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Master's Program in Industrial Engineering and Management

Development of the Operations Innovation Lab at Axis Communications

A process for managing the Front-End of Innovation

by

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Abstract

Innovation plays an increasingly important role in many sectors, and receives growing interest from companies, researchers and nations. Increasing attention has been paid to the Front-End of Innovation (FEI), the initial part of the innovation process, where proficiency has been shown to have the greatest impact on future innovation success. Research is however centered around product innovation in dedicated innovation teams. While such innovation remains a core driver of sustainable competitive advantage in companies, enabling other functions to innovate could allow them to scale more efficiently and further contribute to competitive advantage, if managed well.

In this single case study, a FEI process for Axis Communications' operations department (Operations) is proposed. Furthermore, key activities to conduct during FEI and Critical Success Factors (CSFs) for managing FEI at Operations are also identified.

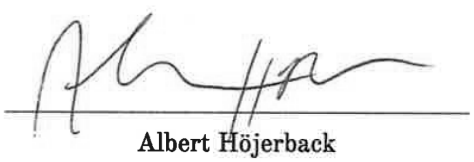
The study showed that a Stage-Gate process is well suited for Operations, and that both key activities and CSFs for Operations show large similarities with extant literature, as only minor modifications had to be made. Implementing the process is expected to (1) increase innovative output, (2) enable and improve the progression from opportunity to evaluable concepts, (3) enable the development of radical innovation and (4) engage and enable coworkers in innovative work. The results could serve as inspiration for future research into how FEI could be managed in broader settings, and in operations departments more specifically.

Keywords: Innovation process, Front-End of Innovation, Fuzzy Front-End, Critical Success Factors

Declaration

This Master's thesis has been authored in complete collaboration as a part of Master of Science degrees in Industrial Engineering and Management by two friends and students at Lund University, the Faculty of Engineering. Each author has been equally involved in every part of the process and contributed equally. The thesis has not been submitted for any other degree or certification than the Master's degree mentioned.

It is hereby declared that this thesis is solely the result of our own work, except where explicitly stated otherwise, and that all references, to the best of our abilities, have been accurately and honestly provided. Works used herein have been cited and referenced in accordance with standard referencing practices and credited to the original authors.



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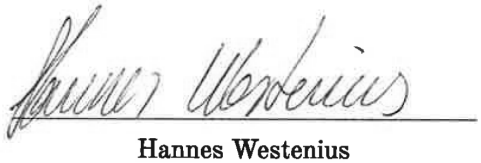

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We had a lot of fun writing this thesis, and hope that you will enjoy reading it!

Abbreviations and Vocabulary

Axis = Axis Communications
CSF = Critical Success Factor
FEI = The Front-End of Innovation
LOFA = Leap Of Faith Assumption
NCD = New Concept Development Model
OIL = Operations Innovation Lab
Operations (capital O) = The operations department at Axis Communications
VOC = Voice of Customer
R&D = Research and Development
TPFE = Three Phase Front End model

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1

Introduction

The introduction chapter aims to present the topics of Innovation and the Front-end of Innovation, as well as present the case study organization and research questions of this thesis.

1.1 Background

Innovation can be described as the creation of something significantly *new* and significantly *useful* in the eyes of a user (European Commission, 1996; OECD and Eurostat, 2018). It plays an increasingly important role in many sectors, and has received growing interest from companies, researchers and nations (OECD and Eurostat, 2018; Gassmann and Schweitzer, 2014). Entire research fields and educations have been dedicated to it, with motivations such as it being key to achieve or maintain competitive advantage and realize leaps in societal development (Swedish Ministry of Enterprise and Communications, 2012). While innovation literature still has a focal point on the later phases of the innovation process such as the actual development of new products, processes or other types of innovation, increasing attention has been put on the so called *Front-End of Innovation* (Koen et al., 2014; Frishammar and Florén, 2008).

The Front-End of Innovation (FEI) is a subset of the innovation process, reaching from the identification of a new possible innovation opportunity to the point where a decision is made on whether or not to pursue the opportunity further (Kohn and Hüsig, 2003). Simply put, the purpose of FEI is to determine *what* to develop or pursue. The increasing attention paid to FEI may stem from the numerous studies and scholars that have shown many Critical Success Factors (CSFs) for innovation projects relates to the Front-End, and that proficiency in some of the key elements in FEI is the greatest indicator of future innovation success (Koen et al., 2014; Cooper and Kleinschmidt, 1987).

While FEI is gaining increasing attention, the literature review conducted in this thesis showed that literature gaps still exists. First, a vast majority of FEI research has been conducted on product innovation, in spite of numerous product-centric articles pointing out the need for further research in other types of innovation domains (Kurkkio, 2011; Frishammar and Florén, 2008). Secondly, scholars have reached no consensus on key activities, and the sequence in which to perform them during the

FEI see Subsection 3.3.1. Thirdly, we found no articles where the FEI is discussed in an operations setting, instead most focus on research and development (R&D) departments. These are literature gaps which affected this thesis, and will in part be addressed.

1.2 Background of Case Study Organization and Issue of Study

This thesis is a single case study conducted in cooperation with Axis Communications (Axis), a market leader in high quality network video. Axis as a whole will not be studied, instead an in-depth study of their operations department (Operations) will be conducted which, together with the issue of the study and research questions, are presented below.

1.2.1 Background of Case Study Organization

Operations is comprised of five functions, see Figure 1.1, that are responsible for Axis' supply chain, quality, environmental impact, production preparation, sourcing and procurement while both production and logistics are outsourced. In Figure 1.2, Operations' activities are mapped in the traditional value chain for comparison. The inclusion of inbound and outbound logistics was made as Operations are responsible for coordination of these as well.

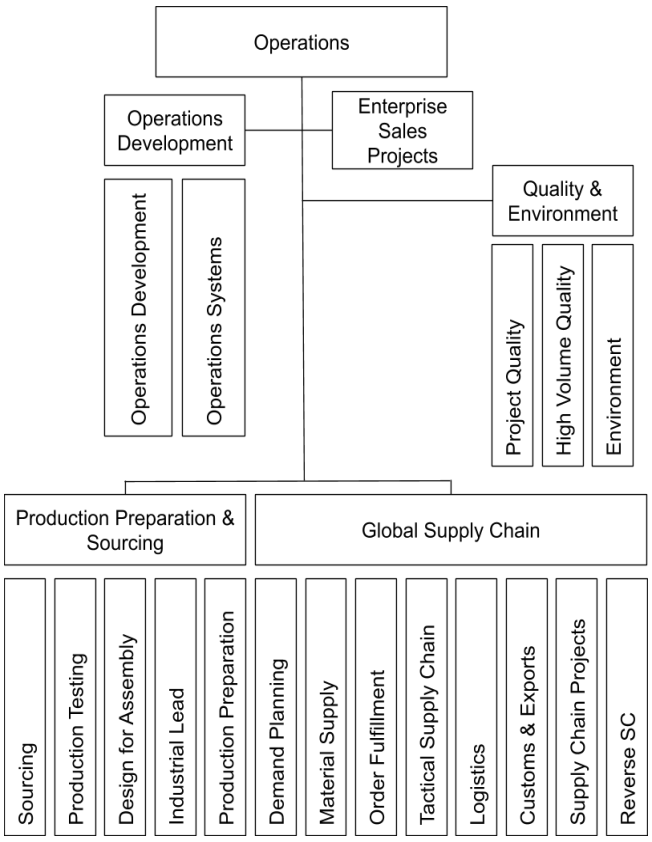

Figure 1.1: Operations' organizational chart

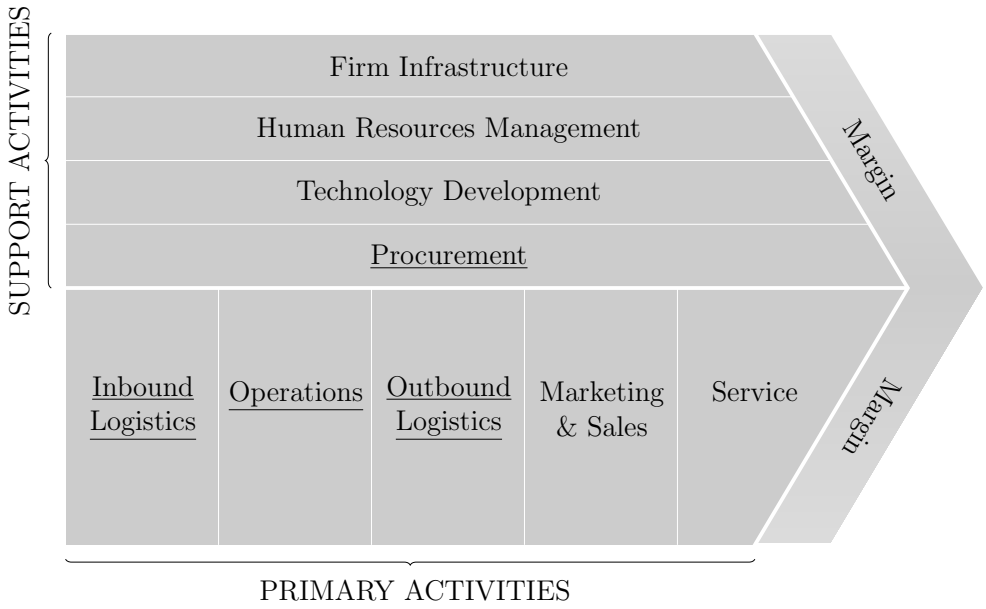

Figure 1.2: The value chain with Operations' activities underscored, adapted from Porter (1985)

In an innovation context, Operations is characterized by the fact that innovation efforts are not product specific, few coworkers are dedicated innovation resources, and coworkers have significant operative responsibilities. There is a process for large scale formal development of innovation in place, as well as smaller groups tackling local, incremental, smaller scale innovation.

1.2.2 Issue of the Study

Since the mid nineties Axis has grown rapidly and while product innovation has been a strength and strategic foundation of the company, the organizational ability to manage innovation within Operations needs further development (Lindroth, 2019). To cope with a projected doubling of sales the coming four years Operations are currently exploring ways of becoming more innovative, and will implement a side structure called *Operations Innovation Lab* (OIL) to realize this ambition (ibid). A study conducted by Boston Consulting Group found that the third most common obstacle when investing in innovation is the *difficulty of selecting the right ideas to pursue* (2010). According to Vice President of Operations Per Ädelroth, this is one of the biggest issues at Operations as well.

"It's not that we don't have ideas, it's that we need to understand how to evaluate them and quicker decide which to pursue further. [..]Currently, our only tool is a long and costly formal development process" (Ädelroth, 2019).

Ädelroth clarified the statement with explaining that a process for reaching a semi-concrete evaluable concept was missing, and needed (ibid). Furthermore, Lindroth described that Operations would benefit from an improved way of handling more radical ideas from their coworkers (2019). In combination, these factors call for a FEI process, which will be the scope of this thesis.

1.3 Purpose

The purpose of this thesis is to suggest a process design for the Operations Innovation Lab that allows an increased innovative capacity, through involving Operations' coworkers and by addressing the Front-End of Innovation.

1.3.1 Research Questions

More specifically this thesis will answer the following research questions:

1. What is a potential process for the Operations Innovation Lab that addresses the Front-End of Innovation?
2. What are key activities to conduct during the Front-End of Innovation at Operations?
3. What are Critical Success Factors for managing the Front-End of Innovation at Operations?

1.3.2 Process Goals

The design goals of the process are that it should:

- Increase innovative output
- Enable and improve the progression from opportunity to evaluable concepts
- Enable development of radical innovation
- Engage and enable coworkers in innovative work

These design goals will guide the development of a process and serve as criteria for evaluating the final outcome.

1.3.3 Focus and Delimitations

In this thesis we will suggest a process for OIL that targets FEI, and will take an identified opportunity as exogenous input. Thus, factors regarding the input, e.g. innovative culture and motivation of coworkers, will not be covered. Furthermore, the actual implementation of OIL and the decision of whether or not to do so, is out of scope. Knowledge management regarding the process is also out of scope. Finally, this thesis will investigate CSFs for managing FEI, but the current fulfillment or performance of these factors will not be studied.

1.3.4 Disposition

This thesis consists of 8 chapters, the contents of which are presented in short below:

1. Introduction
Innovation, Front-End of Innovation, case study organization and research questions are presented.

2. Methodology
Describes how the thesis was carried out.

3. Frame of Reference
Provides detailed background information on Front-End of Innovation related to the research questions, and ends with a process model suggestion - iteration 1 - for Operations Innovation Lab.

4. Learning Loop 1
Empirical findings are presented and analyzed, and Iteration 2 of the process model is created.

5. Learning Loop 2
Results of the final data gathering are presented and analyzed, resulting in Iteration 3.

6. Final validation
The results of the validation of Iteration 3 are presented and analyzed.

7. Conclusion
Answers to the research questions are presented in this chapter.

8. Discussion
The generalizability of the results, academic contribution and limitations of this thesis as well as suggestions for future research and suggested next steps for Operations are discussed.

2

Methodology

The methodology chapter aims to present how this thesis has been carried out. The chapter presents the research approach, research process, and methods for data collection and analysis. The chapter is concluded with a short discussion of the credibility of the thesis.

2.1 Research Approach

As the purpose of this thesis is to suggest a process for OIL at Operations, a normative single case study methodology was employed with an abductive research approach, as will be motivated below.

A *normative study* was selected as it is best suited for answering the suite of research questions and to fulfill the purpose of the thesis, i.e. creating a process. Normative studies aim to find a solution to an identified problem and are common in engineering research, argues Höst et al. (2006). In comparison, descriptive studies aim to figure out and describe something, exploratory studies seek to find deep understanding of a subject and explanatory ones seek causality and explanation for something (Yin, 1993).

A single case study methodology offered the greatest possible depth of understanding and high flexibility, which matches the purpose of this thesis, and is why it was chosen out of the following four methodologies described by Höst et al. (2006). (1a) Single case studies are apt at describing a phenomenon or object in depth, and are especially appropriate for studying contemporary phenomenon that are interconnected with their environment so that they cannot be studied in isolation. However, it does offer little in way of generalizability (Yin, 1994). Furthermore they are the best at providing comprehensive investigation and great depth of understanding (Feagin et al., 1991; Blair, 2016). (1b) Multiple case studies offer some additional generalizability and similar potential depth of understanding, but command much more time and resources. (2) Surveys are bound by a stricter methodology with the purpose of generalizing conclusions from a sample to a population and are appropriate when trying to describe something using quantitative tools. (3) Experiments, on the other hand, are designed to find causalities and explanations and examines a phenomenon

under strict parameters (Höst et al., 2006). (4) Lastly, action research is used to study something while continuously and iteratively improving it, which has proved powerful in applied science fields (Näslund, 2002). For this thesis, action research was first seen as viable and appropriate, but was later ruled out due to time constraints inhibiting the design, implementation and study of a process of this scale. As previously mentioned, a single case study methodology was selected, as it offered the greatest possible depth of understanding into a subject and high flexibility in its process.

An abductive research approach was used as it enables the development of new theory wile permitting flexibility, which facilitates the fulfillment of this thesis' purpose. There are three main research approaches: deductive, inductive and abductive (Spens and Kovács, 2006). Deductive research approaches aim at testing known theory, and starts with prior theoretical knowledge before building a theoretical framework, a hypothesis and finally testing it empirically to create knowledge. As its polar opposite, inductive research approaches construct new theories based on observations that build towards a hypothesis, proposition or general law (ibid). In reality, the greatest scientific discoveries have neither followed an exclusively deductive or inductive process, and many studies are in fact a combination of the two (Kovács and Spens, 2005). Kovács and Spens argue that an abductive approach is "*Systematized creativity or intuition in research to develop 'new' knowledge*" which is needed to "*break out of the limitations of deduction and induction, which both are delimited to establish relations between already known constructs*" (2005, p.136). The purpose of an abductive research approach is to develop new theory and understanding of a new phenomenon and, albeit with low ambitions of generalization, to apply developed hypotheses or propositions in an empirical setting (ibid).

The abductive research process starts, either from pure observations or from prior theoretical knowledge (as the inductive process) and proceeds into a learning loop of intertwined theory building and observations. Ultimately, the process develops hypotheses or propositions which are empirically applied in order to create knowledge (ibid). Abductive approaches are common in case studies and offer great flexibility of working process (Kovács and Spens, 2005). Dubois and Gadde argues that the full potential of case studies are unlocked in combination with an abductive research approach, and that they are otherwise only limited by linearity without learning loops (2002). Furthermore, an abductive approach is well suited for borrowing theory from adjacent research fields and for breaking new research ground (Spens and Kovács, 2006). Timmermans and Tavory argues that it is the most appropriate choices for "*[...] empirically based theory construction*" (2012, p.167). An abductive research approach was therefore selected for its aptitude in developing new theory and understanding of a new phenomenon while permitting a great deal of flexibility. It allows the building of an empirical understanding and theoretical framework in advance of creating a process suggestion, which might ultimately be applied and validated empirically. It should be noted that in lieu of a creating formal *propositions*, the end goal of the research is the process and its activities that will be suggested as a complete package to Operations.In Figure 2.1 all research processes are illustrated.

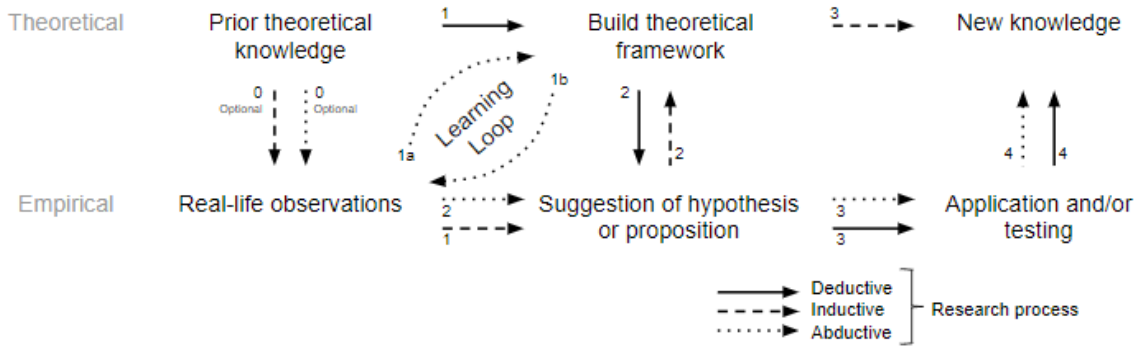

Figure 2.1: Deductive, Inductive and Abductive research processes. Adapted from Spens and Kovács (2006) and Kovács and Spens (2005)

2.2 Research Process

This thesis commenced with formulation of the background described in Section 1.2 through informal interviews and conversations with Operations coworkers and the supervisor of this thesis. Ultimately, this lead to the purpose, research questions and the process' design goals. Referring to the numbering in Figure 2.1, our abductive research process will be described below.

The research process started in the optional step 0, *Prior theoretical knowledge*, with the creation of chapter 3 which included formalizing an innovation theory starting point, creating a generic FEI framework, identifying general CSFs for managing FEI, and building a list of activities. This concluded in the first iteration of a process suggestion, Iteration 1.

Step 1a and 1b was the first *learning loop*, Learning Loop 1, between conducting *Real-life observations* and *Building theoretical framework*. The purpose of the observations was to test the theoretical contributions' validity at Operations and elicit input on the direction in which to improve and adapt it. Here, Iteration 1 was shown to key stakeholders, potential users and owners of the process, so that they could react to it, the CSFs, the activities, and provide input on key design parameters. This feedback was taken into account and analyzed to build further theory and adapt the theoretical results to Operations' reality, which concluded in Iteration 2, an improved process suggestion.

Next, Learning Loop 2 took place where Iteration 2 was shown to key stakeholders, potential users and owners of the process in a group interview forum. The purpose was to elicit feedback on the inconsistencies identified related to the first iteration. The group interview's results and the captured observations were analyzed in order to construct the final iteration, Iteration 3.

Step 2, *Suggestion of hypothesis or proposition*, is where Iteration 3, a final process suggestion for OIL is suggested.

In step 3, Iteration 3, was tested with key stakeholders, potential users and owners in a survey on how well the design was judged to meet its design goals.

