly defined.

In order to explore this hypothesis, some pre-set criteria to measure the process against were established. Based on these criteria, process data was gathered in three phases of progressive elaboration.

With reliability in mind, multiple data sources were pursued where possible, but this proved difficult due to the data being related to a process description.

- Data source triangulation was pursued where possible, through the use of more than one data source. This was not always achieved. The analyses of the process on different levels of details, is considered to partly provide multiple data sources on the process.
- Interviews were held and the opinions of active participants in the process gathered through a series of questions asked on the topic. Multiple interviews were held allowing for observer triangulation as more than 1 observer was used.
- In addition to this, through the use of active-participation the researcher was able to participate in some of the processes and gather direct observational data.
- Based on the above, it could also be argued that Methodological triangulation is achieved through the combination of different types of data collection methods, thereby further strengthening the reliability of the data.

Based on the evaluations described above, it is concluded that the **hypothesis is proven to be true.** The process as it is currently implemented is improperly defined. At a high-level, it meets the basic requirements, but on the functional level, it does not. Within the operational area, there are some significant improvements needed.

The process is studied in its current format, so some of the observations on process maintenance and ownership might not be directly relevant in relation to some of the projects studied, or all of the phases within the projects. It is however relevant for some of them, and considered highly relevant from the direct observations made on ongoing projects.

5.4 The Research Question

It was proposed that the primary reasons 'Why products being released through the NPD process are failing to be ready from an operational point of view' is due to the process being improperly defined(H2) and the process not being followed(H1). Both of these hypotheses were proven to be true.

During the evaluation of these hypotheses, some additional points were noted that are not directly related to each of the hypotheses if you consider them as discrete evaluations.

To explain; the hypothesis that the 'Process is not being followed', evaluates the detailed results of actual projects and whether they adhere to the basic guidelines of the process as was defined at the time of the project being run. It does not explore the broader concept of the process being followed in terms of being true to the basic fundamental principles of NPD which is there to help take an idea through to a product, which is then sold after release. The exploration done excludes the consideration of whether the very fundamentals of the NPD process are adhered to. It is basically saying – A decision was made that the project should be run through the NPD process, so let's evaluate whether the project stuck to the criteria of 'following the processes'. Thus it is chosen to look at it in this one-dimensional manner. The reasoning being that projects are failing to meet operational readiness needs when there are specific guidelines as to what should be done and in place when production starts up. If these operational readiness needs are not met it could quite simply be just down to the fact that not all of the needed deliverables are being completed at the time required or as required which is still a matter of simple process adherence. The sought after outcome is the same, regardless of the underlying conditions are for seeking the outcome.

The hypothesis of the 'Process is improperly defined', looks at the details of the process and how it is defined in its current state. It explores whether all the needed activities are defined, whether all of the needed templates and guidelines are in place. It further attempts to validate how the process is currently defined against the measurement criteria of what is included in a well-defined NPD process and processes in general. Within this study it is assumed that the overall NPD process and how it is designed and functioning is a suitable model.

Combining the evaluation of these two hypotheses into one study transforms this from a one-dimensional evaluation into a two-dimensional one. From the results of the process definition, it is clear that there are some drastic improvements needed, so one could ask the

question to what extent is it possible to follow the process if the process is not properly defined. If it had been found that the process was being followed regardless of the process definition issues, the discussion would be different.

To this; add the additional observations from the interview data that the product is in some cases sold prior to the project having gone through the NPD process and that of intentional scope limiting. This suggests the question as to whether the process as it is currently defined within the Company is suitable for its needs. The NPD process model appears to be modelled pre-dominantly on high-volume based industries. The Company operates within the Oil and gas sector, where the oppertunities are finite and fluctuates from year to year; thus making it very important to seize the oppertunities when they arise. Project pursuits can last numerous years, for which you need to be engaged and be included in the bidding stage from the beginning, otherwise the opportunity will not be available later on. This in some cases includes bidding with technologies which have not completed the full development & release cycles, but are expected to be completed at the time of contract award.

It is thus thought that the considerations within the decision making framework within such an environment will be different to that within consumer and other high-volume based markets. A counter-argument to this could be that if the upfront homework was really done properly, then the Company would not end up in situations of having to make decisions based on potential missed oppertunities. So if more effort is put in with the end users at an earlier stage, the needed technologies could potentially be identified earlier, and released in time.

One of the greatest "challenges that users of Stage-Gate® face is making the gates work" (Cooper, 2011). There are numerous ways indicated within the literature; that the current decision gates within the Company can employ; to improve this aspect; such as success criteria, scorecards, must-meet criteria etc. None of these will however help to change the decisions made if the product is sold prior to being released through the NPD process.

A critical aspect within this environment of speculation between project award and product release is project planning; as this is the aspect that ties the speculation points together. I.e. when the project expects it will be completed, versus when the project needs to be completed. If the project planning is not done in a robust enough manner at the beginning, the cycle of making commitments prior to product release will continue, as one of the variables considered when decisions on project start-up is made is project duration. A scenario could be to delay

the start-up of one project, in favour of another due to conflicting resources, as the estimated project duration is short enough to do so. Then during project execution the duration estimate proves to not have been robust enough, and we are back at the difficult decision of pre-release market entry.

In addition to the points discussed above, a series of other underlying causes that are relevant to answering the central thesis question were identified. These are summarised in the previous chapter, but it can be said that these correspond closely to the typical shortcomings identified within the literature review chapter. Further, the cause and effect technique used to derive these is considered an established method. A potential short-coming with how the cause and effect technique was employed is that it did not include a broader active audience to explore the underlying causes, these were identified based on theory, documentation- and interview –data.

Utilising the frequency analysis a few of the central highly interlaced underlying causes were identified. The validity of a few of these will briefly be discussed further here.

Lack of process ownership & training. It could be argued that during the execution timeline of some of the projects that were studied, that a process owner was in place and that some training was provided, so lack of process ownership & training cannot be considered an underlying cause. This could be considered a real option in regards to process ownership, but only up to the point where process maintenance is not a factor. Process ownership as earlier discussed is not only about having somebody assigned to implement and co-ordinate but is also about how responsibilities are delegated and those persons enabled to ensure progress continues regardless of the role of the single owner.

In regards to training, the counter argument to this is that the content and the extent of the training should be considered. Was the training putting across the right message and the benefits we will get from this process and providing clear guidance on how we will use this new process, or was it a general introduction to the process and individuals are expected to gain the rest of the knowledge themselves. The strength and intent of the message sent should be considered. Process ownership in combination with leadership might be the more pertinent point. This is further supported by interview responses that limited training has been provided, and that it was unclear as to who owns the process.

The impact of strong leadership with a clear vision and expectations towards the process should not be underestimated in terms of the impact it will have in improving the use and adoption of the process. Employees look towards their leaders for ques in terms of behaviour, whether intentionally or not, so by addressing the leadership aspect and strength you will naturally start adapting the culture surrounding the process towards the direction you want.

Suggested future work would be to assess the effectiveness and benefits of corporate/overarching work processes when imposed on businesses across a large variety of industries that function on different business models.