Ultimately, in step 4, conclusions were made regarding the potential process' applicability to Operations and whether any general conclusions can be draw from the results.

2.3 Data Collection

The data collections will be described in the subsections to come. Initially, a literature review was conducted to formalize an innovation theory starting point and both identify and research building blocks for a FEI process further, see Section 3. Next, a series of empirical data collections took place, intertwined with building further theory in the form of process design iterations. These include interviews, surveys and a group interview, as will be described in detail next.

2.3.1 Literature Review

Building on existing knowledge is fundamental to good scientific methodology and ensures that academic resources are spent on advancing theory, which is why a literature review is an essential part of a thesis, according to Höst et al. (2006). As advised, this literature study started wide, in innovation literature, to build a rough understanding of the subject area before making initial selections and going deeper (ibid).

The method *Citation Pearl Growing* was used to delve deep into the right topics and dismiss others, which is considered a strong methodology for thesis work (Rowley and Slack, 2004). Starting in early relevant information sources, called pearls, a number of suitable terms, cited articles and authors are identified and researched further before the process repeats itself (ibid). During the process, informal interviews took place with coworkers at Axis where we absorbed knowledge and continuously scoped and realigned the study. This led to the increased relevancy of some articles above others and vice versa, and a bibliography with notes and references was built. Initially, three early relevant articles were (1) Cooper and Kleinschmidt's 1987 article *New Products: What Separates Winners from Losers?*, (2) Hansen and Birkinshaw's 2007 article *The Innovation Value Chain* and (3) Khurana and Rosenthal's 1998 article *Towards Holistic "Front Ends" In New Product Development*. Early search terms included "Innovation Process", "Supply Chain Innovation", "Bi-modal Supply Chain", "Intrapreneurship", "Corporate ventures", "Front-End of Innovation", "Critical Success Factors for Innovation" and "Management of Front-End of Innovation". In later stages of the literature study, the main terms used were: "Process", "Front-End of Innovation", "Fuzzy Front-End", "Management" and "Critical Success Factors" in different combinations. Ultimately, 103 sources were studied, out of which 64 were studied in detail. The nine most influential had a significantly large impact on the direction of this thesis and they are presented in Table 2.1.

Table 2.1: The 9 most impactful articles to this thesis

Authors	Published	Title
Bessant et al.	2010	Backing outsiders: selection strategies for discontinuous innovation
Cooper and Kleinschmidt	1987	New Products: What Separates Winners from Losers?
Frishammar and Florén	2008	Where New Product Development Begins: Success Factors, Contingencies and Balancing Acts in the Fuzzy Front End
Goodale et al.	2011	Operations management and corporate entrepreneurship: The moderating effect of operations control on the antecedents of corporate entrepreneurial activity in relation to innovation performance
Hansen and Birkinshaw	2007	The Innovation Value Chain
Johnsson	2018	Innovation Enablers and their importance for innovation teams
Khurana and Rosenthal	1998	Towards Holistic "Front Ends" In New Product Development
Koen et al.	2001	Providing clarity and a common language to the "fuzzy front end"
Xu et al.	2006	Total Innovation Management: A Novel Paradigm of Innovation Management in the 21st Century

2.3.2 Empirical Data Collection

Case studies are flexible in nature and typically utilize a variety of data collection tools (Tellis, 1997), most commonly interviews, observations and archive analyses (Höst et al., 2006). Höst et al. further states that survey tools are apt for collecting codifiable data, which can be used in combination with interviews (ibid). In the absence of a process to study, observations were ruled out, the other methods, however, were found to be useful in different applications.

Interviews and Survey

Semi-structured interviews were conducted with a stratified selection of interview subjects in the upper managerial levels of Operations, as well as innovation experts from other departments at Axis. Interviews in general provide great results if performed correctly, and are excellent for exploring new issues in depth or provide context to other findings as advised by Boyce and Neale (2006). They are however prone to bias and require good interviewing practices to be followed (ibid), which is why detailed interview protocols were designed, see Appendix A.1.

Semi-structured interviews were chosen in contrast to *structured* interviews that strictly follow prepared questionnaires or *unstructured* interviews were questions are asked as they come to the interviewers mind (Höst et al., 2006). Semi-structured interviews allow the use of both open- and close-ended questions (Tellis, 1997) and provides a balance between capturing nuances and details with finding codifiable majority views on design choices (ibid).

A stratified selection was made, splitting the entire population of possible interviewees consisting of Axis coworkers into *stratas* (groups). One strata was Innovation experts while the remaining consisted of Operations coworkers that where split into stratas based on reporting hierarchy and function. This is motivated for two reasons. First, this thesis is written under a 20 week time constraint, and to enable deep interviews, in line with the abductive research approach, they have to be limited in number. Secondly, the most applicable customers to this process design are directors and managers within Operations, a small group of individuals with experience in

designing work processes. From that group, a selection of those with relevant innovation experience or close future connection with the process was made with as great diversity and representation of different branches as possible. Innovation experts from other pars of Axis were also included to provide perspective and experience.

In the start of the first learning loop, Iteration 1 was to be evaluated and improved with key stakeholders, potential users and owners of the process. It was found that semi-structured interviews were most appropriate. The purpose was to evaluate applicability of the studied theory to Operations and get input on the design choices and trade-offs made. As a part of the semi-structured interviews, a short 5 grade Likert scale survey was utilized to find a majority view on the direction in which to alter design choices in coming iterations. See Appendix A.1 for the full interview guide for the semi-structured interviews.

Group Interview

When Iteration 2 had been created, it was presented in a smaller group interview as part of the second learning loop, designed as a semi-structured group interview. The purpose was to elicit input on the second iteration of the process while giving a chance for the group to reason with each other on points of inconsistency identified in the previous round of interviews so that a majority view or consensus could be found. In an effort to enable better group discussion, a smaller group was selected from the nine prior interviewees, based on their high level of engagement and influence in the organization. Group interviews are effective in settings where "*relationships among respondents are complex and views are diverse*" and can be used to find group opinion, consensus or disagreement (Frey and Fontana, 1991, p.178). They effectively uncover variations in opinion and allow the distinction of shared from dissociated views since participants naturally correct subtle variations, as identified by Schatzman and Strauss (1973). The technique is also apt for finding validation "*for previously gathered data via one-on-one interviewing*" and stimulate elaborations on opinions and views (Frey and Fontana, 1991, p.179). To fit the purpose, the interviewer took a passive role of only asking probing and open questions, as opposed to taking a directive role, see Appendix A.3. The latter is more fitting if the purpose is to test or triangulate. This was chosen instead of focus groups that are better suited for finding group *interaction* between interviewees and not *answers*, as found by Parker and Tritter (2006).

Survey

A validation of the final process suggestion, Iteration 3, was made using a survey. Surveys are efficient tools for collecting codifiable views from a population and when they are performed two aspects are of critical importance: *Selection* and *Question formulation* (Höst et al., 2006). First, the same selection as for the group interview was made to ensure that, in addition to earlier reasons, the respondents were intimately familiar with the subject matter so that they could provide valid input. Secondly, questions were designed with the principles suggested by Eljertsson (2005). Most notably, these include: simplicity of language, avoid leading questions, short and concise questions, mutually exclusive and collectively exhaustive alternatives and providing neutral options (ibid), as shown in Appendix A.4.

2.4 Data Analysis

The data produced in this study were both qualitative and quantitative in nature. However, to reflect the purpose of this single case study, the analysis was qualitative and designed to capture the depth of the data. According to Shields and Twycross the quantitative research focuses on leveraging statistical methods and numerical data, in contrast to qualitative methods that are apt at describing, exploring and going into detail (2003).

The interviews featured open questions that were transcribed, coded and grouped according using an *Editing Method*. Editing methods are suitable for finding patterns in content (Höst et al., 2006). More precisely, the answers to the questions were treated with the *Gioia method* of clustering, a systematic approach to grounded theory (Gioia et al., 2013). The Gioia method details clustering of first-order concepts (possibly quotes from interviews) into second order concepts, and so on, until appropriate aggregate concepts are found. These can be analyzed while keeping full transparency and traceability (ibid). In contrast to scrutiny-based tools, this provides qualitative rigor, and is more appropriate due to the limited sample size than quasi-statistical methods (Höst et al., 2006). Compared to key-word based methods Gioia clustering is more appropriate in cases of high complexity and ambiguity (Höst et al., 2006), such as this. The Gioia method of clustering further ensures traceability and enables validation of the study and comparison with theory (Gioia et al., 2013).

The closed questions produced quantitative data that were summarized in a heatmap respectively in histograms. Although quantitative, they were also analyzed qualitatively by comparing and contrasting to interview results in accordance with the purpose of this thesis. Furthermore, the sample size prohibits inference to larger populations and the use of quantitative methods such as statistical analyses was therefor not considered viable.

2.5 Credibility of This Thesis

When determining the credibility of a study the following three dimensions are often examined: (1) Reliability, (2) Validity and (3) Generalizability (Rosengren and Arvidsson, 2002). The different dimensions are discussed in turn in the following subsections.

2.5.1 Reliability

Reliability is a measurement of the consistency a method or instrument has over time and with different observers (Robson and McCartan, 2016), i.e. the extent to which a method or instrument yields the same result on different occasions with similar settings (Bell 2002). Reliability depends on the accuracy of the chosen research method or technique (Mason, 2002). In this thesis semi-structured interviews, surveys and literature reviews were conducted. To ensure a high reliability of the interviews both authors attended each interview, and crosschecked notes immediately after each interview and later on compiled them using the Gioia method to ensure that no traceability was lost. As advised by Boyce and Neale (2006), one of the

authors took a more passive role and ensured that the same questions were asked to all interviewees, and clarified questions or statements when needed. The person also intervened so that the interviewer did not accidentally ask leading questions, used the right body language and controlled their personal opinions. The stratified selection was made to represent diversity in hierarchy, function, expertise and underlying organization, in accordance with good practice (ibid).

The surveys that were conducted were either anonymous or conducted during the semi-structured interviews. While the reliability of the anonymous answers is seen as high, the fact that the interviewees answered the surveys during the semi-structured interviews in the presence of the authors may pose a problem as the respondents could have altered their responses to please the authors. However, during the interviews it was emphasized that all feedback would be greatly appreciated and that their honesty would ensure a better end result, thus this risk is believed to be negligible.

In the group interviews the techniques for individual interviews carried over as advised by Frey and Fontana, and special attention was paid to group dynamics and developing a setting where views could be freely expressed (1991). Since the group was familiar with working together and had a very democratic and non-hierarchical cohesion, it seemed as if they had no problem expressing views. Frey and Fontana also identified that one person's views might sway another's before opinions have been voiced. To mitigate this problem, special care was taken to ask for individual opinions after small group discussions before initiating free discussion where opinions could be swayed (ibid).

The reliability of the literature review is deemed high as thorough evaluation of sources, according to Rowley and Slack's recommendations (2004), and triangulation was used. This ensured that the overwhelming majority of literature used was from peer reviewed, published and cited academic articles or highly cited books by known authors in the field of innovation, and that other resources were valued accordingly. Triangulation was achieved in this thesis through using multiple sources used to corroborate a statement or claim, which is a widely adopted strategy to increase the rigour of a study (Robson and McCartan, 2016).

2.5.2 Validity

Validity concerns whether or not a study or measurement measures what it intends to measure (Robson and McCartan, 2016). To ensure high validity of the interviews a thorough selection of interviewees was made, as described earlier, and clarifying questions were asked to ensure that answers were interpreted in the correct way. Even though the majority of the interviewees lacked FEI-specific knowledge, their knowledge of Operations and managerial process design, combined with preparation material on FEI, included in Appendix A.3, leads the authors to believe that the validity of their answers remains high. However, the fact that the authors created the FEI-specific preparation material may have been a source of bias in some direction, but to avoid skewing their opinions the material was created in an objective manner and contained no information about our suggested process model. Furthermore, interviewees with large innovation experience from other departments than Operations

were also included. To further increase the validity of this thesis external interviewees could have been a good addition, but were excluded due to time constraints.

The validity of the literature review is deemed high due to the strategy that was used. As described in Section 2.3, the literature review first had an exploratory phase were multiple different keywords were used. This phase exposed the authors to many different aspects of the innovation field, which made sure that keywords that would be well suited for finding relevant articles were selected. Having decided upon the keywords, the citation pearl growing strategy ensured that relevant literature was studied. To avoid selection bias the citation pearl growing strategy was complemented with new literature searches with different keywords whenever a new topic was discovered.

2.5.3 Generalizability

The final frequently used credibility measure is generalizability, which measures the degree to which the results and conclusions can be inferred to a larger population (Rosengren and Arvidsson, 2002). The generalizability of a study depends highly on the selection of the studied population, thus single case studies are in general never generalizable (Höst et al., 2006). However, a thorough and detailed description of the setting and characteristics of a study and its population can increase the *transferability* of it, as the probability of another object behaving in a similar way increase if the context is similar (ibid). Transferability is a related measure, and it is defined as the extent to which knowledge can be applied in a different situation. In the analysis and discussion, a review of the result is made and their generalizability and transferability discussed in turn.

3

Frame of Reference

This chapter is a compilation of extant literature and it aims to provide a frame of reference for the reader, focusing on innovation and the Front-End of Innovation. The chapter is concluded with a process design section where the first process model suggestion for Operations Innovation Lab is created. Iteration 1, as it is called, is based on four building blocks defined in this literature study, and is then studied empirically in Learning Loop 1 in the next chapter.

3.1 Innovation

"*[Innovation is] the successful production, assimilation and exploitation of novelty in the economic and social spheres*" - European Commission (1996, p.9)

"*[Innovation is] a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)*" - OECD and Eurostat (2018, p.20)

As defined by the European Commission (1996) and the OECD and Eurostat (2018), an innovation is a combination of two aspects; something significantly *new* and significantly *useful* in the eyes of a user. Considering innovations' importance, it is no surprise that it has been studied immensely from various vantage points, and broken down into many typologies and taxonomies, which will be discussed below.

The OECD and Eurostat, differentiates between two fundamental types of innovation: *product* and *process* innovation (2018), depending on the object of innovation. Xu et al. (2007) further complemented this view by also adding *Organizational* and *Business Model* innovation, which will be used in this thesis.

Innovation literature commonly attempts to define and explore innovations in dichotomies around a focal point of some sort (Garcia and Calantone, 2002; Augsdörfer et al., 2013). For example, the dichotomous terms "discontinuous vs. continuous" consider company competencies, "sustaining vs. disruptive" consider market impact while the most frequently used terms "radical vs. incremental" consider *disruption* in a vaguely defined technical and market perspective. (Garcia and Calantone, 2002). Unfortunately, Garcia and Calantone also identifies that there is no consensus on the

definitions, which diminishes their usefulness greatly (ibid). Augsdörfer et al. came to the conclusion, in a highly comprehensive literature study, that the core elements of both *radical* and *discontinuous* innovation "*are too congruent to indicate a clear difference*", meaning that the phrases are practically synonymous (2013, p.31). In this thesis we will use the dichotomy "incremental vs. radical" - incremental innovations being those with little impact (technologically and for the user or market), low risk, and are closely related to current competencies, and radical innovations that are the opposite.

3.2 The Innovation Process

Innovation can be described as a process where an opportunity is converted into something beneficial that is deployed at a user. In a meta-study of innovation process models, Du Preez and Louw identified that most models involve some pattern of a combination of the following phases: (a) idea generation and identification, (b) concept development, (c) concept evaluation and selection, (d) development, and (e) implementation (2008). The literature study found that a three phase process was most common, as shown in Table 3.1, with low granularity in the early phases compared to Du Preez and Louw's findings.

In an attempt to find a consensus from the authors above, this thesis will define the innovation process in three phases as: (1) FEI, including phases from opportunity to a go/cancel decision for formal development, (2) Formal Development, a formal development process, (3) Launch, an implementation of the innovation. The frequently used term Commercialization was avoided to acknowledge that potential process, organizational and business model innovations might not be commercialized per se, but rather launched or implemented. Some models, especially those relating to Open Innovation, emphasize how a large number of potential innovations are reduced continuously through the innovation process with a funnel-illustration (Koen et al., 2001; Docherty, 2006; Du Preez and Louw, 2008). This thesis' definition of the Innovation Process is illustrated in Figure 3.1. The phases will be described in detail below.

Table 3.1: Three phased Innovation Process models are the most common in literature but define the phases in various ways

Source	Phase 1	Phase 2	Phase 3
Definition used in this thesis	Front-End of Innovation	Formal Development	Launch
Du Preez and Louw (2008)	Idea Generation Concept Development Concept Evaluation and Selection	Development	Implementation
Hansen and Birkinshaw (2007)	Idea Generation	Conversion	Diffusion
Cooper and Kleinschmidt (1987)	Predevelopment	Development	Launch
Koen et al. (2001)	Front-End of Innovation	New Product and Process Development	Commercialization
Docherty (2006)	Fuzzy Front-End	Development	Commercialization

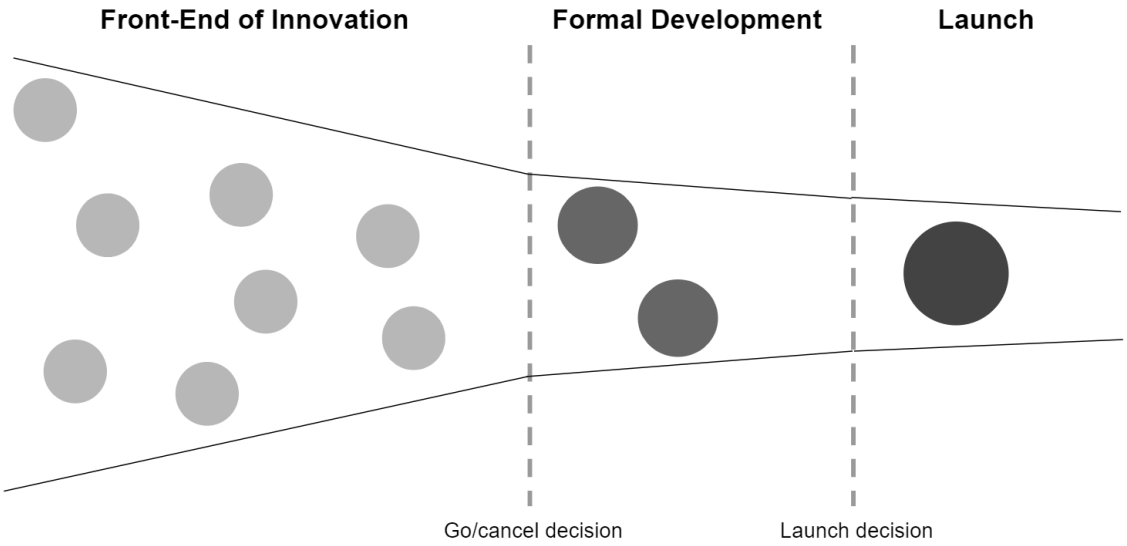

Figure 3.1: The Innovation Process phases

As FEI will be the focal point of this thesis, it is explained in detail under its own Section: 3.3 *Front-End of Innovation*. To give a brief overview: the phase takes a vaguely defined perception of an "opportunity" to the point where a concept of an innovation can be evaluated for Formal Development (Kohn and Hüsig, 2003). As Operations has a Formal Development process in place, and need a process for reaching evaluable concepts, improvements in the management of FEI could potentially be highly impactful.

The Formal Development phase starts when a concept has been approved for formal product or process development, and ends when another go/cancel decision has been made regarding Launch. This phase has been studied not only extensively (Brown and Eisenhardt, 1995; Andrade-Valbuena and Merigo, 2018), but also by many separate research fields such as "*[...] strategy, marketing, operations management, innovation, [and] engineering [...]*", due to its multidisciplinary applications (Andrade-Valbuena and Merigo, 2018, p.329). However, further study of Formal development literature falls outside the scope of this thesis.

Ultimately, the Launch phase is where a completely developed innovation is deployed to a user or customer, and starts when a decision is made that a developed concept is ready for launch. Much of the well cited innovation literature pay little attention to this phase (Cooper and Kleinschmidt, 1987; Khurana and Rosenthal, 1998; Koen et al., 2001; Du Preez and Louw, 2008). Instead, literature on commercialization and diffusion of innovation tend to cover the topic separately (with, in turn, little mention of the first two phases). Tidd et al. (2005) describes the need for marketing efforts and early customer involvement, a variety of exploitation models depending on ownership of innovation and tools to reduce uncertainty of market interactions, Utterback and Abernathy (1975) illustrates how a company's innovation focus shifts from product to process according to life cycle maturity, and Vernon (1979) introduced the product life cycle model describing exploitation and international import/export balances of innovation. However, the detailed study of Launch phase literature fall outside the scope of this thesis.

3.3 Front-End of Innovation

FEI is the initial part of the innovation process, and refers to the activities leading up to the go/cancel decision of starting a formal development process (Kohn and Hüsig, 2003). As observed by Kurkkio, research regarding FEI has been conducted almost solely from a product innovation perspective (2011). Thus, this thesis is forced to draw heavily upon product specific literature and through iterations with stakeholders strive to adapt the findings to a non-product innovation centered setting, which OIL likely will be.

Academia lacks consensus regarding key activities during FEI, its structure and processes (Florén and Frishamar, 2012). However, recurring descriptions are that during the Front-End an opportunity turns into an idea, which is further refined into a concept, which later is evaluated resulting in either a formal development project or cancellation (Kohn and Hüsig, 2003). Common activities include market and competitive analysis, financial analysis and technology and production capability assessments (ibid). FEI is typically hard to manage due to lack of reliable information as it usually exhibits low levels of formalization and contains both high uncertainty and uncontrollable factors (Ho and Tsai, 2011).

Although FEI is difficult to manage, its importance has been argued for among scholars at least since the late 1980s (Cooper and Kleinschmidt, 1987). There are two main themes of argued benefits from proficiency in FEI: (1) multiple CSFs for Formal Development and Launch are related to FEI, and (2) resource efficiency and effectiveness can be increased if well founded decisions can be made early (Cooper and Kleinschmidt, 1987; Khurana and Rosenthal, 1998; Florén and Frishamar, 2012). Starting with the former, Cooper and Kleinschmidt found that the three most critical success factors for Launch success all related to FEI: (1). Product Superiority (emphasizing the importance of screening at the end of FEI), (2) Proficiency of predevelopment activities, and (3) protocol (having a clear definition of the concept and its business implications in advance of Formal Development) (1987). Since Cooper and Kleinschmidt, multiple similar observations have been made, e.g. Khurana and Rosenthal identified that "*[..]the most significant benefits [for any new product development project] can be achieved through improvements in the performance of the front-end activities*" (1998, p.57). As for the second argued benefit, proficiency in FEI can allow long term resource efficiency and effectiveness as it enables management to early make an informed decision of which ideas and concepts to pursue further (Florén and Frishamar, 2012). This decision is facilitated by an early and precise filtering and prioritization of ideas and concepts (Kohn and Hüsig, 2003). This filtering not only saves the company money, as the total investment into a concept increases along the innovation process, but it also makes sure that the company's innovative resources are committed to the right ideas (Florén and Frishamar, 2012; Brown and Eisenhardt, 1995).

3.3.1 Processes for the Front-End of Innovation

In contrary to the Launch phase, where a structured process is widely accepted in both theory and practice, the topic of a process for FEI is still up for debate (Gaubinger and Rabl, 2014). Some scholars argue that there are cases where there is no need for a process at all, and they argue that it can reduce creativity and productivity in FEI (Khurana and Rosenthal, 1998; Koen et al., 2001), while others maintain that a formal process is needed to both reduce uncertainty and increase success rate (Kohn and Hüsig, 2003; Goodale et al., 2011). Goodale et al. found in a study on the effects of *Risk Control* and *Process Control Formality* on innovation performance, that Process Control Formality was positively related to innovation performance. Conclusively, Goodale et al. identified that "*The successful pursuit of innovation demands that managers approach the innovation challenge with the understanding that the means by which potentially desirable innovation outcomes might be generated can be well understood and deliberately constructed. There are rules, methods, and general process knowledge that can be brought to bear as resources in facilitation of successful innovation efforts. As such, it is often not the absence of rules and well-understood procedures that results in successful innovation (as one might infer from a cursory review of the popular business press), it is their presence*" (2011, p.124-125).

To gain further knowledge regarding FEI-processes, we conducted an exploratory literature review. The literature review revealed that there are three well-cited FEI process models suitable for the scope of this thesis, see Table 3.2. Google scholar, Scopus and Web of Science were consulted for citation data, and since all showed the same ranking as Google scholar, the other sources were omitted. The three models coincide with the ones mentioned by Gaubinger and Rabl (2014) as the three most frequently cited models, i.e.: (1) *Stage-Gate process*, (2) *Three Phase Front End Model(TPFE)*, and (3) *New Concept Development Model (NCD)*. In the sections to come, a short description of each model is presented. The description of Stage-Gate is based on Cooper (2016), TPFE on "*Towards Holistic 'Front ends' In New Product Development*" by Khurana and Rosenthal (1998) and NCD on "*Providing Clarity and a common language to the 'Fuzzy Front End'*" by Koen et al. (2001), for further details on the models the reader is referred to corresponding article.

Table 3.2: Sources of FEI-models and their number of citations

Source	Google scholar	Comment
Cooper (2008)	1394	Included
Koen et al. (2001)	963	Included
Khurana and Rosenthal (1998)	933	Included
Reid and de Brentani (2004)	815	Excluded due to different scope
Florén and Frishamar (2012)	103	Excluded due to few citations
Kohn and Hüsig (2003)	41	Excluded due to few citations
Kurkkio (2011)	32	Excluded due to few citations
Gaubinger and Rabl (2014)	24	Excluded due to few citations

The Stage-Gate Process

Presented in 1987 by Cooper and Kleinschmidt, the Stage-Gate is a process model for the entire innovation value chain. Since its inception numerous updates have been released where identified pain points have been addressed. The current standard model covers both FEI and Formal Development, where the FEI part of the model is from Discovery to Gate 3, see Figure 3.2. In a more recent article, Cooper defines a *stage* as "*a set of prescribed, cross-functional and parallel activities to be undertaken by the project team*" (2016, p.2). The stages lead up to a *gate*. A gate consists of required deliverable, i.e. what the project team must bring to the decision point, criteria against which the deliverables are judged and finally defined outputs e.g. a go/cancel decision and a list of future deliverables and time-line. In his 2008 article Cooper states that not all ideas need to go through all stages and gates, that some stages may be combined depending on the nature of the project, and that the gates are fuzzy and fluid allowing for iterations between the stages.

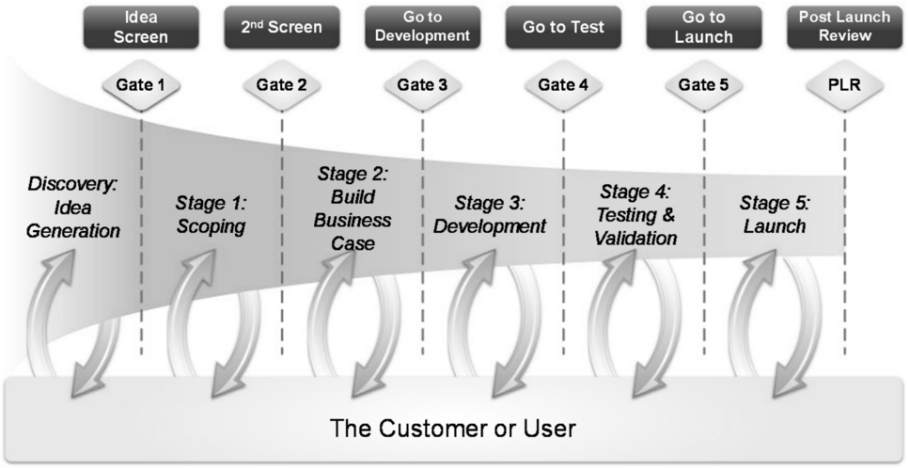

Figure 3.2: The Stage-Gate model, Cooper (2016)

The Stage-Gate process starts with the *Discovery* stage, which is a more or less formal stage aimed at finding ideas for further investigation. Common activities during the discovery stage is, according to Cooper, conducting primary technological research, working with lead users or strategic planning to identify new opportunities and using creative methods and mobilization of non-R&D employees.

Following the discovery stage is the first gate - *Idea screen*. The evaluation criteria at this gate is normally not of quantitative and financial nature but aims to assess the idea's potential, feasibility and fit with company policies and strategy. If an idea passes the first gate, resources are allocated to it and a project is created.

Gate 2 is fundamentally a more thorough version of Gate 1, complemented with simple financial calculations, based on preliminary market-, technical-, and business assessments which are the results of an investigation called the *scoping-stage*.

The last stage of FEI in the Stage-Gate process is Stage 2: *Build Business Case*. At this stage a detailed investigation is conducted in order to verify the projects attractiveness while remaining uncommitted to large expenditures. The deliverables for the

stage is a product or concept definition, a thorough project justification and detailed project plan. Key activities to meet the deliverables are concept testing, market and competitive landscape analysis and detailed financial and feasibility analysis.

Gate 3 marks the end of FEI where a formal development decision is made. If the decision is to continue the project, a full team is designated to development of the new concept and the Formal Development process is launched. This decision is based on similar criteria as in gate 2 but more weight is put on the financial analysis. The output of gate 3 is a go/cancel decision and if a go-decision was reached also an agreed upon product or concept and project definition.

Three Phase Front End Model

The next model to be discussed is Khurana and Rosenthal's Three Phase Front-End model (TPFE) presented 1998 in the article *Towards Holistic 'Front ends' In New Product Development*. While the article is mainly concerned with identifying Front-End success factors, it starts of by defining the Front-End. In the article it is stated that the Front-End includes product strategy formulation and communication, opportunity identification and assessment, idea generation, product definition, project planning, and executive reviews. Furthermore, the Front-End is divided into 3 phases: (1)*Pre-Phase Zero*, (2) *Phase Zero: Product Concept* and (3) *Phase One: Feasibility and Project Planning*, see Figure 3.3.

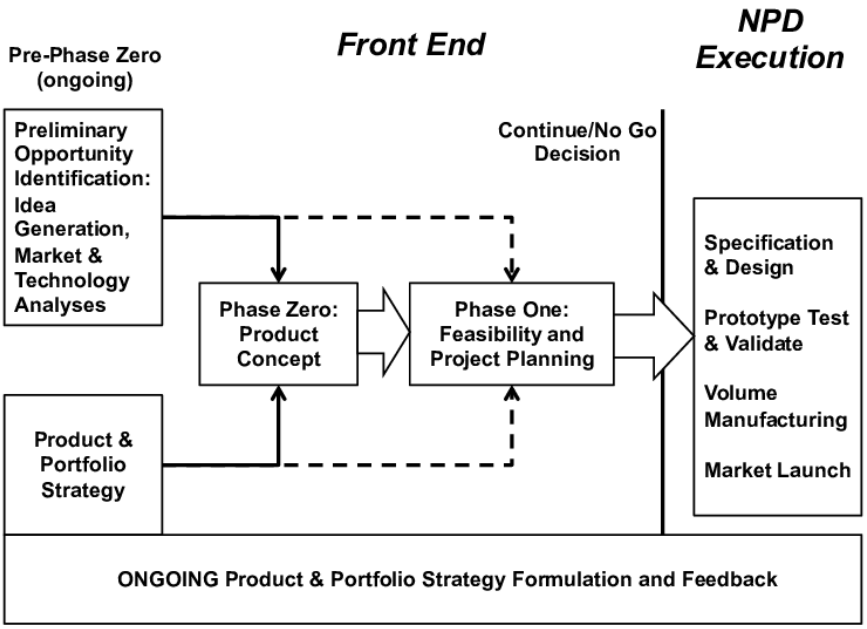

Figure 3.3: The TPFE model, Khurana and Rosenthal (1998)

Citing Bowen et al., Khurana and Rosenthal describe *Pre-Phase Zero* activities to be activities regarding three kinds of visions: about the business, the project, and the product. During this phase the idea is investigated in and of itself as well as in relation to business strategy and the current Formal Development portfolio (Bowen et al., 1994 according to Khurana and Rosenthal, 1998). Typical activities include idea generation, market analysis and technology appraisal.

If management deems a new opportunity worth exploring, phase zero is initiated and a core team is formed. The team's responsibilities include "*[..] a) identify customer needs, market segments, and competitive situations, b) perform a technology evaluation of current capabilities and requirements, as well as the alignment with existing business and technology plans, c) identify core product requirements, d) test the concept, e) specify the resources needed to complete the project, and, f) identify key risks and challenges*"(Khurana and Rosenthal, 1998, p.60). While Phase zero is more focused on developing and testing the concept, phase one focuses on the feasibility of the project including specifying needed resources and organizational support.

New Concept Development Model

The last of the frequently cited models for FEI is *The New Concept Development Model* presented by Koen et al. (2001). Despite describing the activities in FEI as often being chaotic, unpredictable and unstructured, Koen et al. introduced the term FEI as a replacement to "Fuzzy Front-End". This was done to get rid of the implication from the term "fuzzy" that the Front-End of Innovation is mysterious and cannot be managed.

In Koen et al.'s study a project team with representatives from eight large companies was formed, best practices were discussed and the NCD was synthesized. The NCD describes FEI using five elements: (1) *Opportunity Identification*, (2) *Opportunity Analysis*, (3) *Idea Genesis*, (4) *Idea Selection*, and (5) *Concept & Technology Development*. In addition to the five FEI-elements, NCD suggest that FEI is powered by an *Engine* consisting of the company's leadership and culture, and affected by *Influencing factors* such as the business strategy, competitive landscape, organizational capabilities and maturity of the technologies being used, see Figure 3.4.

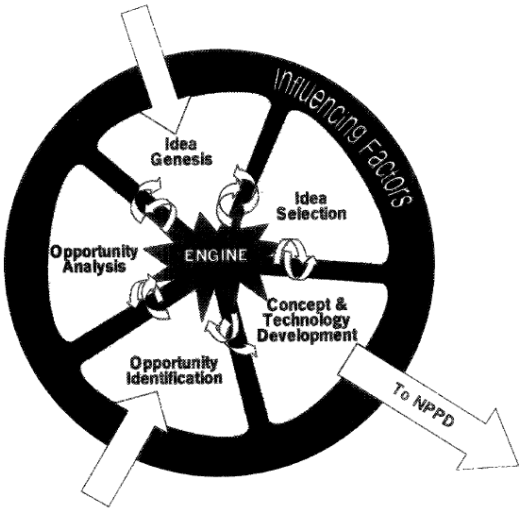

Figure 3.4: The New Concept Development model, Koen et al. (2001)

The elements will be discussed in a clock-wise progression, following Koen et al.'s structure, however as the authors note: "*[..] ideas are expected to flow, circulate and iterate between and among all the five steps, in any order or combination, and may use one or more elements more than once*"(2001, p.48-49).

Opportunity Identification is the element where new opportunities are recognized. Often driven by business goals, this element can contain both formal and informal tools and activities such as organized brainstorming- and problem solving sessions or simply ad hoc water-cooler discussions. Having identified an opportunity, further investigations are made in the Opportunity Analysis element often resulting in an initial technology and market assessments. Tools for analyzing a new opportunity include focus groups, market studies, competitive intelligence and trend analysis.

Idea Genesis is this element where an opportunity is turned into a concrete idea, and the result is a more developed description of the potential innovation. Throughout the Idea Genesis element, the emerging idea is examined, discussed and developed and contact with end-users and other sources of new perspectives are encouraged in order to stimulate creativity and alignment.

Idea Selection is the element concerned with selecting which ideas to pursue further. Although formalized selection processes are difficult to conduct in FEI due to a natural information shortage, Koen et al. suggest that idea selection models should take market and technology risks, investment levels, competitive realities, organizational capabilities and unique advantages as well as financial returns into account. Finally, Koen et al. also suggest that the selection should be done with less rigor, allowing for ideas to grow and advance in the process in spite of uncertainty.

Concept and Technology Development regards the development of the last deliverables needed to enter Formal Development, a business plan and project proposal. The business case is developed based on the factors of the idea-selection as well as overall project risk, and its formality depends on the business culture and nature of the opportunity.

3.4 Building Blocks for the Process Design

Having studied the well-cited processes, and relevant FEI literature, the following four building blocks for a FEI process was identified:

- A generic FEI framework for understanding the phases of FEI
- Activities to perform within the process
- A list of the roles involved in the process
- Critical Success Factors to account for during the design and the use of the process

These building blocks are defined in the following sections. Together, they will be used to form a process that accounts for CSFs and guides actors through the progression of the FEI phases and activities.

3.4.1 Generic FEI Framework

Our literature review confirmed the lack of consensus regarding key activities, analyses and the order in which to do them that Florén and Frishamar (2012) observed. However, the study of the three most cited FEI-models resulted in a generic FEI-framework, and a list of activities and analyzes which will later be used as the foundation for the OIL-process.

We found that FEI consists of four major thematic phases, that a potential innovation iterates through while being continuously assessed. The framework, as illustrated in Figure 3.5, shows these phases in a suggested logical progression from left to right, although there is no consensus on the order in literature. As it is developed, an opportunity's potential impact, feasibility and fit with the organization is intermittently analyzed with, increasing scrutiny and intensity.

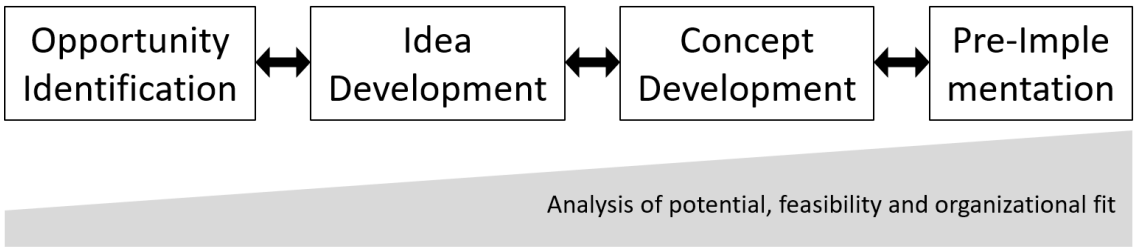

Figure 3.5: A generic FEI framework consisting of four phases. Continuous screening with increasing rigour is performed throughout, although it is important to note that there is no consensus on the order in which the phases must be undertaken

Opportunity Identification is where activities are conducted to find and interpret opportunities for innovation e.g. an unmet customer need. When an opportunity has been identified and deemed to have enough potential and feasibility to be pursued, another set of activities are conducted in order to find ways of exploiting the opportunity. This phase is called *Idea Development*, and results in an *idea* which is a general direction for a solution or opportunity exploitation strategy. During the next phase the idea is transformed into a more concrete *concept*, where key requirements of the

concept is identified and potential implementations considered. With a concept in place, the *Pre-Implementation* phase starts with investigating more explicitly *how* and *if* said concept can be developed.

For further understanding of the FEI-framework, consider how the FEI-framework could be applied to the famous 90 kilometer long Swedish ultra-ski-marathon *Vasaloppet*. Imagine a fictional scenario of how their Blue Berry Soup Checkpoints (stations where the participant each 15 kilometers gets blue berry soup and water) could have passed its FEI part of the innovation process.