6. Conclusions

This Paper started out with the goal of determining why products are failing to be ready from an operational perspective; when a NPD process is in place and reported to be in use. Two discrete hypotheses were put forward, based on which a selection of projects and the process itself were evaluated against measurement criteria derived from the identified literature. Based on these evaluations, the hypotheses that projects were failing to be ready from an operational perspective due to the process not being followed(H1) and the process being improperly defined(H2), were both concluded to be true.

However, after combining the discrete analyses of the projects and the process, it was suggested that without addressing the process in conjunction with the business needs, consistently following the process will not be possible, as the decision making criteria of the NPD gates will no longer be applicable, or even allow for projects to be stopped without having consequences for the business. The generic Parent company process needs to be customised in such a way that makes it more suitable for the Company's environment and needs.

The problems encountered that triggered this study, were from within the operational functional area. As this is the functional area most exposed to the product after release to manufacturing, problems are expected to be most prevalent within this area. The study indicated that though there are specific improvements that should urgently be addressed within the operational functional area, there were strong indicators that the problems encountered within the operations area is merely a symptom of overall larger problems which relate to how the process is utilised both on a micro and macro level.

7. Recommendations

This thesis took the form of a practice-oriented case study, and thus the recommendations are specific for the Company. A brief overview of focus areas are provided within this work, with detailed recommendations being provided separately and directly to the Company.

The focus of this study, though it was reasonably generalised in some areas in regards to the NPD process, at a detailed process level it only focused on the Operational functional area. There were indicators that most functional areas will benefit from a detailed evaluation. It is thus suggested that the methods used here on a detailed level are duplicated for all functional areas, in addition to a high-level review across functional areas to align on responsibilities in a concerted effort and try drive the cross-functional engagement aspect. Having the process properly and clearly defined is a cornerstone needed while building towards process buy-in and ultimately adherence.

Utilising the frequency plot, further suggested areas for improvement that are thought would have the highest and most widespread impact are as follows:

- Address the 'Process ownership' as it relates to process maintenance and individual leadership roles within the execution of projects to ensure all roles and responsibilities are clear.
- Address how project planning is done and the role of project leadership. This should be considered in conjunction with the current decentralised functionality for project management within the organizational structure as many of the problem areas revert back to project planning, scheduling and leadership.
- Gate review meetings – Revisit the purpose and the tools for these sessions, along with re-alignment on expectations for the participants.
- Process training with a clear vison and mission, and re-enforced on functional level.

<u>Within the Operations functional area,</u>

Based on the SIPOC done for manufacturing, and the feedback from some of the interviewees, one of the suggested improvements would be to review the entire process, to ensure that it makes sense as a whole, but also that it is properly defined from a basic process definition stand-point. Some of the work done within this study can be used a baseline.

- It should be ensured that it is clear what inputs are available and to be used, and what process is to be used to create the deliverables.
- Timing of the deliverables in relation to the rest of the process.
- Definition of deliverables to be clear and accurate as to what is wanted, and at what level of detail.
- Evaluate whether a specific department procedure should be created in order to guide the efforts more precisely. This should also include the introduction of co-ordination structures, both directly within the procedure, but also working with Engineering to ensure it is a mutual adjustment for closer integration.
- Removing non-value adding deliverables, to reduce the time waste going into the creation of deliverables which do not get used. Ultimately there are numerous deliverables and evaluations that one can have and that would be nice to have, but it is a matter of including the right ones which require a level of effort that is balanced between the work-force available and the intended application.

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9. Appendices

Appendix A - Case study protocol

Preparation

1) Background

a) Identify research topic

b) Define the general research objective and type of research (Theory-oriented or Practice-oriented)

c) Identify previous research on the topic

d) Determine specific research objective and type of research (Hypothesis-testing, hypothesis-building or descriptive)

e) Identify any additional research questions that will be addressed, if any

f) Create preliminary schedule with estimates for the different steps

Research

2) Design

a) Choose the research strategy

b) Identify whether single-case or multiple-case will be used

c) Describe the object of study (e.g. NPD)

d) Identify any hypothesis or sub-questions derived the research question.

e) What measures will be used to investigate these hypotheses

3) Case Selection

a) Criteria for case selection – Which projects to analyse. What process data to collect

b) Case Study Procedures and purpose of these. How will the data be selected, collected and analysed

c) Procedures for interviews

4) Data Collection

a) Identify the data available and to be collected in relation to the hypotheses. Find multiple sources of evidence.

b) Create data collection plan, include measurement criteria and sources of evidence from above.

c) Set up documentation management process. Define document numbering system and storage method.

5) **Data Analysis**
   a) Based on theory, identify methods for interpreting data findings.
   b) Include analysis method and documentation references into data collection plan. Ensure triangulation achieved where feasible.
   c) Are there plausible rival explanations. Address these as become applicable.
   d) Use known analytic techniques.

The data analysis will take place as the case study progresses

6) **Plan Validity**
   a) Check plan against Höst and Runeson's checklist items (Runeson & Höst, 2008)for the design and the data collection plan
   b) Check against Yin's validity test points (Construct-, Internal- and -External validity along with reliability).
   c) Revisit schedule and set up detailed Gant chart
7) **Discuss results**
8) **Report research**

Continuously revisit Protocol and validate on track.