A coworker in the race organization noticed that participants needed extra energy during the long grueling race. This opportunity seemed interesting and the need for additional energy was therefore verified with friends who had completed the race. Thus ***Opportunity Identification*** *was complete. Next,* ***Idea Development*** *began with discussions in the organization and with recurrent participants about how to solve the problem. Suggestions that perhaps the organizers could arrange something for competitors at various stages of the race came up. With this broad direction of what needed to be done, the* ***Concept Development*** *phase started, where organizers interviewed competitors and found out that energy supplements during the race indeed was a good idea and that it should be easily absorbed, quick to consume and not hamper their performance. Multiple possible concepts were tried, but blue berry soup at different stations during the race was the most popular and thus a viable concept was created. Now, the organization conducted analyses, as part of the* ***Pre-Implementation*** *phase to make sure that if they would pursue the blue berry soup stations they would afford it, and be able to supply it, thus creating a formal development concept i.e. a viable concept with a clear implementation plan. The formal development concept was ultimately presented to the board, and it was decided to develop the innovative solution, find the best recipes, talk to suppliers of tents and launch the innovation the next year, which concluded the FEI part of the innovation process.*

3.4.2 Activities

In Table 3.3, key activities and analyses mentioned in the three studied articles are summarized. The reader should note that in the analysis of the three models in this subsection, neither of the articles present a prescriptive list of activities to conduct during each phase of FEI, but rather gives examples of possible key activities. Thus, the list of activities suggested by the articles is likely non-exhaustive. Furthermore, the articles disagree on the order in which activities should be conducted. Koen et al. states that an idea is expected to flow between the elements of FEI and thus prescribes no specific order of activities at all, Khurana and Rosenthal on the other-hand aggregate the activities for both *concept development* and *Feasibility and project planning*, leaving it to the reader to interpret in which order they are supposed to be executed. Only Cooper presents a clearer set of recommended activities per phase.

In Section 3.5 an initial suggestion of a FEI process for Operations will be suggested, where both a preliminary selection of activities and analyses suitable for Operations' needs will be made, as well as a sequence proposed to later be discussed and adjusted according to input from key stakeholders.

Table 3.3: Key activities and analyses compiled from studied models

Activities or Analyses	Description
Activities	Primary research
	Strategic planning
	Creative methods e.g. brainstorming
	Problem solving sessions
	Contact with customers or users
	Cross-functional discussions
	Design iterations and evaluations within the team
	Concept testing
	Identification of core requirements
	Test or develop needed technology
	Project plan creation, and resource estimation
Analyses	Alignment with company policies, existing business and technology plans
	Market analysis
	Trend analysis
	Financial analysis
	Competitive landscape analysis
	Technology and partnership assessment
	Organizational capability assessment
	Feasibility and risk assessment of project plan

3.4.3 Roles in FEI

In the context of a process for FEI, there are several roles to consider. Notably Tidd et al. (2005) identifies a list of roles which include: *Inventor (or Innovator)*, *Organizational Sponsor*, *Team Members*, *Team Leader*, *Information Gatekeeper* and *Business Innovator* which are defined in Table 3.4. The inclusion of Team Leader is contingent on there being a team, which might not always be the case. However, as identified by Johnsson (2016) "*it has been proven that multifunctional- or cross-functional teams in general perform better than a single individual*" since a range of knowledge can improve idea generation and avoid internal rivalry (Johnsson, 2016, p.3). Furthermore, Johnsson found that innovative performance as measured by output, cost reduction, risk sharing, and time to market, for example, has been shown to be improved when using teams (2016).

The term *Champion* is also frequently used in innovation literature, which involves "*[...]selling the idea to the management and getting the management sufficiently interested in the project*", done by a person who "*is intensely interested and involved with the overall objectives and goals of the project and who plays a dominant role in many of the research-engineering interaction events through some of the stages, overcoming technical and organizational obstacles and pulling the effort through its final achievement by the sheer force of his will and energy*" (Chakrabarti, 1974, p.58). Comparing Chakrabarti's to Tidd et al.'s views, the champion role seems to be able to be undertaken by both Inventor and Organizational Sponsor, or a mix of the two. In Frishammar and Florén's CSF review, presented in Section 3.4.4, the presence

of such a champion is identified as a CSF by many FEI scholars, and several other CSFs are related to actions performed by the role (2008).

When innovative work is to be performed by individuals inexperienced with the process, Johnsson found that another role, the *Facilitator*, is key (2018). A role whose responsibility it is to educate, advise and raise the company's awareness of innovation, and guide individuals, teams and departments through the innovation process (ibid). It has been identified that high involvement of non-R&D personnel in innovative work increases innovative capacity in companies (Bessant, 2003; Xu et al., 2007; Tidd et al., 2005), and in the case of such a strategy, Facilitators are of central importance.

Furthermore, to satisfy the second CSF identified in Frishammar and Florén's review (2008), someone has to perform a screening. Similarly, both Cooper and Kleinschmidt and Khurana and Rosenthal mention needing a gatekeeper of some sort to complete screening in their suggested innovation processes, which is why *Gatekeeper* is also added the list of roles summarized in Table 3.4.

Table 3.4: Roles in FEI as identified and defined in this literature study. Note that they are not necessarily mutually exclusive, and some roles could be held by a single individual in some cases

Role	Definition
Inventor or Innovator	The source of critical technical knowledge
Champion	Selling the idea to management and stakeholders, often the inventor or team leader responsible
Team member	Part of the development team
Team Leader	Leading the team, either as a part of the team or outside of it, and "paving the way" in the organization
Facilitator	Guiding Innovator and Team, as well as advising, educating and raising awareness of innovation in the company
Gatekeeper	An individual or a group, often senior, who evaluate and decide on an innovations' viability for continued progression
Information Gatekeeper	A person who connects people, information and competencies through networking
Business Innovator	An organizational champion who drives the process progression and ensures a connection with the broader market and user perspective
Organizational Sponsor	Pulls strings in the organization, procuring resources. A person of power and influence

3.4.4 Critical Success Factors in FEI

Critical Success Factors are factors that substantially impact the success of a process or activity and that must be performed well. In the scope of this thesis, they are interesting since they provide design parameters to consider in the design of OIL's process as well as consideration for the management of FEI. Several scholars have studied the subject, and meta-studies have been made, as will be shown below.

The earliest contributions to FEI-specific CSFs came from Cooper and Kleinschmidt who, as previously mentioned, empirically tested FEI-specific and other general innovation CSFs in 1987 in a study of new product launch successes and failures (1987). They identified, among several CSFs, that; proficiency of predevelopment activities, and Protocol (having a clear definition in advance of Formal Development) were the best predictors of product success. In their concluding remarks, they also noted that both of these CSFs are controllable variables rather than situational or environmental (ibid).

Khurana and Rosenthal (1998) made prominent contributions to the field in 1998 when they not only defined a process for managing FEI, as mentioned above, but also studied FEI-specific CSFs in a multiple case study of Fortune 500 (or Japanese equivalent) companies from Japan and the U.S. with Formal Development processes in place. They found 14 CSFs and that successful companies approached FEI management with a holistic view and noted that a major shortcoming of many companies was the poor translation of business goals into guidelines for FEI - exacerbated by difficulties of providing leadership in the stage (ibid).

In 2000, Koen identified 10 CSFs for successfully receiving funding at the end of the FEI phase in interviews with product champions who participated in his course (2000). As an example, the most important CSF was "*product fit with corporation's long term strategy*", and all CSFs were categorized into the buckets Team, Strategic Fit and Material Impact on Corporate Performance (Koen, 2000, p.5).

Ultimately, in 2008 Frishammar and Florén (2008) published a very comprehensive literature review on *CSFs for managing the front end* as identified in FEI literature specifically (as opposed to Kohn and Hüsig (2003) who made a similar, and also highly comprehensive, review on both Formal Development literature and FEI literature). We will henceforth accept Frishammar and Florén's identified CSFs in their entirety in the writing of this thesis because of their explicit applicability to the FEI stage and since the seminal works mentioned earlier in this section are included in their meta study. The CSFs are presented in Table 3.5, without any particular order. Frishammar and Florén further comments that these CSFs are influenced by product innovation specific settings, and would likely be somewhat different in other settings (ibid).

Table 3.5: Critical Success Factors for managing the Front-End of Innovation, Frishammar and Florén (2008)

Critical Success factors for managing FEI	Obtained from literature
1. The presence of idea visionaries or product champions	Conway and McGuinnes (1986); Griffiths-Hemans and Grover (2006); Heller (2000)
2. Idea refinement and adequate screening of ideas	Boeddrich (2004); Bröring et al. (2006); Conway and McGuinnes (1986); Cooper (1988); Cooper and Kleinschmidt (1987); Elmquist and Segrestin (2007); Griffiths-Hemans and Grover (2006); Khurana and Rosenthal (1997); Kohn (2005); Lin and Chen (2004); McAdam and Leonar (2004); Murphy and Kumar (1996; 1997); Rosenthal and Capper (2006); Zien and Buckler (1997); Verworn
3. An adequate degree of formalization	Boeddrich (2004); de Brentani (2001); Gassmann et al. (2006); Khurana and Rosenthal (1997; 1998)
4. Early customer involvement	Alam (2006); Bacon et al. (1994); Cooper (1988); Cooper and Kleinschmidt (1987); Gassmann et al. (2006); Langerak et al. (2004); Murphy and Kumar (1997); Verworn (2006); Zien and Buckler
5. Internal cooperation among functions and departments	Bacon et al. (1994); Conway and McGuinnes (1986); Gassmann et al. (2006); Heller (2000); McAdam and Leonar (2004); Moenaert et al. (1995); Murmann (1994); Kohn (2006); Verganti (1997); Verworn (2006)
6. Information processing other than cross-functional integration and early customer involvement	Bacon et al. (1994); Börjesson et al. (2006)
7. Senior management involvement	Koen et al. (2001); Khurana and Rosenthal (1998); McAdam and Leonar (2004); Murphy and Kumar (1997)
8. Preliminary technology assessment	Bacon et al. (1994); Cooper (1988); Cooper and Kleinschmidt (1987); Murmann (1994); Verworn (2006)
9. Alignment between NPD and strategy	Bacon et al. (1994); Khurana and Rosenthal (1997; 1998)
10. An early and well defined product definition[1]	Backman et al. (2007); Bacon et al. (1994); Cooper (1988); Cooper and Kleinschmidt (1987); Dickinson and Wilby (1997); Khurana and Rosenthal (1997); Kohn (2006); Montoya-Weiss and Calantone (1994); Montoya-Weiss and O'Driscoll (2000); Parish and Moore (1996); Seidel (2007); Song and Parry (1996)
11. External cooperation with others except customers	Khurana and Rosenthal (1997); Murmann (1994)
12. Learning from experience capabilities of the pre-project team[2]	Verganti (1997)
13. Project priorities	Khurana and Rosenthal (1997); Murphy and Kumar (1997)
14. Project management and the presence of a project manager	Khurana and Rosenthal (1997); Nobelius and Trygg (2002)
15. A creative organizational culture	Murphy and Kumar (1997)
16. A cross-functional executive review committee	Khurana and Rosenthal (1997)
17. Product portfolio planning	Khurana and Rosenthal (1997)

[1] *Early* is defined in relation to Formal Development
[2] *Pre-project* team refers to the FEI team

3.5 Process suggestion for the Operations Innovation Lab, Iteration 1

This thesis aims to suggest an operating process for the Operations Innovation Lab at Operations. After summarizing the literature study in a framework (Subsection 3.4.1), compiling a list of activities 3.4.2, identifying roles (Subsection 3.4.3), and finding CSFs for managing FEI (Subsection 3.4.4), an initial process iteration will be suggested in this Section. The process will map onto the generic framework, include activities and roles identified, and be designed to account for all CSFs. As each CSF is accounted for by a specific design choice during the next section, it will be mentioned.

At Operations there are already department specific groups that handle incremental, local innovation, a Formal Development process for managing large projects, and as identified in interviews (Lindroth, 2019; Ädelroth, 2019) a culture that enables innovative thought and personal initiative. However, a need to increase innovative output, manage radical innovation, involve coworkers and better reach evaluable concepts has surfaced. These needs collectively indicate that there is a discrepancy between the management of FEI at Operations and what is needed in theory. The suggested process will encompass the activities in FEI, from a coworker's suggestion of an opportunity to the point where a decision has been made regarding Formal Development, and the process will be owned by the Operations Innovation Lab as it is known internally.

3.5.1 Process Design

A process is a set of linked activities that transforms an *input* from a supplier into an *output* for a user/customer and is managed by a process owner (Davenport, 1993), as shown in Figure 3.6. In more complex varieties, a process map can also include supporting resources, stakeholders and control entities, for example. Davenport further emphasizes how inputs and outputs should be "*clearly identified*", in order to create an actionable guiding tool for organizations that puts an emphasis on "*improving how work is done*" and on taking the customer's perspective (1993, p.5).

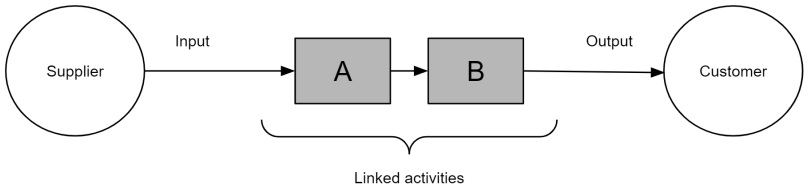

Figure 3.6: A Generic Process Model

Process Boundaries and Definition

The suggested process for OIL maps to the FEI framework defined in Section 3.4.1 to ensure a smooth progression through FEI and into Formal Development. It takes a *defined opportunity* (an opportunity that has been analyzed and considered by the coworker) from an Operations coworker as its input and produce a *formal development concept* (see definition under Section 3.5.1) and a decision on Formal Development

to the process' customer as its output, see Figure 3.7. The choice of input was done by request of Operations, as a process where non R&D coworkers could pursue their own ideas was wanted. For that reason, the first phase of this thesis' generic FEI framework, Opportunity Identification, is considered out of scope of the lab's working process. The choice of output was made for two reasons. First, having an early and well defined product or concept definition was identified as a CSF for managing FEI (Frishammar and Florén, 2008). Secondly, having a decision on Formal Development as output of the process integrates well with the rest of the innovation process. To reach the desired output successfully, the opportunity must be developed, analyzed and tested.

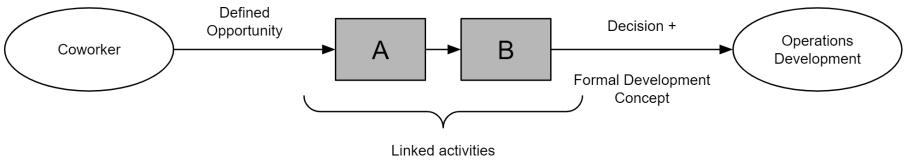

Figure 3.7: The process will take a defined opportunity as its input and produce a decision on Formal Development as its output

Process Structure

To enable an efficient progression through the theoretical FEI phases, with ample room for both creative freedom for innovators and control for management, the suggested process utilizes a stage and gate structure, as was used by Cooper in the Stage-Gate model (see Section 3.3.1). This is done with Frishammar and Florén's CSFs *An adequate degree of formalization* in mind and attempts to find a good middle ground (Frishammar and Florén, 2008). The suggested structure attempts to combine the best aspects of the three FEI processes studied in Subsection 3.3.1 and a balance between the excessive rigour of the TPFE model, the lacking structure of the NCD model, and the low granularity of the Stage-Gate model. It also allows for both *idea refinement and adequate screening of ideas* if designed properly, which was the most commonly occurring CSF in Frishammar and Florén's literature review (2008). As defined earlier in Section 3.3.1 a stage involves a set of activities that lead up to a gate where a deliverable is measured against criteria. In our model, a decision of go/cancel/hold/reiterate will be given to each innovation as it passes a gate, as will be elaborated upon later in this section. Although the process is most easily drawn and described as if it were a linear one, it is important to note that a hold decision or a reiterate decision breaks linearity and returns the process to earlier stages.

The suggested process consists of four gates and three stages that transform a defined opportunity into an idea, a concept, and ultimately a formal development concept, as shown in Figure 3.8. As the process culminates with the Formal Development Gate, the final output is both a decision on launching a formal development process and the formal development concept itself.

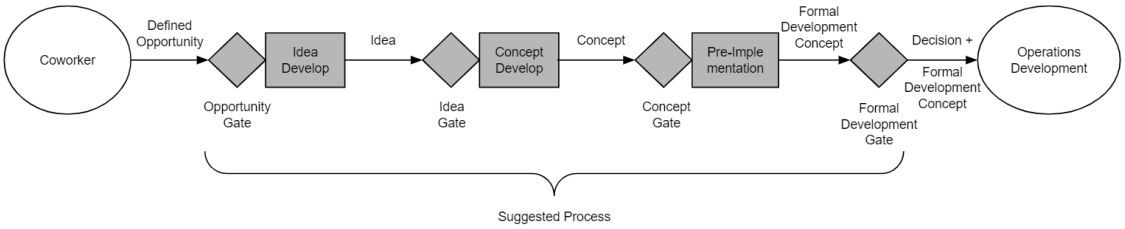

Figure 3.8: The suggested process

The primary theoretical phase Opportunity Identification is exogenous to the scope of this process, meaning that it is expected of coworkers to innately, and without support, identify opportunities and consider them to the point that they may be presented to the Opportunity Gate.

Stages and Activities

The process is divided into three stages, which will in turn be described below. In the stages we have laid out a situationally adaptable toolbox of activities in what we found to be the most logical sequence, which will later be adjusted according to feedback from Operations. Furthermore, some of the activities in Table 3.3 are divided into sub parts (e.g. *Identification of core requirements* was divided into *Use Case analysis* and *Concept requirement and definition*) for increased flexibility and readability. We have also added two activity that was not found in the previous models, namely *Formulation of Leap of Faith Assumptions* and the *Testing* of them. Leap of faith assumptions are assumptions that need to hold for an innovation to viable, and are important to formulate to ensure that opportunities and ideas can progress in the face of uncertainty (Ries, 2017). As FEI is characterized by a lack of reliable information and uncontrollable factors it is critical to be able to progress despite uncertainty (Ho and Tsai, 2011; Frishammar and Florén, 2008; Koen et al., 2001).

Once the defined opportunity passes the Opportunity Gate, the potential innovation is inside the OIL process. Now, Idea Development starts, where key activities include: understanding the customer or end-user, brainstorming on potential solutions, and initial feasibility analysis, see the full list in Figure 3.9. What was an opportunity, a potential need or possibility, or a technology, is now transformed into a more concrete idea of what type of solution might be viable to a certain need. Ultimately, this idea is developed to the point where it can be presented to the Idea Gate, where an evaluation is made and another go/cancel/hold/reiterate decision awarded. As *early customer involvement* is identified by multiple authors as a CSF for FEI (Frishammar and Florén, 2008), small scale customer or end-user interactions can preferably be carried out at this stage. Furthermore, *Internal cooperation among functions and departments* is the third most cited CSF in Frishammar and Florén's literature study, and it is therefore suggested that cross-functional discussions and interactions are carried out throughout the entire Innovation Lab Process. In addition, *information processing other than cross-functional integration and early customer involvement* is also recognized as a CSF in the aforementioned study, which is captured by e.g. trend analysis in this stage, and benchmarking in the latter stages.

In the Concept Development stage, the idea is transformed into a concept through a number of key activities such as: identifying core requirements and proof of concept creation and testing. As in the TPFE model, the focus shifts gradually from an innovation's potential impact to its details and feasibility. This transforms the idea into a concept, which is later presented for the Concept Gate where it is given another go/cancel/hold/reiterate decision. If applicable, a preliminary technological assessment can be made in this stage. This has been identified to be significant since proficiency in this activity was found to be strongly linked to Formal Development success (Cooper and Kleinschmidt, 1987), and a crucial way of reducing uncertainty before an investment (Frishammar and Florén, 2008).