Appendix B - Data Collection plan

Hypothesis	Data to be collected	Data source 1	Data source 2	Data source 3	Data Storage Document Reference	Data analysis	High level observations	Further data to be collected
H2. The process is improperly defined								
Stage 1								
	H.2.3.1. Details on Company process	Sharepoint site for process flow, & required deliverables(interactive site including guidelines)	Training material available	High-level(process description) procedures & scorecard template - TCE	MST 100_Data gathering overview; MST_103_detailed comparison of deliverables;	H2.3.1.1.1. Comparison of phases, gates, functional areas and gate deliverables	H2.3.1.1.1. Phases, gates & gate criteria exist H2.3.1.1.3. Inconsistencies with the gate deliverables H2.3.1.1.2. Functional areas do not align with the organisational structure	Interview data & participant-observation
	H.2.3.2. Parent Company process description, high level description & deliverables	Sharepoint site for process flow, & required deliverables(interactive site including guidelines)	Procedures on sharepoint site	Training material received on NPD	Final results - " Summary sheet" in MST_102_Summary of comparison			
	H2.4.1. Review key process procedures	High-level(process description) procedures - TCE,	Department/functional area level procedures	Description from sharepoint site	MST 100_Data gathering overview	Method -Review of procedures, while comparing to high-level process description, and theory. Log anomalies. H2.4.1.1. Is a process manager defined? H2.4.1.2. Do procedures exist on high level NPD process? Review for level of definition. H2.4.1.3. Do procedures exist on high level NPD process? Review for level of definition. H2.4.1.4. Are clear guidelines on activities & expectations included?	H2.4.1.1.1. High level and functional procedures that exist are outdated.	Interviews
	H2.4.2. Details on process for Operations functional areas	Description on Sharepoint site	TCE for referenced templates & procedures	Previous process assessments	Results in "summary sheet" of MST 104_SIPOC analysis	H2.4.2.1. SIPOC,	H2.4.2.1.1. The process for operations and the related deliverables are improperly defined	Interview data & participant-observation
H1. The process is not being followed								
Stage 2								
	H1.1.1. Scorecard completion	Teamcenter - Scorecards	Gate review presentation	TCE - Project gate review MoM	MST 101 - Data collection and evaluation of projects overview- tab named " Overview"	H1.1.1.1. % completion rates, for all functional areas, and then for operations only	H1.1.1.1.1. Not all deliverables are completed for gate reviews	Interview data & participant-observation
	H1.2.1. Scorecard gate customisation	Teamcenter - Scorecards	Gate review presentation	TCE - Project gate review MoM	MST 101 - Data collection and evaluation of projects overview- tab named " Overview"	H1.2.1.1. Are gate deliverables being customised, or all adopted as is	H1.2.1.1.1. Customization is being practiced, but not always appropriately	Interview data & participant-observation
	H1.3.1. Review overview of gate keepers	Gate review MoM template	Gate review meeting invites		MST 100_Data gathering overview	H1.3.1.1. Overview available -Yes/No	H1.3.1.1.1 Gate keepers are unclear	Interview data & participant-observation
	H1.3.2. Review records of decisions from gate review	TCE - Project gate review MoM			MST 100_Data gathering overview	H1.3.2.1. Are decisions clear & clearly documented for all gates H1.3.2.2. Decision aligns with status of deliverables?	H1.3.2.1.1. Lack of consistent documentation on gate decisions	
	H1.3.3. Documentation of criteria used prior/during gate review	Documented gate criteria checklist within TCE	TCE - Project gate review MoM	Gate review presentation	MST 100_Data gathering overview	H1.3.3.1. Criteria used for all gates – Yes/No	H1.3.2.2.1. Projects are let through gates irrespective of the status of their deliverables	Interview data & participant-observation
	H1.3.4. Gates being passed vs. Deliverables completed	TCE - Project gate review MoM	Gate review presentation & procedure	Teamcenter - Scorecards	MST 101 - Data collection and evaluation of projects	H1.3.4.1. # of gates having all deliverables in place vs. # of gates passed		
	H1.4.1. When functional areas engaged	Project timesheets	Review of development schedules		MST 101 - Data collection and evaluation of projects	H1.4.1.1. Are man hours on project spent throughout phases, or always peaking before and after gate review?		
	H1.4.2. Deadlines communicated	Review of development schedules	Participant-observation		MST 100_Data gathering overview	H1.4.2.1. Scheduling reviews - Are all deadlines for the same time, or is cross functional work planned for?	H1.4.1.1.1. Lack of cross functional collaboration	Interview data & participant-observation
	H2.1.1. & H1.4.3. Inputs & Outputs across functional areas taken into account	Review high-level procedures	Review department level procedures		MST 100_Data gathering overview	H2.1.1.1. Review whether covered in procedures		

Appendix C - Interview guide and responses

Each of the respondent's answers are included below within the interview guide.

Subject number 1

Question #	Question / Sub-questions
	Experience
1	How many years have you been working within the Company?
	12
2	How many of those years have you been involved with NPD work?
	Since its introduction in various roles (Sales, service, TPM). So approximately 6 years.
2.1.	Of those years how many were as a functional area contributor (works on specific projects) and how many a functional area lead (responsible for types of deliverables for process in general), if applicable?
	All as functional area contributor
	Purpose of Process & common vision
3	In your own words, what would you describe the purpose of the NPD process to be?
	To ensure correct product development in a consistent manner, with pre-defined and agreed specifications. So that it has been ensured ahead of product development starting that there is a market for the product being developed, and that resources are not being spent on the pet projects of senior managers. Within the process the gate criteria are good control questions, as they make you think, but they are not all directly relevant to the Company, and should be adjusted, as though they make you think some relevant questions might be missed out on. The gate criteria checklist needs adaption and scaling to the Company's business area, which for some products are low volume high value(Engineering to Order), whereas the current criteria looks to cater for high volume, low value structure, and thus time is spent on questions which are not relevant.
3.1.	Within your group, do you think that everybody understands and shares this common vision?
	Yes, a common vision shared within the group as there are detailed discussions including cross-functional relationship.
	Process definition & adherence
4	Do you consider the process to be clearly defined? Considering the top level, the functional area level and all functional areas
	Top level process, with the phases and gates are clear. Functional, more detailed level, the activities are not clear and not all applicable for the company and all types of projects. Deliverables badly defined. Deliverable names and

	descriptions dot not align, it asks for updated deliverables for functional areas when there was no original deliverable in the previous phase. Some of the deliverables are only applicable if you are developing a whole new product, and not when you are doing upgrades and additional functionalities. But the current mandates on doing deliverables demands that all completed to some extent. (Allows limited scalability of process). General process definition in terms of inputs, outputs and process to be used is not clear. It is for a few, but definitely not all. This results in time being wasted discussing and figuring out what to do, unclear responsibilities, makes things confusing and there will be inconsistencies as different people will interpret things differently.
4.1.	Based on experience within process, would you consider all the needed tools, templates and guidelines are in place? And do you consider these guidelines to be up to date?
	No
4.2.	Is it clear where to find this information, along with project specific information when implementing the process?
	Yes, but relies heavily on functional area communication, and e-mails. Which can cause confusion and mix ups. It is currently not required to store all deliverables in the same place.(TCE) Suggestion for improvement is that it should be made clearer where what information should be stored.
4.3.	Based on your experience and exposure to the process, would you consider the process to be followed? Consider this from the perspective of recent projects and previously completed projects. I.e. any consistent improvements, or variation of improvements depending on who is involved?
	No, the process is not always followed, and due to the state of the deliverables, the process is open for interpretation and thus there is no consistent way of doing things. Some projects have been more successful than others, but this is heavily dependent on who is involved and there previous experience.
4.4.	Based on this previous answer, what do you think the potential reasons are for us falling short of the mark, or making further improvements?
	Availability of resources and prioritization of these resources. How we plan when deliverables should be completed by. Sometimes not using the process for the right purpose. In some cases 'holding the company hostage', as a customer PO has been issued, so there is no way of not allowing the project to proceed. There is sometimes too heavy a focus on the gate date, and not enough being focused on the phase we have to go through to get to the gate. For some projects work is only started on the gate a few weeks ahead of the gate. Example used, is that when going through gate 1, it should maybe be reviewed what will be done for a gate 2 and get sign-off for what is agreed for the gate 2 at the gate 1 review. Put the focus on the phases, not on just the gates. An additional point was mentioned that form a gate 3 and onwards, that the process is currently run in too a serialized fashion, and it should be considered how and when parallel

	work can be started. Should agate 4 be fully passed before phase 5 activities are started on. (This discussion was in context of the Company and its business area) **Based on the discussion, the additional question was asked as to why it is thought there is such a heavy focus on the gate only and not the phases.** It was thought that this is due to people's understanding of the process, and belief in the value that the process is meant to bring. Also it could be due to lack of training.
	Cross-functional Collaboration
5	For the deliverables that are created by your functional area, is it clear what deliverables are used by other functional areas, and which are required as input?
	Some are clear, but not all.
5.1.	Do department procedures incorporate the cross-functional work flow of the NPD process?
	N/A, as no department procedures in this respect
5.2.	Do we have structures in place to co-ordinate the design work with the manufacturability work? Or is it luck of the draw on who is involved and their motivations?
	N/A
	Value-adding activities
6	Do the procedures/guidelines within your functional area incorporate the activities and work needed for the NPD process? Or is this work considered to be add-ons?
	No, as functional area does not operate with singular procedures, and the ones that exist are not relevant to the NPD. NPD requirements aligns closely with the day to day activities for the Product Owner and marketing, but probably not for sales. I.e. The sales requirements for the NPD will be in addition to what they do on a day to day basis.
6.1.	In your opinion are all deliverables that are being created and followed up on during the gate reviews value adding?
	No, not all. Example provided is that for the last project, they had to create a document referring to existing documents in order to satisfy how the process is being run. This exercise was considered to have added no value.
	Process maintenance & continuous improvement
7.	Do you consider that there are any process improvements needed? Either in general, or within your specific functional area. I.e. If there was one change you could implement, what would it be?
	Yes, absolutely. Suggested improvements are as follows: More clearly defined activities within the process, and requirements. Consider whether the functional area responsible (person creating the deliverables) should be responsible for the customization of the deliverables, or should this be the functional area lead. Consider the personnel involved in the gate reviews. Maybe somebody that does not have