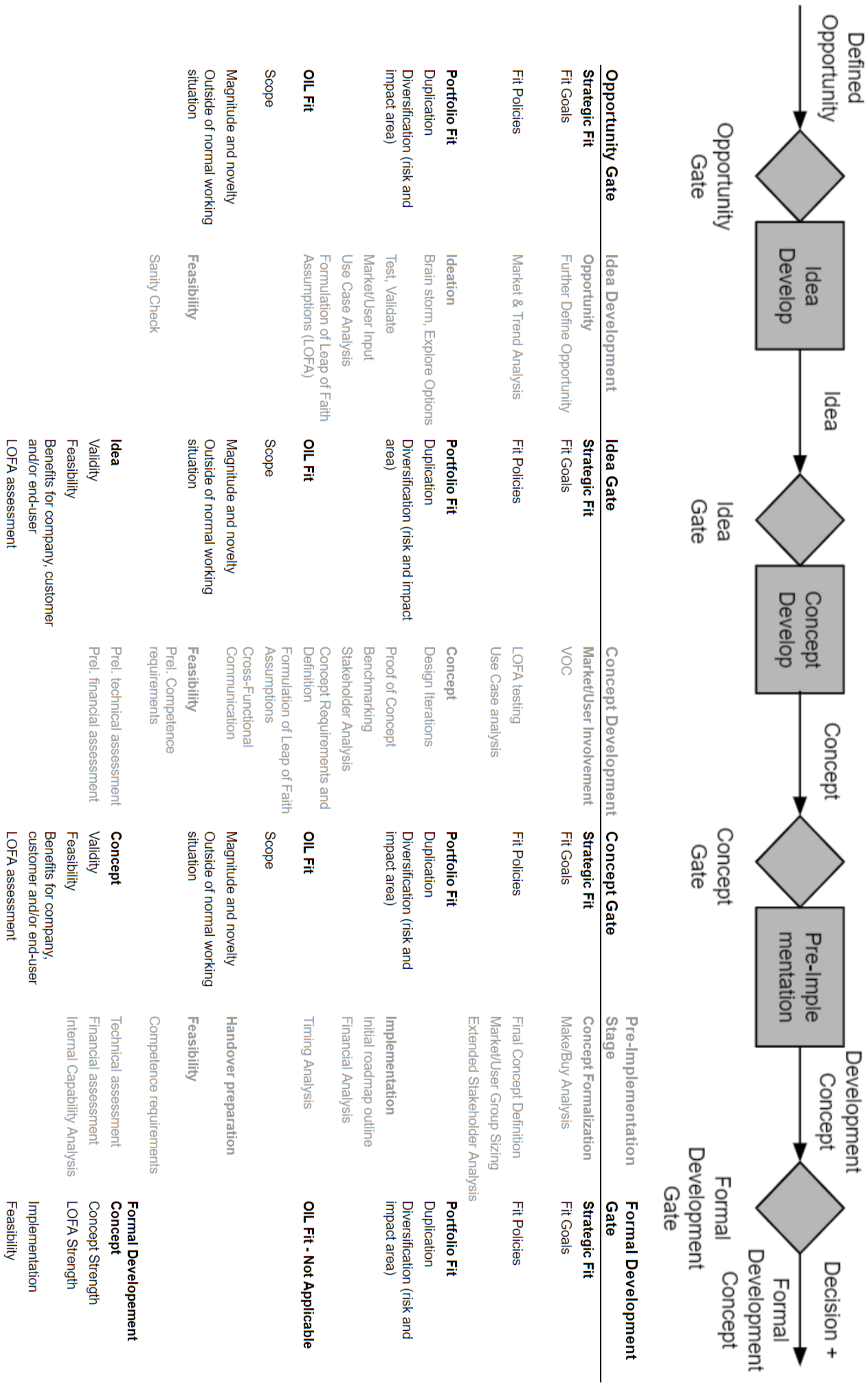

Figure 3.9: The suggested process, Iteration 1, in its entirety. Activities and criteria that could be used are suggested below each stage or gate, respectively

When the concept is approved and enters the Pre-Implementation Stage, the focus shifts from the concept itself to its realization and business consequences. Activities in this stage include analyzing internal capabilities to see if they match the concept's requirements, constructing an initial implementation plan and a more thorough financial and technical analysis. Ultimately, this will transform the concept to a formal development concept that can be evaluated for Formal Development, which happens at the final point in the process, the Formal Development Gate. Here, the ultimate go/cancel/hold/reiterate decision in advance of Formal Development is made.

Since the OIL is intended to increase innovative output, it is important that this FEI process integrates well with the existing Formal Development processes. A disconnect might impede the flow of the whole innovation process from FEI to Launch. The CSF *Learning from experience capabilities of the pre-project team*, as identified by Frishammar and Florén (2008), pertains partially to the Formal Development teams' absorption of the FEI team's experience and can be accommodated for if this integration is well made. Therefore, it is emphasized that the output of the process is not a concept, but a formal development concept and a decision on Formal Development.

Gates, Decisions and Criteria

Each gate awards a go/cancel/hold/reiterate decision to the potential innovation based on predetermined criteria, and the decision is accompanied with a discussion of what needs to be explored further, as suggested by Tidd et al. (2005). A *go*-decision signals the immediate start of the next stage, and can be bundled with feedback. If the potential innovation fails to meet the set criteria but is still considered viable, a *reiterate*-decision will be awarded. This means that the potential innovation will return to the same, or a previous stage, for further development on its point of weakness. Sometimes, the timing is just not right, or an external issue may intervene, giving cause to a *hold*-decision, where the process is suggested to continue but at another time. A *cancel*-decision however, means that the potential innovation proved not to be worthy of further study at all, and that it will be dropped. Ries notes that it is important that the cancellation of a potential innovation project should not in itself be considered a failure, but rather an opportunity for learning and sharing knowledge (2017). To see each project as an opportunity to learn, regardless of it being a pursued fully or not, is further emphasized by Frishammar and Florén who states that the CSF *Learning from experience capabilities of the pre-project team* is achieved by drawing on experience from previous projects, no matter how they ended. However, the systems and processes for managing knowledge is out of scope for this thesis.

Different criteria are used to evaluate the potential innovation at each gate. The criteria used in the gates needs to be accepted in the organization as a good basis on which to make decisions (Bessant, 2003). Furthermore, in the studied literature, little focus has been paid to which specific criteria to use in FEI. As a result, criteria were developed based on what was needed to satisfy CSFs and to assess the results of previously performed activities. In conclusion, all gates are suggested to screen for *Strategic Fit*, *Portfolio Fit* and, in all but the last gate, *Operations Innovation Lab fit* with increasing rigour. Furthermore, to assess the progress made in the previous stage, a thematic group of criteria that pertains to prior activities are also added.

The criteria themselves are mainly our own contributions to patch holes left by literature and will be verified with Operations in the next chapter, Learning Loop 1. Screening for Strategic and Portfolio Fit of an innovation were identified as CSFs (Frishammar and Florén, 2008), while OIL fit assures differentiation with other places of innovation and enables a measure of project portfolio management.

Roles

The suggested process is initiated and supplied with an input by an Operations coworker, *the Innovator*. The Innovator will be central to the process as they not only initiate it, but also commit their time. Furthermore, they are advised to act as Champions, driving the potential innovation forward and selling it to management, as the presence of an idea visionary is one of the CSFs identified by Frishammar and Florén (2008).

When an Innovator approaches the OIL, the defined opportunity is presented to the first of several gatekeepers, individuals who evaluate an input based on given criteria, and awards a go/cancel/hold/reiterate decision. As the potential innovation continues through the process, its compounded investment, the number of affected departments and the importance of gatekeeping increases. Therefore, it is recommended, that fewer individuals are involved in the early decisions, and that each group of gatekeepers is adapted to the unique project and to the gate in question by involving the relevant stakeholders. The gates and choice of gatekeepers provide an opportunity to satisfy Frishammar and Florén's CSFs *Senior Management Involvement* and employing *a cross-functional review committee* by involving the right senior managers. Not only may they provide input and have the experience needed to evaluate a project, but also provide it with organizational credibility in its continued path in the organization.

A senior coworker might also choose to be involved as an Organizational Sponsor (possibly in combination with being a Gatekeeper) and influence the innovation project in the organization by pulling strings and procuring resources. Being a person of power and influence, the Organizational Sponsor convinces critics.

Few Operations coworkers have innovation as their main focus area (Lindroth, 2019), and could therefore likely benefit from support during the FEI process. Thus, the appointment of a Facilitator is suggested, motivated by the discussion in Subsection 3.4.3. The Innovator will continuously be guided by the Facilitator who advises, educates and help plan the stages. Specific tasks include setting deadlines, composing gatekeeper groups, coordination cross-functional collaboration, and advising Innovators. During the stages of a process, the Facilitator is recommended to set *Project Priorities* (the prioritization between quality, time and resources), with stakeholders and the Innovator as this was identified as a CSF by Frishammar and Florén (2008). In later stages, the focus will shift to innovation related efforts as project management is transferred to a Team Leader (discussed later), or similar.

Besides the aforementioned micro-level role, the Facilitator is also recommended to hold a macro role of working with the process and its stakeholders. The per-

son should connect people, information and competencies, and also be responsible for development and performance of the process itself, educating the company on its workings and the importance of innovation. Essentially, the Facilitator will fill the roles of being an Information Gatekeeper and a Business Innovator. While any number of innovation projects could be driven in the lab at once, the Facilitator's time is of course a finite resource that needs to be managed and balanced. There are however many potential synergies between the roles that make combining them logical. For example, one who knows of all innovation projects could surely be the one who reports on the lab's performance, and one who sees all innovation projects and raises company awareness could surely connect people and information.

The scope of projects might require a team to be formed. This is not only an eventuality, but also identified as a best practice in literature (Johnsson, 2018). The Team Leader therefore has an important role of coordinating the team. In the suggested process, a team will be formed as the Innovator and Facilitator find a need. An individual in the team will be appointed Team Leader, and take a project manager role of high involvement and ambassadorship, while the Facilitator continues in the role of advisor. This design accommodates the CSF of *Project management and the presence of a project manager* as identified by Frishammar and Florén (2008), while keeping teams lean and flexible.

Two Final CSFs to Consider

In the previous parts of this section, all but two of Frishammar and Florén's identified CSFs have been included and accounted for in the design. The two remaining CSFs are, *External cooperation with others except customers* and *A creative organizational culture*. The former is out of scope, but the suggested process could indeed be altered to include such interactions and Operations are encouraged to explore the topic further. Furthermore, the latter is acknowledged as important and a key driver in providing the suggested process with new input, but no further investigations into Operations culture will be made as it is also out of scope.

4

Learning Loop 1

This chapter presents the results and analyses from Learning Loop 1, where Iteration 1 of the process model was shown to coworkers at Operations and adapted according to their feedback. This provided answers to the third research question, as well as input for Iteration 2 of the process model.

4.1 Introduction to Learning Loop 1

Learning Loop 1 began after the Frame of Reference was created and had two purposes. First, we wanted to understand how applicable the literature we had studied was for Operations. Secondly, we wanted to get input from relevant and knowledgeable coworkers at Operations. Understanding the applicability of the studied literature, as well as gaining the input from the organization, enabled us to adapt our process suggestion to Operations and create Iteration 2. Furthermore, it also provided answers to research question 3 as discussed in Section 4.3.4.

The empirical data collected in Learning Loop 1 consisted of semi-structured interviews. Interviewees were initially asked questions regarding important activities, roles, criteria and CSFs during FEI at Operations. Then they were presented with our process suggestion, Iteration 1, and asked for their reaction on it. Lastly, a short survey was conducted as part of the interviews which was designed to gauge the interviewees' opinions regarding some observed designed dichotomies.

The three distinct phases of the interviews yielded three types of data, which will first be presented in Section4.2 and then analyzed in Section4.3. In the results section, the reader will be presented with the compilation of the interviewees' answers to the initial open questions, followed by compilations of the interviewees' reactions to Iteration 1. Both in the form of a so-called *heatmap*, and a table which highlights the interviewees differences of opinions. Lastly, the results of the short survey are presented. The analysis will be conducted in a more thematic manner, merging results from the three interview phases and comparing them with literature and Iteration 1. Finally, this chapter is concluded with a step-by-step walk-through of how Iteration 2 was created and how feedback from this learning loop was taken into account.

4.2 Results

4.2.1 Initial Open Questions

The interviewees were asked for their opinion on four subjects related to FEI, see questions 1-4 in Appendix A.1. During this interview, FEI was described as a process that takes a defined opportunity as input and produces a formal development concept as output, in accordance with our delimitations.

The answers to each question were transcribed into statements, coded and then grouped according to the Gioia-methodology, see full results in Appendix C. This gave us an overview of reoccurring topics for each of the questions: activities, roles, criteria and CSFs. Following below, the open questions will serve as headlines and the aggregate results from the Gioia-clustering are presented in tables below respective questions. The statements, *First order concepts* shown in Appendix A.1, were clustered into discussion topics, *Second order concepts* included in the tables, that were ultimately grouped into aggregate themes and presented in Tables 4.1 through 4.8 below.

What 3-5 activities are important to perform in FEI for Operations?

Table 4.1: Aggregate themes identified with regard to activities to perform in FEI at Operations and second order concepts

Activities - Aggregate themes	Discussion topics - Second order concepts
Assuring Organizational Support	Analyze touchpoints and dependencies, Champion campaigning, Internal alignment (cross-functional), Internal alignment (horizontal), Internal alignment (vertical)
Building Business case	Formal development project planning, Large scope ROI analysis, Small scope ROI analysis
Building capabilities	Collaboration and partnerships, Formalized learnings, Internal and external information seeking
Conceptualizing and delimiting the project	Concretize and delimit project, Formalization of concept, Root cause analysis
Market and user research	Primary and secondary research
Planing the OIL project	Planning, Securing resources
Screen potential innovations	Formulation of criteria, screening

What 3-5 roles should be involved in FEI at Operations?

Table 4.2: Aggregate themes identified with regard to roles in FEI at Operations and second order concepts

Roles - Aggregate themes	Discussion topics - Second order concepts
Champion	Champion campaigning
Change drivers	Managers have key roles in changing innovation culture
Facilitator	Motivation and coaching, Process support
Innovator	Idea owner, Innovator finding opportunities
Organizational Sponsor	Providing senior support
Other resources	Central OIL-group, IT expertise
Process owner	Process managing, networking and facilitating collaboration
Project manager	Project management and reporting
Team members	Small core team with diverse, dedicated and relevant resources, Different personality types needed

What are 3-5 important criteria for Operations when evaluating a new potential innovation?

Table 4.3: Aggregate themes identified with regard to criteria to measure during FEI at Operations and second order concepts

Criteria - Aggregate themes	Discussion topics - Second order concepts
Justification	Business Case, Strength of concept and analysis
Project feasibility, Investment and risks	Concrete criteria in combination with visionary component to allow risk-taking and longer investment perspective, Feasibility, Investment, Next stage plan, Risks
Strategic and organizational fit	Organizational, cultural and strategic fit. Timing of investment. Well considered and integrated touchpoints and dependencies

What are Critical Success Factors for managing FEI at Operations?

Table 4.4: Aggregate themes identified with regard to CSFs to consider in FEI at Operations and second order concepts

CSF - Aggregate themes	Discussion topics - Second order concepts
Align innovation efforts with strategy	Strategic alignment to assure effectiveness
Appropriate review committee	Appropriate review committee
Autonomous innovation teams	Autonomy and self-sufficiency that enables momentum. Clarity in responsibility sphere, budget requests and time allocation with enough autonomy
Customer orientation	Involving the end-user
Effective OIL project management	Effective project management. Involve the idea creator and work intently
Efficient cross-functional collaboration	Collaborate cross-functionally efficiently
Presence of full-time innovation team	Presence of full-time innovation team
Guiding structure and documentation	Clarity of purpose and process. Process support and facilitation
Process support and facilitation	Process support and facilitation
Innovative Culture	Appropriate culture. Organizational innovation mindset. Rewarding and encouraging innovation
Lenient early screening	Lenient early screening to allow development of rough opportunities
Senior management involvement and organizational support	Assure organizational support. Management buy-in and support
Strong internal communication, focusing on success stories	Clear communication. success stories
Balance daily operations and innovative work	Ability to leave current responsibilities and work with an idea full-time. Enough slack to allow opportunity recognition and participation in innovative work. Sufficient resources. Sufficient time to work concentrated and develop something. Test with care to avoid disruption

4.2.2 Reactions to Process Design

After the open questions regarding FEI, the interviewees were given a thorough introduction to Iteration 1, i.e. our first process suggestion for OIL. The interviewees were then asked about their overall impression of the structure of the process. All interviewees stated that the flow was logical and that the Stage-Gate structure was appropriate, but three interviewees voiced additional concerns. The first two concerns regarded *how* and *if* a new technology without an identified need had a way into the process, while the third concern was regarding the deterrent effect a process can have on participation in and of itself.

Following the question regarding the overall structure, the interviewees received a copy of Iteration 1, see Figure 3.9. The interviewees were then asked to highlight, downplay, add, move or remove any activity or criteria with the explanation that an untouched activity or criteria will be interpreted as if the interviewee agree that it should be part of the model. A highlight was codified as +1, a downplay -1 and remove -2, and the input regarding each entry was summed into a "importance index". The activities, criteria and their importance indices were then compiled into a heatmap, see Table 4.5. In the heatmap activities or criteria written with a letter in brackets afterwards demonstrates that it was added by an interviewee, and the letter in the brackets shows which interviewee did the addition. Furthermore, during the compilation of the results we noticed multiple occasions where the some interviewees highlighted and item, while others downplayed the same. Such conflicts are shown in Table 4.6.

There were three occasions were an interviewee wanted to move an entry during the interviews. It was indicated by one interviewee that the criteria *Policy fit* should be moved from the opportunity gate to the concept gate, and the activity *Sanity check* should be moved from idea-development to concept development. Since policy fit already was a criteria at the concept gate, and the sanity check is encompassed in the activities at concept development this move indication were instead codified as *remove*. Furthermore, one interviewee indicated that *Voice of Customer* activities should be moved from concept development to the Pre-Implementation stage, which is not illustrated in Table 4.5. The motivation was that its often hard to gauge a customer's response or preferences through conceptual discussions, instead its preferred to have something to show them.

Table 4.5: Heatmap showing the aggregate reactions to process suggestion Iteration 1

Opportunity Gate		Idea Development		Idea Gate		Concept Development		Concept Gate		Pre-Implementation Stage		Formal Development Gate	
Strategic Fit		**Opportunity**		**Strategic Fit**		**Market/User Involvement**		**Strategic Fit**		**Concept Formalization**		**Strategic Fit**	
Fit Goals	3	Further Define Opportunity	1	Fit Goals	1	VOC	3	Fit Goals	0	Make/Buy Analysis	0	Fit Goals	0
Fit Policies	-3	Market & Trend Analysis	2	Fit Policies	-2	LOFA testing	2	Fit Policies	-3	Final Concept Definition	0	Fit Policies	-2
Scalibility, [A]				Scalibility [A]		Use Case analysis	2	Scalibility [A,I]		Market/User Group Sizing	0	Scalibility [A]	
Core Values, [E]										Extended Stakeholder Analys	0		
Portfolio Fit		**Ideation**		**Portfolio Fit**		**Concept**		**Portfolio Fit**				**Portfolio Fit**	
Duplication	2	Brain storm, Explore Options	2	Duplication	2	Design Iterations	0	Duplication	1			Duplication	2
Diversification (risk and impact area)	-2	Test, Validate	1	Diversification (risk and impact area)	0	Proof of Concept	0	Diversification (risk and impact area)	-1	**Implementation**		Diversification (risk and impact area)	-1
		Market/User Input	0			Benchmarking	2			Initial roadmap outline	1		
		Use Case Analysis	3			Stakeholder Analysis	1			Financial Analysis	1		
OIL Fit		Formulation of Leap of Faith Assumptions (LOFA)	1	**OIL Fit**		Concept Requirements and Definition	0	**OIL Fit**		Timing Analysis	0	**OIL Fit - Not Applicable**	
Scope	3			Scope	3	Formulation of Leap of Faith Assumptions	0	Scope	2	Handover preparation	1		
Magnitude and novelty	-4			Magnitude and novelty	-4	Cross-Functional Communication	1	Magnitude and novelty	-3				
Outside of normal working situation	-2	**Feasibility**		Outside of normal working situation	-3	**Feasibility**		Outside of normal working situation	-2	**Feasibility**			
		Sanity Check	-1			Prel. Competence requirements	1			Competence requirements	2		
		Initial timeplan assessment [I]		**Idea**		Prel. technical assessment	2	**Concept**		Technical assessment	2	**Formal Developement Concept**	
		Initial budget assessment [I]		Validity	1	Prel. financial assessment	1	Validity	0	Financial assessment	1	Concept Strength	0
		Initial risk assessment [I]		Feasibility	1	Risk mitigation planning [G]		Feasibility	0	Internal Capability Analysis	1	LOFA Strength	0
				Benefits for company, customer and/or end-user	2			Benefits for company, customer and/or end-user	1	Risk mitigation planning [G]		Implementation	1
				LOFA assessment	1			LOFA assessment	0	Lessons learned [G]		Feasibility	1
				Financial assumptions check [F]				Risks [G]		Business model and go-to-market assessment [I]		Risks [G]	
				Risks [G]				Internal alignment/dependency check [I]					

Table 4.6: Conflicts of opinion in reactions to process suggestion Iteration 1

Opportunity Gate	Positive	Negative	Idea Gate	Positive	Negative	Other stages and gates	Positive	Negative
						Concept Gate		
Strategic Fit			**Strategic Fit**			**Strategic Fit**		
Fit Goals	4	-1	Fit Goals	2	-1	Fit Goals	1	-1
Fit Policies	2	-5	Fit Policies	1	-3	**OIL Fit**		
						Outside of normal working situation	1	-3
Portfolio Fit			**Portfolio Fit**			**Formal Development Gate**		
Duplication	3	-1				**Strategic Fit**		
Diversification (risk and impact area)	1	-3	Diversification (risk and impact area)	1	-1	Fit Goals	1	-1
OIL Fit			**OIL Fit**			**Idea Development**		
Magnitude and novelty	2	-6	Magnitude and novelty	1	-5	**Feasibility**		
Outside of normal working situation	2	-4	Outside of normal working situation	1	-4	Sanity Check	1	-2

4.2.3 Survey on Design Dichotomies

When designing the first iteration of the process, a number of dichotomies where identified, and subjective choices had to be made. One example of this was the balance between providing structure and offering flexibility. To gauge the organization's opinion on the choice of strategy, a short survey was conducted, see Table 4.7. Originally two more questions were included, but due to frequent misinterpretations the questions were removed. The interested reader who wants to see the removed questions, please see Appendix A.1.