	the same level of personal buy-in into the projects or product should be there to ask the 'stupid' questions.
7.1.	Are you aware of any specific planned improvements?
	No.
	Project execution
8.	What would you consider to be the typical challenges encountered preventing projects form meeting goals (such as gate review dates, completion)?
	Resource availability is an issue. Most issues come back to how we do our planning. When assessments are made for when something can be completed by, this is often done with 100% utilization of the resources. There are no guidelines on what utilization rates to use, and how these estimates should be calculated, i.e. with multiple loops. In some cases, there might be pressure on the person asked to do the planning to give the 'right 'answer. It should be considered how this gets moderated, so that we commit to timelines we can trust. How we scope projects is sometimes and issue. Scope purposefully limited during starting up phases, even though it is not a true reflection of what is needed. This is thought maybe to be in order to take shortcuts and get the 'pet' projects through.
8.1.	What KPIs are currently in use to measure the success of a NPD project? What about the product?
	No specific ones are known of, aside from what might already be in the deliverables.
	Gate reviews & decision making
9.	Who are the gate decision makers?
	Senior Management team, but in some cases other people might represent them. It was mentioned that this information is not clearly noted down anywhere.
10.	What are the criteria employed to determine whether a project will proceed through a gate?
	That all deliverables are completed. All other criteria are subjective as far as interviewee is aware.
11.	Are there clearly defined outputs from a gate review- I.e. action plan for the next phase, agreed deliverables for the next gate, commitment of resources (people and financial?)
	No
12.	Budget and resource commitments. Are these verified, and if so, how. I.e. how resources calculated in total, and it verified that there are enough for all projects and ECRs? Are they verified and considered upfront?
	No, limited resource planning, if any. It is however mentioned that some of this is partially covered through the portfolio review process, and that there are some improvements planned in this area.

13.	**If applicable, depending on earlier answers.** Based on the previous section you have been working with development projects to some extent since the NPD process was introduced into the company. What improvements in development project performance would you attribute to the process?
	Upfront preparation. Proper assessment of what is to be developed upon an assessment of the market needs. Validation of ROI before starting work on development. Most improvements seen are on the upfront side, would not say it has drastically improved the quality of the engineering, but that has always been a strength. It was also mentioned that further improvements can be made on knowing the market, based on some of the tome constrained situations we still find ourselves in. Having the top level process makes people think and make better decisions.
	Process ownership
14.	Who owns the process and the defined deliverables for each functional area? Single person, Functional area process owner(responsible) (E.g. For project management who is responsible for dictating which deliverables should be reviewed as part of scorecard? Who validates the quality and completeness of the deliverables ahead of a gate review?
	After organizational restructure it was unclear as to who owns the overall process. Functional area process ownership is unclear.
	Training
15.	Is process training done? What about refresher training?
	No specific training done to knowledge, and interviewee has never received any form of training in the process
16.	Do we have structures in place to co-ordinate the design work with the manufacturability work? Or is it luck of the draw on who is involved and their motivations?
	N/A
	Some additional points noted during the interview
	It was questioned whether all the deliverables are currently linked to the correct gate. How process is currently run has limited flexibility. Additional question: Within the industry that we operate, and how the process is currently structured are we able to pass gate 5 prior to selling the product. No, most likely not in its current format, as the length of the pursuit process is immensely long compared to other industries. An example of the last project having taken 7 years from the point of inquiry started to PO award. Industry heavily driven by customer specifications, but it is thought that we should be able to learn from the Parent company in terms of integration with operators, and thereby allowing us to anticipate their needs more. Also working more closely with the operators will allow us to be able to ask about future needs, instead of reacting only once we have seen the specifications.

Subject number 2

Question #	Question / Sub-questions
	Experience
1	How many years have you been working within the Company?
	10 years
2	How many of those years have you been involved with NPD work?
	6 years
2.1.	Of those years how many were as a functional area contributor (works on specific projects) and how many a functional area lead (responsible for types of deliverables for process in general), if applicable?
	Of the 6 years, 4 months as functional area lead, in the form of shared responsibility across the functional group to update documents as seen fit.
	Purpose of Process & common vision
3	In your own words, what would you describe the purpose of the NPD process to be?
	To get the whole Company on board and ready to deliver a new product, when it is time to hand it over to the line organization.
3.1.	Within your group, do you think that everybody understands and shares this common vision?
	Yes, would think so, but this is more of an opinion, as has never been discussed within the group. It can however be said that the approach within the group to use the process varies from person to person.
	Process definition & adherence
4	Do you consider the process to be clearly defined? Considering the top level, the functional area level and all functional areas
	High level process is clearly defined. Functional area work required is clear within the scorecard and that the functional areas need to be engaged in order to ensure that the work gets done. Quality is to be driven by the functional area responsible. But based on knowledge on some of the deliverables being produced, the overall quality of these deliverables can be questioned. Specific functional area's procedures & templates are outdated, and heavily up to the judgement of the specific person. It is considered a positive that the requirements are not heavily detailed, but it can also be seen that some more clear guidelines might be useful to ensure that there is consistency and a clear understanding of the level of quality that is needed.

4.1.	Based on experience within process, would you consider all the needed tools, templates and guidelines are in place? And do you consider these guidelines to be up to date?
	For functional area, yes, but outdated.
4.2.	Is it clear where to find information on the process? What about on the specific projects using the implemented process?
	For own functional area, yes. For other functional areas a centralized storage place is dictated from Project Management, but how things are stored and what is stored up to that point is unclear and unknown.
4.3.	Based on your experience and exposure to the process, would you consider the process to be followed? Consider this from the perspective of recent projects and previously completed projects. I.e. any consistent improvements, or variation of improvements depending on who is involved?
	Yes, the process is followed.
4.4.	Based on this previous answer, what do you think the potential reasons are for us falling short of the mark, or making further improvements?
	N/A based on previous answer
	Cross-functional Collaboration
5	For the deliverables that are created by your functional area, is it clear what deliverables are used by other functional areas, and which are required as input?
	For most it is clear how used and by whom. There is however 1 deliverable that it is thought not to be used.
5.1.	Do they incorporate the cross-functional work flow of the NPD process?
	This aspect can be improved
5.2.	Do we have structures in place to co-ordinate the design work with the manufacturability work? Or is it luck of the draw on who is involved and their motivations?
	N/A
	Value-adding activities
6	Do the procedures/guidelines within your functional area incorporate the activities and work needed for the NPD process? Or is this work considered to be add-ons?
	The process implemented originally was very heavy, but there has been improvements, with the latest version being considered reasonably well aligned with the work being done in own functional area. Cannot comment on how it compares to before the NPD process was introduced. Process definitely ensure better organizational alignment.