Table 4.7: Survey on design dichotomies

Question/Valuation	Too	A little too	Well	A little too	Too
1. Flexibility vs Structure	Flexible	Flexible	Balanced	Rigid	Rigid
2. Innovator Freedom vs Management Control	Much freedom	Much freedom	Balanced	Controlled	Controlled
3. Focus on Creativity vs. Implem. (business)	Much Creativity	Much Creativity	Balanced	Much implem.	Much implem.
4. Number of stages/gates	Few	Few	Balanced	Many	Many

Each answer was converted to a numerical value, where 1 was assigned to the leftmost option and 5 to the rightmost option, as shown in Table 4.7. The distribution between answers, as well as the averages for the different questions and the entire survey are found in Figure 4.1 and Figure 4.2.

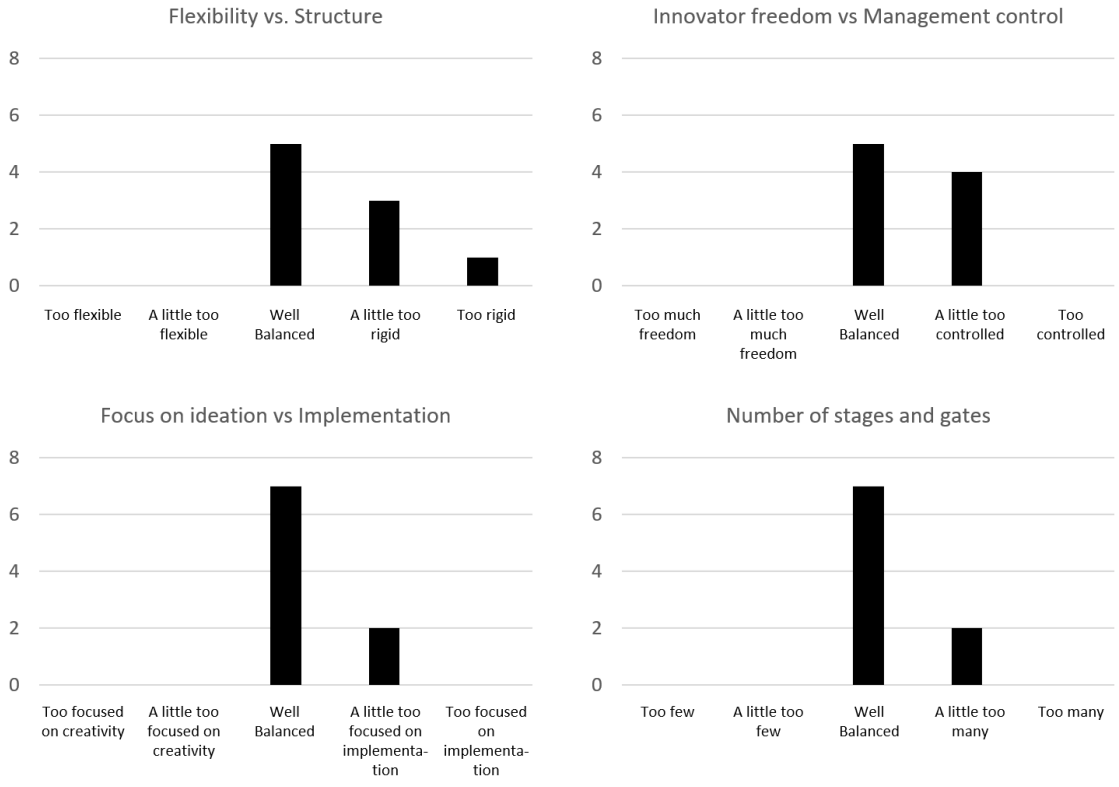

Figure 4.1: Interview survey on Iteration 1's performance in relation to design dichotomies

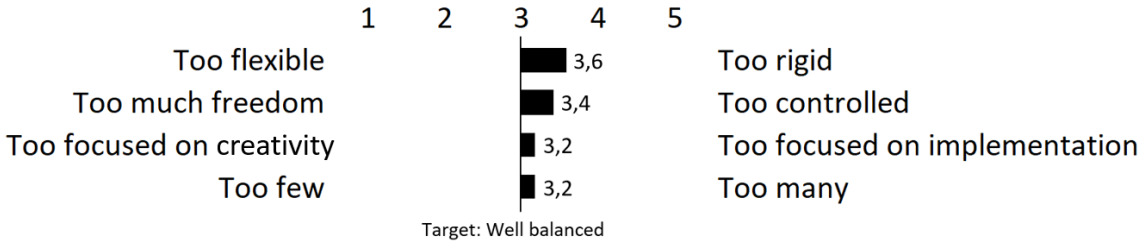

Figure 4.2: Interview survey averages on Iteration 1's performance in relation to design dichotomies. A value of 3 was the target, meaning that it was well balanced

4.2.4 Final Remarks, Thoughts and Questions

Before the interviews were concluded, the interviewees were asked if they had any final remarks, thoughts or questions. Six out of nine interviewees responded no, and the three remaining made the following remarks:

"*We want to premiere innovativeness, and to do that I think it's important that we don't rush through this process. Currently we're often skipping to the last step without having all our bases covered.*" (Interviewee D)

"*[referring to earlier remarks about the interviewee's skepticism about having an innovation process at all].. this isn't an Innovation process per se, it's a process for handling innovations instead of creating them which I think is great. It has to be flexible, which this is process is, since sometimes you have to be able to progress even though there are still uncertainties.*" (Interviewee F)

"*When it's all said and done, it comes down to how the process is managed and used. Earlier when Axis tried something similar [referring to Innovation X, Appendix B] the problem was that it was used to bypass ordinary processes, which eventually led to the initiative losing support in the organization. Also, some line-managers were upset that key individuals were taken from their ordinary roles.*" (Interviewee F)

"*I think the focus on radical innovations should be downplayed a little bit. Encourage everything, even the smallest innovations, but hope and prepare for the radical ideas. And this process works for both types!*" (Interviewee H)

"*I think the Operations coworkers are quite process-minded, and with that in regard I think this process would fit them really well.*" (Interviewee H)

4.3 Analysis

When analyzing the empirical data from the interviews, we noticed a large overlap between their answers and the literature we had studied. The interviewees mentioned most of the activities, criteria, roles and CSFs that were discussed in literature already in the initial open questions. The elements that were not discussed then, were almost all corroborated in other questions or discussions. The fact that most of the, by literature, suggested activities, criteria, roles and CSFs were brought up by the interviewees validates the theoretical contributions' applicability to Operations. Further, the interviewees' additions show that the list of CSFs and key activities to conduct during FEI can be adapted to Operations' needs with the addition of only a few entries. In the subsections to come the findings regarding activities, criteria, roles and CSFs are analyzed in turn, followed by an overall analysis regarding frequently discussed themes.

4.3.1 Activities

After the Gioia-clustered summary of the initial open questions, see Table 4.1, had been analyzed, the following reflections were made. First, there is a large overlap between what the interviewees suggest and the activities in Iteration 1. Secondly, Iteration 1 further included several tools for innovative work that the interviewees did not suggest such as: Trend Analysis, Use Case Analysis and LOFA Formulation. Thirdly, the interviewees added several activities related to two aggregate themes. Under *Assure Organizational Support* several interviewees suggested activities related to identifying organizational dependencies and touchpoints affected by pursuing an innovation and activities related to creating internal alignment. Under *Planning OIL project* the interviewees added activities related to planning the OIL project itself and managing internal resources.

When presented with the suggested process and its toolbox of activities the interviewees agreed with almost all of the suggested activities and chose to make a few additions and one removal, as shown in Table 4.5 in the results section. The additions were: (1)Initial time plan, budget and risk assessment to the Idea Development stage, (2) Risk mitigation planning to the Concept and Pre-Development stages, (3) Lessons learned to the Pre-Development stage and (4) Business model and Go-to-market assessment to the Pre-Development stage. The activity Sanity check was suggested to be removed by one interviewee, but highlighted by another, which leads us to believe that it was appreciated by the majority.

The activities Formalized Learning and Root Cause Analysis are additions that were not explicitly included in the process suggestion, but touched upon in the thesis. They will therefore be made more explicit, but not regarded as additions by the interviewees.

4.3.2 Roles

The answers to the initial open question, shown in Table 4.2 in a Gioia-clustering show first that, once more, most of the roles suggested by the interviewees were covered by the literature study, validating its relevancy for Operations. Secondly, all roles identified in the literature were identified by the interviewees, who further added two new roles and one role that can be interpreted as a combination of two previously identified roles.

The two other resources identified were (1) Central OIL support personnel and IT experts, and (2) Change Drivers, mainly managers, that take a key role in changing the mindset of their coworkers. While the latter is mainly targeted at the implementation of OIL which is out of scope, the former is more interesting and seems to be very topical at Operations. There is a strong belief in the organization that IT is an area that holds much potential for innovation, but where internal competencies are lacking. This was only partially included in literature under Team Members, and warrants a more pronounced place in the second iteration of the process design.

Additionally, Process Owner was added, a role that is suggested to accept applications and drive the process, as well as connect competences and projects by networking. This maps well onto the, by the literature study identified, Business Innovator in combination with Information Gatekeeper. In comparison with how the Facilitator's role was defined in this thesis (see Roles in Section 3.5) this would indicate that the Facilitator be named Process Owner, and made responsible for advising Innovators on a micro-level as well as managing the process' performance. The latter would include development of the process, to educate Axis on its workings and the importance of innovation, and connect people, information and competencies. This may seem like an insurmountable task, but there may be many synergies between the roles, as described in Section 3.5.

4.3.3 Criteria

Analyzing the Gioia-clustered summary of initial open questions, see Table 4.3, the following reflections were made. First, most of the suggestions by the interviewees had been covered in Iteration 1. Secondly, Iteration 1 further included criteria in two dimensions that the interviewees did not comment on. Under Portfolio Fit criteria that took into account other projects at Axis and diversification of risk and attention was suggested by the authors, and under OIL Fit criteria regarding scope, size and magnitude of the innovation was posed, as well as whether it was part of the coworker's normal working responsibilities or not. Thirdly, the interviewees added criteria the following themes: Scalability under the aggregate theme Justification, Next stage planning under Project Feasibility, Investment and Risks and criteria pertaining to organizational touchpoints and dependencies under Strategic and Organizational fit.

Having presented the suggested process and its list of criteria, and analyzed the interviewees' reactions, there are four key takeaways. First, the Opportunity Gate was often seen as too rigid and could deter participation, but the screening was approved by all. Secondly, screening for policy fit may leave old, detrimental legacies

unchallenged, and should not be included. Even limiting oneself to innovating along organizational goals was seen as excessive by one interviewee. Instead, a fit with core values was suggested as an aid for finding alignment as well as encouraging radical innovation. Thirdly, many aspects of OIL fit were frequently downplayed, much to our surprise. It was surprising as there seemed to be a desire that OIL should run a certain type of projects, which will be discussed in Section4.4.4. However, with the intention of not discouraging applicants, Magnitude and Novelty received downplays, and the criteria Outside of Normal Working Situation was considered irrelevant. Scope in the same category, however, was appreciated. Lastly, Risks and Scalability were suggested to be added to several of the stages, along with explicitly accounting for Internal touchpoints and dependencies.

The aforementioned third observation surprised the authors since the apparent goal of implementing OIL seemed related to allowing a certain kind of risky, new, radical, exciting, smaller scale innovation project, which would logically require some form of screening to assure that niche. This warranted a follow-up during the group interview where new criteria were developed by the group interview participants.

4.3.4 Critical Success Factors

The Gioia-clustered answers to the initial open questions, shown in Table 4.4, suggests that almost all CSFs identified by Frishammar and Florén, with minor modifications, also apply for Operations as can be seen in Table 4.8.

Answering the Third Research Question

To provide a final answer to research question 3 we started with Frishammar and Florén's CSF list (see Subsection 3.4.4) and adapted it according to input from the interviews. This final list of CSFs for managing FEI at Operations is shown in Table 4.8. In the list of CSFs the reader is asked to notice that 15 out of 17 original CSFs were corroborated and kept with minor changes, and only two excluded. The largest change to the former CSF list was that number 7, Senior management involvement was changed to Senior management involvement *and organizational support*. This highlights that support is needed throughout the organization, not just from management, as line managers and employees must be ready to prioritize and participate in innovation work in order for it to succeed. The removed CSFs are number 13, Project priorities, and 15, External co-operations with others except customers. The first received no mentioning, and the latter was only briefly discussed, which is why they were both omitted.

When analyzing the discussed themes we identified 5 new CSFs for managing FEI at Operations, which were subsequently added to the original list of CSFs. The only new theme that was discussed and did not render an addition of a CSF was Presence of full-time innovation teams, see Table 4.8. The statement suggests that it is critical that innovative work at Operations is carried out by dedicated innovation teams, rather than regular Operations' coworkers, if FEI should be managed successfully at Operations. This statement is seen as a direct conflict with the setup where the innovation work is conducted by Operations coworkers supported by a facilitator. The setup that involves Operations coworkers was appreciated by all interviewees,

including the interviewee who stated that dedicated innovation teams was a CSF. Thus dedicated innovation teams are not seen as a CSF for managing FEI at Operations.

As previously mentioned we added 5 new CSFs to Frishammar and Florén's list of CSFs. (1) The CSF *Balance daily operations and innovative work* was added as it became apparent that disruptions to the internal processes and day-to-day duties have large consequences for Operations, and Axis as a whole. Discussions on the subject mentioned the difficulty in freeing up coworkers from current responsibilities as it would be detrimental to ongoing processes and that prototyping could prove to be a similar challenge. However, there is a risk of becoming outdated if too little innovation is pursued and thus a balance is needed. (2) *Lenient early screening* was added as a CSFs as some interviewees experience a lack of really innovative ideas and willingness to pursue them in the organization. Prematurely canceling the ones that come forward was believed to cause a negative spiral and loss of input to the process. (3) Since potential innovations at Operations could affect multiple different departments and require different competences, a fear of losing momentum was expressed by many of the interviewees. To avoid such loss of momentum teams with critical competences and clear authority, summarized with *Autonomous Innovation teams*, are seen as a CSF. (4) In multiple interviews the need for *Process support and facilitation* was brought up, and it was therefore added to the list. The experienced need for this is based on the fact that not many of Operations current coworkers have innovation as their main area of expertise, and could therefore need guidance to become effective innovators. (5) The final addition to the list was *Strong internal communication, focusing on success stories* as it was discussed by four of nine interviewees. The main reason was that it was seen as integral in maintaining an interest in OIL and thereby ensuring an inflow of ideas and interested coworkers. The final CSF list is shown in Table 4.8.

Table 4.8: Adaption of Frishammar and Florén's CSFs for managing FEI to Operations resulting in a final list for Operations in the right-most column

Frishammar and Floréns CSFs	Action	Motivation	**CSFs for managing FEI at Operations**
1. The presence of idea visionaries or product champion	Minor change	Idea champion, and activities related to them, were discussed in both Roles and Activities, see Appendix C.2 and C.3	The presence of idea visionaries or concept champion
2. Idea refinement and adequate screening of ideas	Kept unchanged	The Stage-Gate process and its phases were appreciated and seen as important by all interviewees, as discussed in Section 4.2.2	Idea refinement and adequate screening of ideas
3. An adequate degree of formalization	Kept unchanged	Highlighted in multiple interviews, see eg. *Guiding structure and documentation* in Figure C.5 in Appendix C.4	An adequate degree of formalization
4. Early customer involvement	Kept unchanged	Mentioned as a CSF by one interviewee, see *Customer orientation* in Figure C.4 in Appendix C.4. Activities related to early customer involvement received highlights and no downplays, see Table 4.5	Early customer involvement
5. Internal Co-operation among functions and departments	Minor change	Both pros and cons of cross-functional collaboration was discussed in the interviews, thus the addition of *appropriate* was made	Appropriate cross-functional collaboration
6. Information processing other than cross functional integration and early customer involvement	Kept unchanged	*Market analysis, Trend analysis* and Benchmarking are all activities relating to this CSF, and they all received highlights and no downplays, see Table 4.5	Information processing other than cross-functional integration and early customer involvement
7. Senior management involvement	Changed	The addition of organizational support was done to highlight that support is needed throughout the organization, not just from management, as line managers and coworkers must be ready to prioritize and participate in innovation work	Senior management involvement and organizational support
8. Preliminary tech assessment	Kept unchanged	The activities *Preliminary technology assessment* and *Technology assessment* both received highlights and no downplays, see Table 4.5	Preliminary tech assessment
9. Alignment between NPD and strategy	Changed	FEI activities need to be aligned with strategy as well, not only formal development. See *Align innovation efforts with strategy*, in Figure C.4, Appendix C.4	Align innovation efforts with strategy
10. An early and well defined concept definition[1]	Minor change	Defining concepts and producing knowledge for basing decisions is one of the key values of OIL, as identified in interviews with Ädelroth (2019)	A well defined concept definition
11. External co-operation others except customers	Omitted	Omitted as it was only briefly mentioned by one interviewee. However, could indeed be a CSF as large parts of Axis' value chain is outsourced	-
12. Learning from experience capabilities of the pre-project team[*]	Minor change	*Handover preparation* was highlighted as meaningful Activity, and *Formalized learning* added to the Process map, see Table 4.5 to enable learning from other OIL projects	Effective handover to Formal Development and formalized learning
13. Project priorities	Omitted	Lacks mentions	-
14. Project management and the presence of a project manager	Kept unchanged	Highlighted in multiple interviews. See *Effective OIL project management*, and *Project manager* in Figure C.4, Appendix C.4	Project management and the presence of a project manager
15. A creative organizational culture	Minor change	Highlighted in multiple interviews but with different wording. *Innovative Culture* in Figure C.5, Appendix C.4, is seen as synonymous	Innovative Culture
16. A cross functional executive review committee	Minor change	Gatekeepers should, according to multiple interviewees, be altered depending on the nature of the potential innovation, and Axis as a whole should be considered when evaluating a new project, see eg. *Appropriate review committee* in Figure C.4, Appendix C.4. However, it might be the case that a potential innovation only affects one function, rendering the cross-functional review committee superfluous	Appropriate review committee
17. Product portfolio planning	Minor change	To screen for duplication was seen as important, see Table 4.5, which is a basic level of project portfolio planning. Product was changed to emphasize that potential innovations can be more than products	Project portfolio planning
		Additions	**Additions**
		See motivation in Subsection 4.3.4	Balance daily operations and innovative work
		See motivation in Subsection 4.3.4	Lenient early screening
		See motivation in Subsection 4.3.4	Autonomous innovation teams
		See motivation in Subsection 4.3.4	Process support and facilitation
		See motivation in Subsection 4.3.4	Strong internal communication, focusing on success stories

[1] *Early* is defined in relation to Formal Development
[2] *Pre-project* team refers to the FEI team

4.3.5 Frequently Discussed Themes

Screening, Gates and Criteria

During the interviews, several of the interviewees stated that the screening for new opportunities or ideas should be very lenient. This was also reflected in the heatmap analysis of the process model, which showed that *Fit policies*, *Magnitude and novelty* and *Outside of normal working situation* all received a negative importance index in all gates. *Diversification (risk and impact area)* got a negative index in all gates except in the idea gate, where it received a neutral score. Common motivations for the downplay of said criteria and want for a lenient screening was that OIL needs to be welcoming to ensure coworker interest and the supply of new opportunities and ideas. This point of view was further emphasized by the Interviewee H who stated that the initial opportunity gate should be removed, and that each employee should have the right to dedicate at least 40 hours to pursue an innovation whenever they want.

However, voices of concern regarding too lenient screening were also raised and almost all criteria received highlights as well, see Table 4.6 While most agree that existing policies and goals could be challenged, the common attitude was that the potential innovations at least should be screened to see if they fit with Axis' goals. The screening was deemed vital for many to ensure both that obvious losers were weeded out, and that organizational support was achieved. Furthermore, the need to differentiate OIL from other process development structures was also brought up in the interviews. According to interviewee B and I, such differentiation could help in changing coworkers' mindsets from a classic lean operations mindset, to a somewhat more creative and out of the box mindset, as well as further ensure organizational support by pointing out the gap OIL fills.

The initial questions also highlighted the need to consider strategic fit and the many facets of that aspect. One that was not mentioned in any literature was *Timing in relation to technology development* where a strategic decision has to be made regarding being early adopters of certain technologies or waiting for them to mature.

Resources, Competencies and a Clear Delegation of Authority

During the interviews multiple interviewees stated that CSFs for OIL include that the future projects are given enough resources to conduct the project. They further stated that the team needs to have enough competence and a clear delegation of authority to assure an efficient progression through the process without loosing momentum. The most frequently mentioned resource need was time. As most Operations employees currently work with little slack in their agenda, simply adding participation in OIL to their duties is seen as impossible by the interviewees. Instead, support from line-managers and a way to allow for periods of absence to enable the potential innovator to work intently with their project is needed. However, removing coworkers from their original responsibilities may cause friction and was something that may have added to the demise of a similar process called Innovation X that was implemented nine years ago (see Appendix B). Additionally, the need for IT-resources or competence within the team was highlighted in numerous interviews. Currently,

many interviewees believe there is a need for additional IT and programming expertise to facilitate likely potential innovations. Thus, either dedicated resources from IT are needed, or additional knowledgeable team members.

A general fear observed in the interviews is that the projects in OIL will lose momentum due to bureaucracy and delays, both due to dependencies on the rest of Axis or other parts of Operations, as well as an unclear delegation of authority.

> "*If I have to run to someone every time I want to purchase something, or bring on someone new on the team, the whole process will be too slow due to me sitting around and waiting for a response. Then the project will lose momentum and interest.*" (Interviewee A)

To avoid such loss of momentum a large degree of autonomy for OIL is suggested. This can be achieved by the OIL-process owner having a separate budget to allocate according to their own choosing and clear authority.

4.4 Process Suggestion for the Operations Innovation Lab, Iteration 2

Having analyzed the results from the interviews, a new and improved OIL process was created, shown in Figure 4.3. Each of the changes is built on feedback from this Learning Loop and they are discussed in this section. The large changes from Iteration 1 to 2 are addressed first at an overall level, then in subsections the changes to specific stages and gates are presented. They are furthermore grouped under descriptive statements that illustrate the desired effect of the changes. In addition, a few minor tweaks were made, such as renaming and merging criteria to better reflect their true meaning and increase the overall readability.

4.4.1 Process Structure

When analyzing the results of the questions regarding the overall structure of the process there are three key takeaways: (1) The Stage-Gate structure is appreciated, (2) The current model is a bit too rigid and could be deterring and (3) A process where a coworker supplies their own ideas and participate in the process, guided by a facilitator, seems to have a good foothold in the organization.

The Stage-Gate structure was appreciated both since it allows screening, which is believed to prevent obvious losers and enable alignment with strategic goals, and since it provides a rough outline of when to conduct which activities. It is therefore kept for Iteration 2.

Although the structure itself was appreciated, the current version is deemed slightly too rigid by the interviewees, which can be observed from the average ratings on the survey questions, see Figure 4.2. Two thematic causes of concerns were observed, one being that it looked as if each activity had to be performed in every innovation project, and the other that it seemed as if there was no way to introduce a new technology as an input to the process. As it is neither suggested that all activities should be conducted for all types of projects, nor that the process should be limited to situations were an employee first has observed a problem or business opportunity, this feedback solicits action.

Notably, only one interviewee suggested a structure where a dedicated team of OIL resources performed innovative work themselves, while the rest suggested that coworkers participate with their opportunities guided by a facilitator. Since a majority suggested it, and the interview who suggested otherwise was positive when shown, the arrangement where coworkers participate and are guided by a facilitator is kept in Iteration 2.

Figure 4.3: Iteration 2 of the suggested process. Notice the gaps purposefully left in the box for first gate criteria. This gap will be addressed in the second Learning Loop

4.4.2 Overall Changes

Some changes were made to the process on a high level to address readability and clarify roles.

Increase the understanding of the process by adding the purpose of each stage and gate to the model

Whenever the stages and gates were presented during the interviews the purpose of each stage and gate was described explicitly, which according to some of the interviewees was very pedagogical. Drawing upon this experience, a purpose was added under each stage and gate to reduce the need for voice-over when the process is presented. The purpose will also, hopefully, increase the understanding of the process, its components and flow, and help guide the innovator and facilitator in their efforts.

Show the different roles in the process, and explicitly where management comes in

The survey that was conducted at the end of each interview originally contained the question *Degree of management involvement*, see Appendix A.1. While the interviewees agreed that management should be involved in the later stages of the process, many also wondered when they and if management were involved at all. These questions demonstrated the need to not only have the stages and gates in the process model, but also to include the different roles, and explicitly show were management comes in. In version 2 this is achieved graphically by a number of different figures at each stage and gate.

Make the process more graphically appealing

Iteration 1 was a rough draft, meant to only capture the most essential parts and act as discussion material for the interviews. The need for a more graphically appealing process became apparent during the interviews as multiple interviewees stated that it looked rigid and perhaps even deterring. This feedback was taken into account and Iteration 2 was created with an ambition to be more graphically appealing and include previously missing elements of the actual model.

4.4.3 Changes in the Stages

The changes in the stages were mainly done to address the experienced lack of flexibility and innovator freedom, but activities regarding the feasibility of the potential innovation were also clarified or added.

Increase the experienced flexibility of the process by emphasizing that the list of activities should be seen as a toolbox rather than a checklist

To address the expressed concern that it looks as if each activity had to be performed in every innovation project, a new layout of the stages is used. The new layout is meant to further stress that the list of activities should be seen as a toolbox rather than a checklist, as shown in Figure 4.3. It is hereafter emphasized that a stage has three objectives which are written in bold with possible activities underneath.

Thus, a less crowded process model can be shown in presentations and other communication materials at Operations, and the fact that the activities are suggestions is emphasized. Furthermore, *stage planning* will be added above each stage in the model to further stress that each project needs to be managed differently, and use its own set of activities during the different stages. During Stage Planning the Innovator, Facilitator and team members pick the relevant activities, set deliverables and decide on the next gate.

Adding *Next stage planning* in each stage was also discussed. Thereby letting the planning of the upcoming stage be a deliverable, as one could argue that such information is required for making an informed decision of whether a potential innovation should progress or not. However, it was omitted as the survey showed that the innovators' freedom should be increased rather than decreased.

Increase the experienced flexibility of the process by showing that OIL can be the right place to experiment with new technology, even ones without obvious use-cases

Concerns were raised regarding whether a new technology could be accepted as an input to the process in Iteration 1. It was indeed intended that new technologies, without obvious business needs or opportunities at Operations, could be allowed into the lab for experimentation and evaluation. A clarification of what constitutes an opportunity was therefore made in Iteration 2.

Avoid an experienced increase of rigour by clarify what a Sanity Check consists of instead of adding new activities

At the Idea Development stage, interviewee I suggested that three activities should be added: (1) Initial time-plan assessment, (2) Initial budget assessment and (3) Initial risk assessment. However, these activities are encompassed in the Sanity Check, and to avoid an enhanced feeling of bureaucracy, Sanity Check is kept. Nevertheless, a clarification stating that these activities could be conducted as part of the sanity check is made.

In an early stage, address an innovation's feasibility with respect to its organizational environment

Two activities were added to the concept development stage and Pre-Development stage, all regarding the feasibility of the future development project and should be conducted with increased rigor during the latter of the two stages: Internal dependency and touchpoint analysis and Risk analysis and mitigation planning.

Internal dependency and touchpoint analysis was added after it was mentioned both by several interviewees in the open questions, and added by interviewee I to the process map. This activity is intended to highlight which other departments, functions or processes might be affected if the potential innovation is pursued. It was seen as a critical activity by interviewee I to avoid sub optimization for Axis as a whole, through local optimization.

Risk analysis and mitigation planning was also added to the Concept Development stage since it was a frequently mentioned activity in the open interview questions and added by interviewee G to the stage.

The reader might note that no activities were removed in the making of Iteration 2. This due to the fact that not a single activity received a downplay, and only one interviewee wanted to move an activity. The activity to be moved was *Voice of the Customer* (VOC), which was suggested to be postponed to the Pre-Development stage, as it is difficult to learn of customers' opinions without having a concrete concept to present. As VOC may impact the concept, and the Pre-Development stage is intended to take a concrete concept as its input, we still recommend that VOC occurs during the concept development stage. However, the timing of VOC could be adjusted during the Concept Development stage to take the feedback from the aforementioned interviewee into account.

4.4.4 Changes in the Gates

Changes in the gates were made to address the perceived rigour and inflexibility of Iteration 1. Most importantly, a contradiction or conflict of interest was noticed between respondents, which is brought to attention.

Achieve openness to all types of innovations and ideas, but also differentiate OIL from other processes and avoid innovation theater

To address the desire for a more lenient initial screening, allowing for ideas that challenge current operating procedures and creating a more welcoming process, multiple criteria were removed. Drawing upon the analysis in Subsection 4.3.5, *Fit policies* and *Magnitude and novelty* were removed from all gates, and *Diversification (risk and impact area)* was removed from all but the last gate. It was kept at the last gate, even though it received a negative importance index, as the management of risk is seen as a crucial element of project portfolio management (Teller and Kock, 2013) and development projects usually infer larger efforts and resources from the affected departments (Lindroth, 2019).

As a result, almost all criteria for OIL-fit were removed in the first gate, so that it only contained the criterion Scope. This almost eliminated screening of innovation projects, which could potentially allow a great diversity in input. This was surprising to us, as there seemed to be a clear and unanimous notion that a certain type of project was desired in OIL. This indicted a conflict.

More specifically, Ädelroth and Lindroth discussed pursuing *radical* innovation and running shorter projects on concepts that are *new*, with little or no demands of success or immediate relevance, in OIL. They discussed running projects that radically changed procedures at Operations to allow efficient growth and, together with Interviewee B, they individually mentioned exploring technologies that are currently foreign to Axis.

However, we failed to see how those types of projects were to be selected if no criteria but Scope was applied. Therefore, a discussion regarding which criteria to use when answering the question *Is OIL the right place?* is included in the next Learning Loop. To facilitate discussion, all first gate criteria under OIL Fit are removed, even though the criteria Scope was appreciated by many, as shown in the heatmap in Table 4.5.

Increase the usability and flexibility of the criteria

To further increase the usability and flexibility of the model, a similar design change as the one in the stages were made. As can be observed in Figure 4.3, each gate now consists of 2-3 main questions, with suggested criteria beneath them that could be used to answer the overarching question. The overarching questions were derived both from the literature study by Frishammar and Florén, where it was stated that screening should be done with respect to an innovation's viability as a business proposition, and the development project's feasibility. Furthermore, as identified when constructing the generic FEI framework, see Subsection 3.4.1, the three most cited models continuously analyzed and screened for potential, feasibility and organizational fit. The question *Is it something for us?* is meant to encompass the potential and organizational fit aspects, while *Can we do it?* regards the innovation's feasibility. The third question, *Is OIL the right place?*, ensures that the potential innovation is routed correctly, which is deemed important both to ensure organizational support for OIL and to keep an innovative mindset.

Make sure that the effect of an innovation is net positive and sustainable for Axis as a whole

Organizational fit and impact was added to the final gate as it is important to not assess a potential innovation completely in isolation as it will likely affect other parts of Operations, but also allow for a bias free development and exploration as far as possible. As with the removal of *Fit with policies* it is important to be able to question what is considered to be set in stone. Furthermore, scalability of the potential innovation was added to the list of criteria in the concept and formal development gate, as it was added to the process map by two interviewees. Interviewee A highlighted Duplication believing it was synonymous with scalability in all gates, while interviewee I added it to the concept gate. It was argued that as Axis is in a period of large growth, and expected to continue on the same path, unscalable concepts will quickly become useless for Operations. A reasoning that Mikael Gren, co-founder of Axis, states that they use when determining which potential innovations to pursue on an Axis-wide level as well (Gren, 2019). The decision to omit Scalability from the first two gates was made as we believe it to be difficult to check for the scalability of a potential innovation without having a concept in place.

5

Learning Loop 2

This chapter aims to present the results and analysis from Learning Loop 2 and present the final process suggestion for Operations Innovation Lab, Iteration 3.

5.1 Introduction

Learning Loop 1 was concluded by the creation of Iteration 2 of the process for OIL, and Learning Loop 2 was then conducted to sort out observed conflicts between what Operations seemed to desire and the results of the interviews. The specific conflict that was identified, and was the focus of Learning Loop 2, was that the criteria relating to OIL-fit were almost all downvoted, despite a vocalized desire for a specific type of projects being run in OIL. The goal of Learning Loop 2 therefore became to get Operations to reason internally and potentially find a consensus or majority view of what the selection criteria for OIL should be. This goal was realized through a group interview with 5 interviewees that represented the top three hierarchies of Operations, facilitated by us. In an effort to enable discussion, the smaller group of five interviewees was selected from the nine prior, based on their high level of engagement and influence in the organization. The interviewees were guided to discuss OIL's position in relation to other internal structures, what constitutes good criteria and finally which specific criteria to use when evaluating a potential innovation in the first gate, see interview guide in Appendix A.3. The results of the group interview is presented and analyzed in the sections to come. Drawing upon the gained knowledge during Learning Loop 2, a final process suggestion, Iteration 3, was created and is presented in the end of this chapter.

5.2 Group Interview Results

As the participants were all familiar with the purpose of this thesis and the suggested process from earlier interviews, they were given a very brief introduction of the thesis and the purpose of the group interview. Next, they were coached through different discussions aimed at finding first gate criteria pertaining to OIL fit.

Initially, the interviewees were led to discuss places of innovation at Axis Operations, and how OIL should be positioned in relation to them, and concluded that: "*Depending on definition, innovation in different forms occur in many places at Axis Operations, and the distinction of them is not obvious*". Furthermore, "*OIL should not replace any [place of innovation], but rather complement them*" and that innovation pursued today can typically be characterized as either incremental improvements or large scale radical innovations driven by burning platforms and high urgency. In OIL, however, the participants found that a certain type of innovation projects should be driven:

- Evaluations of potential innovation areas, technologies, concepts and ideas (in advance of a burning platform)
- Delimitable problems and opportunities that can be scoped and time-boxed
- Innovation opportunities that address (1) new channels and markets, (2) new technologies, organizational forms, processes and concepts, (3) radical leaps from current operations
- Short innovation projects lasting no more than 12 weeks
- Innovation projects that do not naturally belong in any one department or group

Before pursuing first gate criteria, the group found that well designed criteria should meet a set of conditions. They should not deter participation, be few and simple, make for a good reception of applicants (allow soft declination of applications), and further the process' fulfillment of its design goals. Next, after brainstorming in smaller groups, the interviewees discussed potential criteria and agreed in unison to the four criteria, presented in Table 5.1.

Table 5.1: First gate criteria suggested by the group interview

Criteria	Definition
Benefits to company, customer or user	Significant use, or potential use, to Axis, customers, suppliers or Operations itself
Originality and innovation	Significantly new, radical or different in comparison to current technology, system, business model or market relationship
Delimitable in time and scope	Clear boundaries and delimitations can be set
Organizational homelessness	No one place to develop this innovation exists at Operations

5.3 Group Interview Analysis

The group found consensus on four criteria to answer the question *Is OIL the right place?*, i.e. that the potential innovation should be pursued in OIL, see Table 5.1. In this section, the analysis of these criteria is presented in turn, as well as how these criteria were added to the process for Operations Innovation Lab to create Iteration 3.

Benefits to company, customer or user was added to screen for potential innovations that could offer significant potential use to Axis, customers, suppliers or Operations. This matches other criteria that have been suggested and approved in subsequent gates, albeit under the headline question *Is it something for us?*. Therefore, it will be included in Iteration 3, under the same headline question as in other gates, namely *Is it something for us?*.

Originality and Innovation intends to capture the height of originality shown and promote thinking outside the box and questioning norms. Interviewees also commented that the level of originality of a suggestion need not be radical in objective terms, but must be significantly radical in relation to business as usual at Operations. This means that applying the criteria to a technology investigation is rather straight forward too: the technology must be significantly foreign to current competencies. In its entirety, this criteria will be included under *Is OIL the right place?* in Iteration 3.

Delimitable in time and scope was suggested to ensure that projects are feasible in scope and able to be time-boxed to under 12 weeks. The intention with formulating it as "Delimitable" and not "Delimited" was intended to reducing the burden placed on applicants, which the authors agree with. However, since any input to the process reasonably can be delimited, the criteria risks becoming useless. Instead, it is suggested to screen for input that is *Delimited in time and scope* and aid the applicant in finding well founded delimitations. Ultimately, the modified formulation will be included in the third Iteration under *Is OIL the right place?*.

Organizational homelessness takes other places of innovation at Operations into account and attempts to ensure that innovation with a clear home are treated in their original environment. It attempts to make OIL available for cross-functional and network cooperation, while at the same time differentiating it from other potential places of innovation. This criterion also mitigates the risk of repeating a problem with Innovation X where that program was used to bypass line-manager decisions (see Appendix B). But since the criteria *Organizational homelessness* leaves line-management hierarchies intact, potential innovations that are domain specific and have an organizational home are treated in the right environment immediately. This criteria is included in the third iteration under *Is OIL the right place?*.

Together with *Value and goals* and *Duplication*, the aforementioned criteria forms the first gate of Iteration 3. Iteration 3 is the final process suggestion for Operations Innovation Lab, see Figure 5.1, and in the next chapter it is described how this process was validated with stakeholders, customers and potential users of the process.

Figure 5.1: Iteration 3 the final process suggestion

6

Final Validation

This chapter aims to present the results and analysis regarding the final validation of the process for the Operations Innovation Lab.

6.1 Introduction

The abductive research method employed in this thesis entailed a final application or testing of the final process suggestion, Iteration 3. Since the time limitation prohibited actual implementation and observation, the final validation was done through an anonymous survey. The respondents were the participant of the group interview in Learning Loop 2 and included key stakeholders, users and potential owners of the process. The respondents were asked to on the fulfillment of the design goals that were set up at the initiation of this thesis. The design goals of the process were that it should:

- Increase innovative output
- Enable and improve the progression from opportunity to evaluable concepts
- Enable development of radical innovation
- Engage and enable coworkers in innovative work

The results and analysis of the survey are presented in the section to come.

6.2 Survey Results

All five interviewees who attended the group interview were asked to participate in the survey, and all of them responded. The results of the survey, including the respondents comments, are shown in Figure 6.1

Will the suggested process OIL process in your opinion...