	But other functional areas do not always see the value of the NPD, as there is allot of extra work required from the NPD process which does not closely match their 'day job'.
6.1.	In your opinion, are all deliverables that are being created and followed up on during the gate reviews adding value?
	No, within own functional area, there is 1 deliverable the value of is not seen as content covered in another way. There are also some deliverables being created by other functional areas that can be used in better ways than they currently are.
	Process maintenance & continuous improvement
7.	Do you consider that there are any process improvements needed? Either in general, or within your specific functional area. I.e. If there was one change you could implement, what would it be?
	A clearer allocation of resources to the project, with the Functional area leads (who assigns the resources to the project) understanding the level of effort required for a NPD project, and ensuring that the resources assigned has enough time available for the NPD work in additional to existing responsibilities.
7.1.	Are you aware of any specific planned improvements?
	A LEAN initiative had been started, but unclear how the outcome of that was implemented.
	Project execution
8.	What would you consider to be the typical challenges encountered preventing projects form meeting goals (such as gate review dates, completion)
	Resource availability highlighted as the biggest problem. In addition some of the business systems we have in place, make it very difficult to prototype parts. There is also a concern on relationships with subsuppliers, and how they should be engaged in regards to prototyping and development work.
8.1.	What KPIs are currently in use to measure the success of a NPD project? What about the product?
	None that is known of
	Gate reviews & decision making
9.	Who are the gate decision makers?
	Senior management team makes the decisions, but the rest of the people that are present, facilitate the discussion to help them make the decision. One person named, that it was stated it is unclear as to whether they form part of the decision making group or not.

10.	What are the criteria employed to determine whether a project will proceed through a gate?
	Criteria are driven by the PowerPoint templates and by filling those in and answering the questions in them, along with an upfront review with the Business line leader, ensures that all criteria are met in order to make the decisions clear. Completion of the deliverables on the scorecard was also mentioned.
11.	Are there clearly defined outputs from a gate review- I.e. action plan for the next phase, agreed deliverables for the next gate, commitment of resources (people and financial?)
	It is focused on the approval of what has been done to date, and that the project is allowed to move forward. There are no clear commitments being made to resources or anything else. We effectively are still 'hostages' to how managers assign and prioritize resources.
12.	Budget and resource commitments. Are these verified, and if so, how. I.e. how resources calculated in total, and it verified that there are enough for all projects and ECRs? Are they verified and considered upfront?
	Resource planning had been attempted in the past, prior to organizational restructuring, but not at present. It is thought that this is now done based on verbal agreements between managers and the Business Line leaders that own the resources.
13.	**If applicable, depending on earlier answers.** Based on the previous section you have been working with development projects to some extent since the NPD process was introduced into the company. What improvements in development project performance would you attribute to the process?
	Process has helped the organization improve its ability to deliver a better product when handed over to the line organization. How market requirements are assessed has improved.
	Process ownership
14.	Who owns the process and the defined deliverables for each functional area? Single person, Functional area process owner(responsible) (E.g. For project management who is responsible for dictating which deliverables should be reviewed as part of scorecard? Who validates the quality and completeness of the deliverables ahead of a gate review?
	Each functional area was mentioned with a specific name. Project Management was mentioned as responsibility being split across all of the project managers (after organizational changes), in that they agree and propose improvements as each individual sees fit. It is suggested that this solution will not work over the long term, as the individuals do not necessarily have the time available, and you will be losing the overall drive and consistency in what is being done.

	Training
15.	Is process training done? What about refresher training?
	New questions introduced after this interview
16.	Do we have structures in place to co-ordinate the design work with the manufacturability work? Or is it luck of the draw on who is involved and their motivations?
	New questions introduced after this interview
	Some additional points noted during the interview

Subject number 3

Question #	Question / Sub-questions
	Experience
1	How many years have you been working within the Company?
	12 years
2	How many of those years have you been involved with NPD work?
	6 years, mostly working as functional area lead. Was involved at the beginning when process was introduced and being adapted for the Company. Work included work within alignment across functional areas, making templates and so forth.
2.1.	Of those years how many were as a functional area contributor (works on specific projects) and how many a functional area lead (responsible for types of deliverables for process in general), if applicable?
	All as functional are lead.
	Purpose of Process & common vision
3	In your own words, what would you describe the purpose of the NPD process to be?
	To ensure that we are working on the right projects, with the right focus to drive quality in the products we are releasing from an overall business perspective. This also ties closely with project portfolio management and how we do that.
3.1.	Within your group, do you think that everybody understands and shares this common vision?
	Within in immediate group, yes, but within overall department group No. There should probably be more done for people to understand the process. As not everybody works directly on the process, so their understanding of it and its value will not necessarily be

	the same as the rest. There is a heavy influence on this understanding based on how projects are managed. There has been a heavy focus on the gates, instead of the phases. There are however improvements coming in where some areas are shifting the focus to the phases. An understanding is needed for why things are in the scorecard, and that they are not there to be ticked off at the end of the phase. The deliverables should instead be driving the activities. For example, the risk evaluation documents. In regards to focusing on the phases instead of the gates, a maturing process is needed throughout the organization to align to this way of thinking. Stronger management leadership (The 'President) is helping with this and making it more visible. This in turn also helps drive people's buy-in to the process and that they can more clearly see the value. The leadership has made a clear step to leading by example, which will naturally drive improvement.
	Process definition & adherence
4	Do you consider the process to be clearly defined? Considering the top level, the functional area level and all functional areas
	Top level – Templates and aids available, but maybe more is needed than what is available. These are however not updated, which was base do a conscious decision during organizational restructuring, as the Company could no longer have a dedicated resource to managing the process. Within own functional area, time has been specifically spent on updating and creating procedures/guideless and templates.
4.1.	Based on experience within process, would you consider all the needed tools, templates and guidelines are in place? And do you consider these guidelines to be up to date?
	Allot is available. Some missing, and some needs improvements. From when the process was first introduced allot of improvements have been made. One key things that can be seen as having changed is that the business no longer considers this to be a process owned by engineering as it did in the first years. It is starting to emerge and be seen as the business process it was intended to be. This is partly contributed to some restructuring along the way, but heavily due to senior leadership. The roles and needs of the process in respect to the latest restructuring needs to be re-evaluated and aligned again.
4.2.	Is it clear where to find this information, along with project specific information when implementing the process?
	It should be, as efforts have been made within own functional area to do so. Where to store information is also clear within procedures, but this is not always followed up, and thus in some cases not stored as intended. All the documentation as is needed is however available. This is partly attributed to the project structures that are meant to be used for storing documentation. They can be somewhat cumbersome and result in duplication of storage places. This should be clarified.

4.3.	Based on your experience and exposure to the process, would you consider the process to be followed? Consider this from the perspective of recent projects and previously completed projects. I.e. any consistent improvements, or variation of improvements depending on who is involved?
	No, not 100%. There are large variations based on the resources involved. Variations on how well it is followed will also creep in when resources are distributed across multiple projects. There is also a noted variation in how different business lines and locations follow the process.
4.4.	Based on this previous answer, what do you think the potential reasons are for us falling short of the mark, or making further improvements?
	Variations in the business lines. Senior leadership Project leadership Training – On the process, the tools and understanding of the process. Improved procedures and templates will also help.
	Cross-functional Collaboration
5	For the deliverables that are created by your functional area, is it clear what deliverables are used by other functional areas, and which are required as input?
	It should be form the procedures and process, but this is sometimes down to the individuals involved. Some disciplines understand better than others. But understanding of the needs across functional areas can be improved.
5.2.	Do we have structures in place to co-ordinate the design work with the manufacturability work? Or is it luck of the draw on who is involved and their motivations?
	No specific structures, the degree of co-ordination will depend on the people involved
5.3.	Do they incorporate the cross-functional work flow of the NPD process?
	Inputs are defined, but not who will be using them afterwards. I.e. outputs are not mapped to inputs.
	Value-adding activities
6	Do the procedures/guidelines within your functional area incorporate the activities and work needed for the NPD process? Or is this work considered to be add-ons?
	Within own functional areas, this is fully incorporated.
6.1.	In your opinion are all deliverables that are being created and followed up on during the gate reviews value adding?
	No. And based on some of the discussions during reviews, some functional areas do not

	understand what their own deliverables are defined to be.
	Process maintenance & continuous improvement
7.	Do you consider that there are any process improvements needed? Either in general, or within your specific functional area. I.e. If there was one change you could implement, what would it be?
	Yes, needs improvement. There are continuous improvements ongoing within own functional areas. These however focus internally within department and how cross-functional collaboration can be improved there. External cross-functional collaboration is however considered an improvement area for the future.
7.1.	Are you aware of any specific planned improvements?
	As mentioned above, within own functional area improvements are already planned for. On the overall process, there is no specific known improvements planned. It can only be said that one of the strategic initiatives for the next financial year is related to the NPD.
	Project execution
8.	What would you consider to be the typical challenges encountered preventing projects form meeting goals (such as gate review dates, completion)?
	Resource availability, in the sense of lack of dedicated resources. They end up working on multiple projects, which decreases the efficiency. Scope creep Lack of understanding of the technical requirements and what they translate to. Planning – understanding the critical path from an early stage, i.e. what will be the long lead items and address these upfront. Selling the product before the design is frozen. Makes the plans difficult to adhere to, as the process then is not free.
8.1.	What KPIs are currently in use to measure the success of a NPD project? What about the product?
	On time measurements of gate 3, gate 4 and gate 5 reviews. Project performance measurements – CPI and SPI during the progression of the project. Quarterly reviews of strategically important projects
	Gate reviews & decision making
9.	Who are the gate decision makers?
	The senior leadership team. But responsibilities of the gate decision makers in regards to the process might not be clear.

10.	What are the criteria employed to determine whether a project will proceed through a gate?
	Gate criteria checklist should be used, but this is not actively being used, possibly due to expectations not being clear on how to use it, and whose responsibility it is. This will result in a high amount of variability. Assumes that the decision makers use the following – Status of the scorecard (Deliverables being completed), what the Project Manager focuses on during his gate presentation, their own experience and gut feeling. The Company 'President's' expectations and what he communicates is also a driver in regards to the decision making. It is noted that the gate-keepers might benefit from some training, and a clear guideline in terms of what criteria should be evaluated, and what their responsibilities are in regards to the process and the decisions made.
11.	Are there clearly defined outputs from a gate review- I.e. action plan for the next phase, agreed deliverables for the next gate, commitment of resources (people and financial?)
	The main focus is on what was done leading up to the gate. There are actions issued during gate reviews if anything was missing or not as intended or if more information is required.
12.	Budget and resource commitments. Are these verified, and if so, how. I.e. how resources calculated in total, and it verified that there are enough for all projects and ECRs? Are they verified and considered upfront?
	Commitment of resources, budget and people is done on an overall project level, and approved once off. If these need to be adjusted during the course of the project, it is up to the Project manager to request it. No specific review during the gate reviews, but expectation is that PM should be getting sign-offs for these upfront of the gate review.
13.	**If applicable, depending on earlier answers.** Based on the previous section you have been working with development projects to some extent since the NPD process was introduced into the company. What improvements in development project performance would you attribute to the process?
	A better understanding of requirements and scope of projects. Allowing us to do 'the right projects'. IT gives a clearer understanding of resource needs and what the potential timeline for the project might be. Improvements in that manufacturing and product documentation is completed ahead of a product being released. Overall considerations for product is better.
	Process ownership
14.	Who owns the process and the defined deliverables for each functional area? Single person, Functional area process owner(responsible) (E.g. For project management who is responsible for dictating which deliverables should be reviewed as part of scorecard? Who validates the quality and completeness of the deliverables ahead of a gate review?

	There is an overall proves owner Functional area leads are responsible for the verification of quality and completeness ahead of gate reviews.
	Training
15.	Is process training done? What about refresher training?
	No specific training done. Though there has been done a value stream mapping of the process for engineering, which resulted in information being presented on the findings, along with a way forward. Some of this has started to be implemented, but with a large delay since the actual VSM. There were some basic introductions at the very beginning. Alignment on process across business lines are unclear, and then there are difference between sites. Organizational leadership plays a big role here, and for some business lines they have not been willing to embrace the process and thus the next levels down do not see the need for embracing the process. Overall unclear on the process and their expectations towards employees on it.
16.	Do we have structures in place to co-ordinate the design work with the manufacturability work? Or is it luck of the draw on who is involved and their motivations?
	No specific structures, the degree of co-ordination will depend on the people involved
	Some additional points noted during the interview
	Ref resource planning, this should be better considered form the beginning of the projects. From a leadership perspective functional area leads should ensure that the process is prioritized with the rest of the department work. This goes hand in hand with how priorities are set and should think about the long term consequences, not only the short term. I.e. down prioritizing work on production procedures today in favor of active project work, makes sense for the short term, but for the long term, some of the fire-fighting could be prevented by putting this focus upfront.

Subject number 4

Question #	Question / Sub-questions
	Experience
1	How many years have you been working within the Company?
	10 years
2	How many of those years have you been involved with NPD work?
	3 years
2.1.	Of those years how many were as a functional area contributor (works on specific projects) and how many a functional area lead (responsible for types of deliverables for process in general), if applicable?
	Predominantly as functional area contributor, some minor help in creation of templates.
	Purpose of Process & common vision
3	In your own words, what would you describe the purpose of the NPD process to be?
	Ensure that we deliver a product of good quality. Examples given of some products which could have benefited from some from the NPD work processes.
3.1.	Within your group, do you think that everybody understands and shares this common vision?
	Yes think so, but have not worked with everybody on detailed level in regards to the NPD process, so difficult to give a precise answer.
	Process definition & adherence
4	Do you consider the process to be clearly defined? Considering the top level, the functional area level and all functional areas
	Top level definition is probably fine. On functional level, the deliverables are a bit vague. Timing of the deliverables are a bit mismatched with some of the engineering work. And how design changes are handled after a gate 4 in relation to the work done by manufacturing can be improved on.
4.1.	Based on experience within process, would you consider all the needed tools, templates and guidelines are in place? And do you consider these guidelines to be up to date?
	No. There are missing templates. Guidelines are vague/insufficient. There is also some mismatch between what we do in practice and what is in the guidelines, as some of the guidelines ask for allot more information than what is prepared in practice.

4.2.	Is it clear where to find information on the process? What about on the specific projects using the implemented process?
	The project scorecard is predominantly used, so yes, clear where to find. Where to store the information created on the project, no specific guidelines that are aware of, but use the centralized documentation system for the projects.
4.3.	Based on your experience and exposure to the process, would you consider the process to be followed? Consider this from the perspective of recent projects and previously completed projects. I.e. any consistent improvements, or variation of improvements depending on who is involved?
	In terms of creating the deliverables, yes. In terms of creating them on time – No. **Question further explored in terms of how timing of deliverables in relation to gates are planned for.** Deliverables are only asked for a few weeks ahead of the gate review for the early phases, but form about gate 4 there is much closer follow ups. One of the problems highlighted from a previous project is that delivery projects are executed before the actual NPD process is completed.
4.4.	Based on this previous answer, what do you think the potential reasons are for us falling short of the mark, or making further improvements?
	Unsure.
	Cross-functional Collaboration
5	For the deliverables that are created by your functional area, is it clear what deliverables are used by other functional areas, and which are required as input?
	For some outputs (e.g. PFMEA) this provides feedback to engineering. But it was thought that some of the other deliverables are more for internal use. Inputs needed are clear both to those that require them, and those that provide them.
5.1.	Do department procedures incorporate the cross-functional work flow of the NPD process?
	N/A, as there are no specific department procedures relating to the NPD work.
5.2.	Do we have structures in place to co-ordinate the design work with the manufacturability work? Or is it luck of the draw on who is involved and their motivations?
	Not built into the process, but the deliverable descriptions often include info on who provides inputs.
	Value-adding activities
6	Do the procedures/guidelines within your functional area incorporate the activities and work needed for the NPD process? Or is this work considered to be add-ons?
	The work done as part of the NPD projects is to some extent incorporated in the sense

	that it relies on the same skillset. Everyday tasks are however different.
6.1.	In your opinion, are all deliverables that are being created and followed up on during the gate reviews adding value?
	No, there are some that don't add value.
	Process maintenance & continuous improvement
7.	Do you consider that there are any process improvements needed? Either in general, or within your specific functional area. I.e. If there was one change you could implement, what would it be?
	Yes improvements needed. Better description of deliverables Better templates Creation of missing template(s)
7.1.	Are you aware of any specific planned improvements?
	No.
	Project execution
8.	What would you consider to be the typical challenges encountered preventing projects form meeting goals (such as gate review dates, completion)?
	Resource availability – Prioritization of time between 'day-job' and NPD project work. When things are very busy, the day-job takes preference (though prioritization is left up to the individual) Deliveries from sub suppliers Some minor effects form technical difficulties.
8.1.	What KPIs are currently in use to measure the success of a NPD project? What about the product?
	None known of.
	Gate reviews & decision making
9.	Who are the gate decision makers?
	Unclear.
10.	What are the criteria employed to determine whether a project will proceed through a gate?
	Completion of deliverables, maybe. But this is unclear as project pass gates without all of the deliverables being completed.

11.	Are there clearly defined outputs from a gate review- I.e. action plan for the next phase, agreed deliverables for the next gate, commitment of resources (people and financial?)
	Unclear. The main focus is normally on the deliverables for the gates. Deliverables for the next phase are taken phase by phase, and the next gates, discussed a few weeks after the previous gate.
12.	Budget and resource commitments. Are these verified, and if so, how. I.e. how resources calculated in total, and it verified that there are enough for all projects and ECRs? Are they verified and considered upfront?
	Don't know.
13.	**If applicable, depending on earlier answers.** Based on the previous section you have been working with development projects to some extent since the NPD process was introduced into the company. What improvements in development project performance would you attribute to the process?
	N/A
	Process ownership
14.	Who owns the process and the defined deliverables for each functional area? Single person, Functional area process owner(responsible) (E.g. For project management who is responsible for dictating which deliverables should be reviewed as part of scorecard? Who validates the quality and completeness of the deliverables ahead of a gate review?
	No single owner known of. Process pre-dominantly thought of in terms of specific projects, and within those realms customization would occur within own department. (No mention of functional area lead). There are no release or review guidelines.
	Training
15.	Is process training done? What about refresher training?
	Replaced by question 16 and 16.1. and 16.2
	Design for Manufacturability
16.	In your current position, did you receive any training on the NPD process? Both high-level process, but also functional areas specific?
	Only a general introduction on the high-level process. Did not include sufficient details on the lower level processes. No department level training.
16.1	If yes, has there been any refresher training?
	No.

16.2	What about DFM and DFA, any specific training or guidelines provided?
	No specific training, guidelines within the templates are followed.
17.	Has expectations and guidelines been given in terms of the process? I.e. how does it fall within the priorities of your other work? How to customize the deliverables… Are these clearly communicated from the PM and the line manager, and are these consistent?
	No specific expectations or guidelines communicated. Prioritization between regular work and NPD not done, NPD is supposed to be fit in between the rest of the work. Customization of deliverables is done as a discussion between engineer, PM and manager.
18.	Are there existing guidelines for the review and release of the manufacturing deliverables from the NPD?
	No
19.	To your knowledge is a manufacturing representative required to sign off design reviews for new products?
	No formal sign-offs required. Participate in design reviews, but mostly the ones within the later gates, not the early ones.
	Some additional points noted during the interview

Subject number 5

Question #	Question / Sub-questions
	Experience
1	How many years have you been working within the Company?
	10 years
2	How many of those years have you been involved with NPD work?
	6 years
2.1.	Of those years how many were as a functional area contributor (works on specific projects) and how many a functional area lead (responsible for types of deliverables for process in general), if applicable?
	Of this time approximately 4 years actively as a functional area contributor, and 2 years working with engineering in relation to prototyping and providing input to deliverables.

	Purpose of Process & common vision
3	In your own words, what would you describe the purpose of the NPD process to be?
	To make sure all involved gets a look and agrees (or disagrees) in terms of the product that will get produced. Ensuring we are able to purchase, test, produce according to pre-existing procedures. Ensure all departments are involved when we release, so that we can produce the products without problems. Ensure production personnel are trained.
3.1.	Within your group, do you think that everybody understands and shares this common vision?
	Yes, more or less.
	Process definition & adherence
4	Do you consider the process to be clearly defined? Considering the top level, the functional area level and all functional areas
	No. The responsibilities in terms of who should produce which deliverables in the scorecard are clear, and fairly well described on the high level. But within the functional area deliverables, things are still messy sometimes, as the responsible person does not always produce the deliverables, instead somebody else did. Based on. It might be more about how we follow parts of the defined process.
4.1.	Based on experience within process, would you consider all the needed tools, templates and guidelines are in place? And do you consider these guidelines to be up to date?
	Some are in place. Some are good some are only OK, and some are bad. Some of the templates that are available are unclear as to the expectations. SO we don't actually know what is needed. There is a name and a description, but what it actually means is not clear.
4.2.	Is it clear where to find information on the process? What about on the specific projects using the implemented process?
	Know where to find the information, but that does not help if the information that is there is unclear. Referred to both the SharePoint site and the scorecard. For specific projects, it is clear where to store documents. Folder structure that is in place is good.
4.3.	Based on your experience and exposure to the process, would you consider the process to be followed? Consider this from the perspective of recent projects and previously completed projects. I.e. any consistent improvements, or variation of improvements depending on who is involved?
	To a certain degree. We don't disregard it, but sometimes we skip ahead in the phases, prior to even having gone through some of the earlier gates. But in some cases this does make sense in terms of keeping momentum, in the case of smaller upgrade projects. Sometimes are only engaged and asked for deliverables to be completed 1 week ahead

	of the gate review. This is more so for the earlier gates. When we get order ahead of the project being completed, then everything just gets rushed through.
4.4.	Based on this previous answer, what do you think the potential reasons are for us falling short of the mark, or making further improvements?
	There is too much unnecessary documentation/deliverables. Time constraints Some people don't seem to like the process, as it feels too rigid and stops development and the follow of the project
	Cross-functional Collaboration
5	For the deliverables that are created by your functional area, is it clear what deliverables are used by other functional areas, and which are required as input?
	No. Some are, but there are some deliverables that it is unclear as to who uses it and where the inputs should come from. And in some cases who should create the deliverable. In general there is also a lack of feedback form the project managers in terms of what is required when. Have we passed the gate reviews, are updates required and what the timelines are.
5.1.	Do department procedures incorporate the cross-functional work flow of the NPD process?
	No procedures exist. In the SharePoint site there are inputs listed for some, but not for all. There are also no review processes in place.
5.2.	Do we have structures in place to co-ordinate the design work with the manufacturability work? Or is it luck of the draw on who is involved and their motivations?
	No structures in place, it depends on who is working on it (which project managers and project engineers), and this with a varying degree of success.
	Value-adding activities
6	Do the procedures/guidelines within your functional area incorporate the activities and work needed for the NPD process? Or is this work considered to be add-ons?
	No procedures exists, but the day to day activities do not overlap with the NPD work. It uses a similar skillset/knowledge base.
6.1.	In your opinion, are all deliverables that are being created and followed up on during the gate reviews adding value?
	No, some deliverables are not adding value. It feels like some of them we make, for the sake of making it. Project Managers don't ask, and nobody is looking at them, so they do not get the full effort as one would normally do. It is unclear that some of the deliverables being created are actually used, and if so who uses it as input.

	Process maintenance & continuous improvement
7.	Do you consider that there are any process improvements needed? Either in general, or within your specific functional area. I.e. If there was one change you could implement, what would it be?
	Yes, both on the high level and the functional area. It should be assessed what deliverables within the overall process are actually needed and that clear descriptions of their intention and output should be made. There are some that are unclear currently, and this leaves leeway for adjustment. And some are clear as to what they are asking for, but not to what level of detail. Overall a lack of involvement in the projects. Some projects there are no status meetings. It is understandable that the frequency should depend on the phase. Receive next to no information on the phase, and when the gates are planned for. Have been told to ask for information, but at some point that gets tiring. There is however a variation between the different project leaders and engineers.
7.1.	Are you aware of any specific planned improvements?
	No, not that I am aware of.
	Project execution
8.	What would you consider to be the typical challenges encountered preventing projects form meeting goals (such as gate review dates, completion)?
	The delivery dates are very optimistic. Sometimes the project work starts late due to lack of resources, but completion dates do not get adjusted. Project planning is not good enough. For the 'paper' deliverables it can be managed, but sometimes you're waiting for parts, and then when they come in, they do not fit, and then it is decision on redesign or modify, but this decision is taken based on the project schedule. No development cycles in the plans (schedules). This can be a showstopper, and we do not plan for the critical path.
8.1.	What KPIs are currently in use to measure the success of a NPD project? What about the product?
	None, that I know of
	Gate reviews & decision making
9.	Who are the gate decision makers?
	Voting system is used with the 'President' being the final decision maker. Has the impression that the President level has the ability (not necessarily the intent) to influence the others voting, Unsure on whether there are veto powers involved. No specific group identified.
10.	What are the criteria employed to determine whether a project will proceed through a gate? Options(if needed): • Readiness – Deliverables completed

	• Clear must-meet criteria, that if not met the project will not proceed • Critical quality requirements Some form of scoresheet?
	Gate deliverables should be used, and looked at what the status are. PowerPoint presentation, which is a summary of the deliverables to some extent.
11.	Are there clearly defined outputs from a gate review- I.e. action plan for the next phase, agreed deliverables for the next gate, commitment of resources (people and financial?)
	No it is just a decision on the work of the previous phase
12.	Budget and resource commitments. Are these verified, and if so, how. I.e. how resources calculated in total, and it verified that there are enough for all projects and ECRs? Are they verified and considered upfront?
	Does not look like it. Budgeting is presented in the PowerPoint presentation.
13.	**If applicable, depending on earlier answers.** Based on the previous section you have been working with development projects to some extent since the NPD process was introduced into the company. What improvements in development project performance would you attribute to the process?
	Cannot attribute any specific improvements to the introduction of the NPD.
	Process ownership
14.	Who owns the process and the defined deliverables for each functional area? Single person, Functional area process owner(responsible) (E.g. For project management who is responsible for dictating which deliverables should be reviewed as part of scorecard? Who validates the quality and completeness of the deliverables ahead of a gate review?
	For the specific project the assigned resource is responsible. Overall NPD owner is unclear at present. Previous ones were mentioned. The PM ensures that all the different deliverables are done, and the different department resources are responsible for the quality of the deliverables. There is no specific guideline for release, ti is done base don best judgment of the individual, as to who to involve.
	Training
15.	Is process training done? What about refresher training?
	Replaced by question 16 and 16.1. and 16.2
	Design for Manufacturability
16.	In your current position, did you receive any training on the NPD process? Both high-level process, but also functional areas specific?
	One hour introduction session, a few years ago. It was more of a here is the SharePoint

	site, figure it out for yourself.
16.1	If yes, has there been any refresher training?
	No refresher training.
16.2	What about DFM and DFA, any specific training or guidelines provided?
	No specific training or guidelines. It is done using individual knowledge and experience, and by having discussions with people in production and agreeing on the best solution. Standard training / guidelines on DFM DFA are not necessarily directly usable as they are too general, and there are specific considerations within our industry that are not covered.
17.	Has expectations and guidelines been given in terms of the process? I.e. how does it fall within the priorities of your other work? How to customize the deliverables… Are these clearly communicated from the PM and the line manager, and are these consistent?
	No. Prioritization is down to the individual. But everybody wants everything. If a conflict will raise with manager. Customization is done between the engineer and the PM, and then it is a matter if everybody agrees or disagrees.
18.	Are there existing guidelines for the review and release of the manufacturing deliverables from the NPD?
	It is down to the best judgment of the people that have the knowledge. There are however variations form business line to business line as to who should be used for customer documents. And there are conflicting messages on who to use.
19.	To your knowledge is a manufacturing representative required to sign off design reviews for new products?
	No, but maybe we should.
	Some additional points noted during the interview
	There are some overall benefits to be gained from cross-functional collaboration to ensure that we improve the overall output. AS what makes sense for one functional area, could make life very difficult for another.