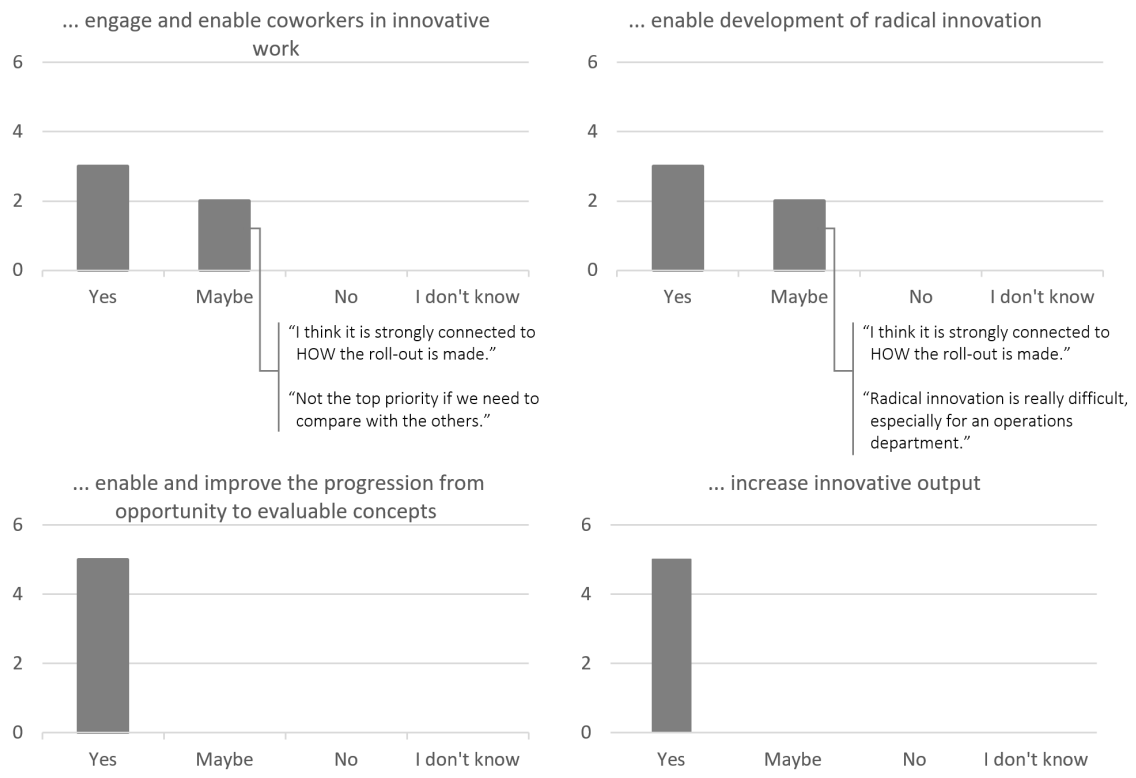

Figure 6.1: Final validation survey results

6.3 Survey Analysis

Figure 6.1 shows that Iteration 3 was well received by respondents. Below, the four questions will be treated in order.

On the topic of "*engaging and enabling coworkers in innovative work*", 60% of respondents agreed fully. One respondent, Respondent A, answered *Maybe* and commented that the nature of "*... HOW the roll-out was made*" would play a pivotal roll. This indicates that the implementation of OIL, which is considered out of scope of this thesis, is important and that proper change management is needed. The other respondent who answered *Maybe*, Respondent B, commented that the matter at hand, compared to the three other design goals, was "*Not the top priority if we need to compare with the others*" which was difficult to interpret. Most likely, the respondent intended to express a view on what the respondent perceived to be least prioritized. It is interpreted that the respondent believes that it will be less prioritized in the implementation as well, hence resulting in that coworkers are "*Maybe*" engaged and involved.

When asked if the process would "*enable development of radical innovation*", 60% of respondents agreed fully. The previously mentioned Respondent A raised the same concern as in the earlier response: that the roll-out will play a pivotal role, which once again highlights the need for change management and strong implementation. Respondent C also answered *Maybe* to the question and commented that "*Radical*

innovation is really difficult, especially for an operations department". The verification of this statement is outside the scope of this thesis, but the fact that it is made by a senior employee at Operations puts some weight behind it. It does also, however, leave the question of *why* it could be especially difficult for operations departments in general to create radical innovations, which would be an interesting topic for further research.

All interviewees responded *Yes* to whether Iteration 3 would *enable and improve the progression from opportunity to evaluable concepts* as well as to the overarching and most significant question of whether it would *increase innovative output*. In conclusion, these results validate that Iteration 3 is a well designed process for OIL that is believed to fulfill the design goals of a process for OIL.

7

Conclusions

This chapter aims to provide final answers to the research questions posed in the start of this thesis.

The purpose of this thesis was to suggest a process for the Operations Innovation Lab that allows an increased innovative capacity, through involving Operations' coworkers and by addressing the Front-End of Innovation. To reach this purpose, the research was structured around the three following research questions:

1. What is a potential process for the Operations Innovation Lab that addresses the Front-End of Innovation?
2. What are key activities to conduct during the Front-End of Innovation at Operations?
3. What are Critical Success Factors for managing the Front-End of Innovation at Operations?

The design goals of the process are that it should:

- Increase innovative output
- Enable and improve the progression from opportunity to evaluable concepts
- Enable development of radical innovation
- Engage and enable coworkers in innovative work

In accordance with our delimitations, the answers to the research questions will not cover topics related to the first stage of FEI, Opportunity Identification. The answers to each question will be presented in the sections to come.

7.1 Research Question 1

What is a potential process for the Operations Innovation Lab that addresses the Front-End of Innovation?

Iteration 3 is a process suggestion for the Operations Innovation Lab, designed as a Stage-Gate process consisting of 4 gates and 3 stages. It is complete with a toolbox of activities and criteria to develop and screen a potential innovation, and is adapted from general literature to fit Operations specifically. The process takes a coworker with a defined opportunity as input and produces a formal development concept and a decision on entering Formal Development as its output. It considers all of Operations coworkers as potential innovators and provides process support and facilitation through a dedicated facilitator and supporting documentation, see Figure 7.1.

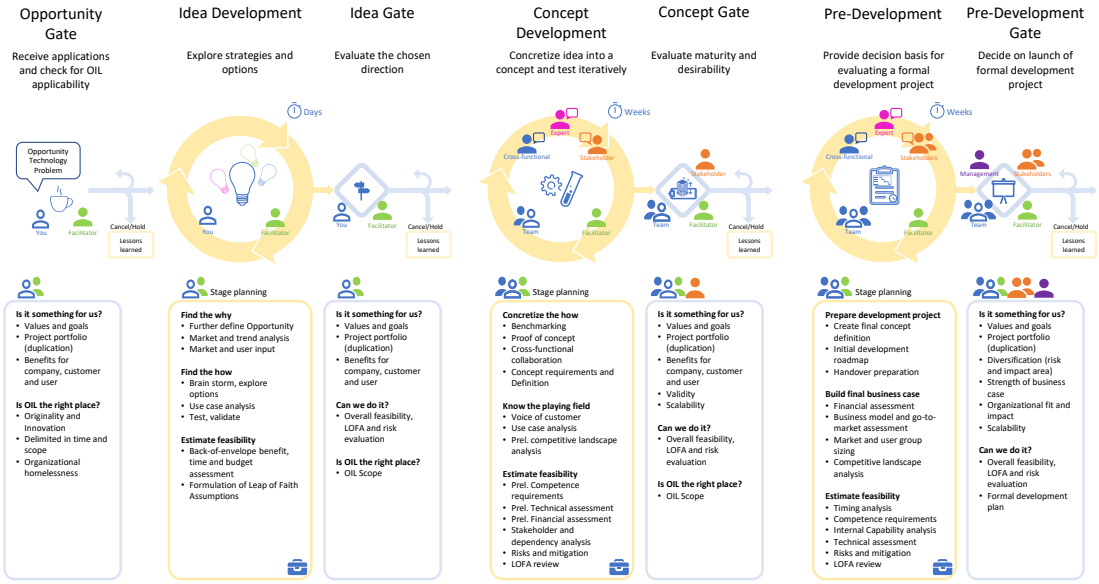

Figure 7.1: (Copy of Figure 5.1) Iteration 3 of the suggested process

The creation of the process started with a thorough literature review, where well cited FEI-processes were studied. Through the literature study, an initial process suggestion was created, Iteration 1. Iteration 1 was rather general, and through interviews with coworkers at Operations, Iteration 2 and 3 were created. Each iteration became more customized to Operations' needs, and Iteration 3 was later validated with the relevant stakeholders.

Iteration 3 starts off with the Opportunity Gate where an Operations coworker, the Innovator, presents a defined opportunity to the Facilitator of the Operations Innovation Lab. A defined opportunity can be a business opportunity, a new technology or an observed problem that the coworker has given some thought and researched a little bit on their own. Based on the questions *Is it something for us?* and *Is OIL the right place?*, the Facilitator and Innovator together decide if the potential innovation should be pursued in OIL, somewhere else, or not at all.

The subsequent stages form a figurative funnel with focus on quick iterations, designed to take a defined opportunity of varying degree of abstractness, and turn it into a tangible formal development concept and a decision on formal development. In the first stage, Idea Development, different strategies and options for exploitation of the defined opportunity are iteratively tested and explored through activities such as *Use case analysis*, *Market analysis* and *Brainstorming*.

The Idea Development stage is followed by the Concept Development stage, where the idea is concretized into a concept and tested with customers or end-users iteratively. It includes concretizing *how* an idea should be pursued through activities such as *Benchmarking*, *Proof of concept*, and estimating feasibility.

In the last stage, the Pre-Development stage, the final concept definition is synthesized and the formal development project is planned. During the last stage emphasis is put on building the business case for the potential innovation, as well as estimating its feasibility, to ensure that the often large and costly formal development is worth pursuing.

After each stage of the process, an appropriate review committee screens the progress to ensure that the potential innovation is seen as desirable, attainable and that Operations Innovation Lab is the correct place to pursue the potential innovation. At each gate, the review committee can award a go/cancel/hold/reiterate decision. While the go and cancel decisions are self-explanatory, hold means that the potential innovation is put on hold for some reason but with the ambition to resume the project. Reiterate means that the review committee believes that a previous stage should be revisited. The review committee consists of the innovator and the innovation team, the facilitator, and relevant stakeholders. In the last gate, management is also involved to ensure that the final gate leads to a decision on formal development, and that a budget is allocated to the coming formal development project.

Iteration 3 also illustrates how an innovation grows in size and complexity as it iterates through the OIL process. The small clocks symbolize that the first stage should be planned to last a number of *days*, while the later two should more easily be described in *weeks*. The figures in the process illustrate how the innovation project amasses more resources and involved individuals as it progresses. Initially, the identified opportunity is discussed between the innovator, *you*, and the facilitator. When the opportunity has been turned into an idea, developed and passed to Concept Development, a team will be formed around the innovator and due to increased complexity, more roles will be involved. Symbolized by *Cross-functional*, individuals from other groups and functions will provide input, collaborate or allow permission. *Experts*, likely involving programmers or IT expertise are expected to be involved in many projects, as well as other *Stakeholders* that are affected by the potential innovation's development or implementation. As mentioned, *Management* are involved in the final gate, but not in the stages.

While untested, this process is considered by the surveyed management at Operations to not only enable and improve the progression from an opportunity to an evaluable concept, but also increase innovative output. And if the implementation is successful, it is also thought to engage and enable coworkers in innovative work and enable the development of radical innovations, which were the design goals initially set.

7.2 Research Question 2

What are key activities to conduct during the Front-End of Innovation at Operations?

The answer to research question 2 is the compilation of the activities included in the process above, Iteration 3 shown in Figure 7.1. The activities were developed based on findings in the literature study, complemented by us, and then adapted to and verified with Operations via interviews. FEI and innovation literature provided a list of activities, see Table 3.3, that was complemented with activities needed to satisfy CSFs and to provide decision basis for criteria that were suggested in literature. In the first learning loop they were adapted to Operations as activities were added, moved, removed or rephrased.

In conclusion, the process suggested here in Figure 7.1 presents an empirically verified toolbox of activities. To facilitate selection of the right tools for the job, the activities are grouped under descriptive statements that, in combination with each stage's purpose, which is aimed to help participating coworkers plan their progress through FEI. In harmony with matching criteria at each gate, they are designed to build a formal development concept through iterative progression.

7.3 Research Question 3

What are Critical Success Factors for managing the Front-End of Innovation at Operations?

Through combining extant literature and both implicit and explicit input from Operations coworkers, we have identified 20 Critical Success Factors for managing FEI at Operations, see Table 7.1. These have served as inspiration when the process iterations for Operations Innovation Lab, were created. We believe that if they are properly taken into account in the management of OIL too, the probability of FEI success at Operations will increase drastically. For full derivation of the CSFs, see Subsection 4.3.4.

Table 7.1: CSFs for managing FEI at Operations

Critical Success Factors for managing FEI at Operations	Description
1. The presence of idea visionaries or concept champions	Someone with a visionary mindset is needed to pave the way internally
2. Idea refinement and adequate screening of ideas	An idea must be allowed to progress despite uncertainty and become iteratively refined. Screening is also vital to weed out obvious losers and make sure that the potential innovation is desirable
3. An adequate degree of formalization	It has been shown that too high, and too low, formalization has negative effects on innovation output. Finding the sweet spot is critical
4. Early customer involvement	Involving the customer, internal or external, is a step towards ensuring that the potential innovation is designed properly
5. Appropriate cross-functional collaboration	Other functions may have insights to provide on, or could be affected by, a potential innovation, which is exacerbate in situations with complex touchpoints and dependencies
6. Information processing other than cross-functional integration and early customer involvement	Other companies, universities or NGOs for example should be seen as important sources of inspiration, information and that can be accessed
7. Senior management involvement and organizational support	Both are needed to ensure that innovation is sufficiently prioritized and given the proper resources
8. Preliminary technology assessment	Understanding what technologies and developments are needed for a potential innovation is a crucial activity for reducing uncertainty before an investment
9. Alignment of innovation efforts with strategy	Aligning innovation efforts with strategy ensures that effort and resources are allocated effectively and that concepts truly are desirable
10. A well defined concept definition	A clear definition including e.g. a prototype and benefit analysis, makes it easier to decide if a potential innovation is worth further exploration
11. Effective handover to Formal Development and formalized learning	Effective handover is needed to ensure that no information is lost between FEI and Formal Development teams. Formalized learning enables both handover as well as learning from previous teams
12. Project management and the presence of a project manager	Together with the Facilitator, a project manager is needed to drive the project forward and employ good project management techniques
13. Innovative culture	An innovative culture will help the generation of new ideas, opportunity recognition (out of scope of thesis), and strengthen organizational support
14. Appropriate review committee	Relevant knowledge and insights is needed to make the right decisions. Senior management should be included in the last stage to also provide credibility and resources
15. Project portfolio planning	Makes sure that the finite available resources are spent in the best way by e.g. minimizing duplication of projects or conflicts
16. Balance daily operations and innovative work	Internal disruptions have dramatic impact, but failing to innovate and e.g. renew processes may result in loss of performance or competitive advantage over time. Finding a balance is also important short-term, eg. prioritizing resources, competency allocation or allowing slack
17. Autonomous innovation teams	Autonomy and self-sufficiency enable momentum, which impacts speed, motivation and success
18. Process support and facilitation	Through process support and facilitation all Operations' coworkers will be able to pursue innovation work to the best of their abilities, which is seen as key to achieve increased innovation output
19. Lenient early screening	Lenient early screening is needed to avoid deterring participation, and early termination of viable potential innovations
20. Strong internal communication, focusing on success stories	Showing that the process works and what it can do, with an emphasis on success stories, is seen as critical to achieve a continuous internal support and interest of the process

8

Discussion

In this chapter the thesis' generalizability, limitations and academic contribution are discussed. Topics for future research and next steps for Operations are also suggested.

8.1 Generalizability

This thesis employed a single-case study methodology, and thus we make no claim of being able to generalize the results to a wider population. However, as Höst et al. noted, the probability of a result being applicable to another object increases as the similarity of the settings and characteristics increase (2006), creating transferability. Thus if Operations characteristics can be properly described, then identifying organizations where the applicability of this thesis might be higher becomes easier and the transferability increases. We believe that the following 4 key characteristics have been most distinguishing when studying Operations: (1) disruption of ongoing processes and activities is a complex, costly and highly respected topic, (2) non-product innovation is particularly relevant and represents a majority of potential and desired innovation, which combined with the first characteristic places an increased importance to managing internal touchpoints and dependencies, (3) coworkers have a varying degree of experience with innovation, and are not expected to be predisposed to innovative work although they are essential for the process, resulting in an increased need for motivation, support and facilitation, and (4) Axis' growth strategy makes the scalability of potential innovations vital. These settings are believed to have had a significant impact on the changes made to adapt the highly generic starting point, Iteration 1, to a final process suggestion for OIL at Operations. If another organization exhibits the same characteristics then it is more likely that our results are transferable to said organization. However, the potential causalities between specific characteristics and our results, and their interrelationships, need be studied further.

8.2 Limitations

This study was conducted under a 20 week time constraint and could therefore not encompass a true implementation of the suggested process, which prohibited rigorous empirical testing and validation. The chosen proxy to field validation was surveying a group of people that were knowledgeable of management, Operations, process design

and familiar with the process itself. Even though they are considered best suited for forecasting the applicability of the process in its environment, the stratified and representative selection possibly introduced further limitations in the form of biases. Any combination of the Bandwagon effect, confirmation bias or the mere-exposure effect could possibly contribute to overly positive results. Anonymity in the final validation survey and, plausibly, a willingness to, and self-interest in, providing good feedback hopefully alleviated some of that potential bias.

Regarding the suggested activities, mainly positive comments were received, and in fact not a single downplay was cast on any activity. This might be related to the fact that there was no "cost" in appraising any number of activities. If a restriction on, let's say 10 activities, would have forced a reasoning of which activities were the most important. For this reason, activities of lesser importance could still be in the process.

8.3 Potential False Negatives

Almost all CSFs identified in literature were corroborated in Operations and kept with minor adaptions. In fact, only two were removed as they were never discussed: *External cooperation* and *Project priorities*. However, we see the results as potential false negatives as we find it difficult to understand why *External cooperation* would not be an appropriate CSF when large parts of Operations' value chain is outsourced with complex and intimate connections. Likewise, it is difficult to see why the trade-off between quality, time and resources spent on a project, which the CSF *Project priorities* represents, would not be an appropriate CSF either. Therefore, further research could be useful in assessing if they are truly insignificant, less important than others, or as important but for some reason not mentioned in this study.

8.4 Academic Contribution

Current literature on managing the Front-End of Innovation is heavily influenced by research made in product innovation and in R&D functions, which fail to accurately describe apt management practices for non product specific innovation in settings outside of R&D, and in Operations departments specifically. Innovation of processes, organizational structures and business models are still underrepresented in both the literature's underlying data and its purpose. Another significant research gap that hinders practical application is the lack of an established understanding of which activities to perform in FEI.

This thesis constitutes an initial contribution to what could become a guiding and applicable academic contribution to business and the practice of managing innovation in the Front-End. It attempts to contribute with (1) knowledge from a non R&D setting, more specifically an operations setting, and also (2) knowledge from non product specific innovation. This is done through the list of CSFs for managing FEI at Operations and the process containing a semi-sequenced list of activities to perform in FEI. While no research gap has been filled, we believe that our results could serve as a contribution to the body of literature needed to fill those gaps.

8.5 Suggestions for Future Research

During the writing of this thesis we came across a plethora of subjects that would be interesting to pursue further, but were forced out of scope due to the time limitation. First and foremost, we call upon researchers to address the literature gaps discussed in the previous subsection. Innovation is increasingly important in almost all sectors, and we believe that allowing innovation research to continually be product-centric would be nothing short of detrimental for future development of the research field. Secondly, we believe that further study on identification of innovation opportunities, which is a topic of concern for some of the interviewees at Operations, would complement the field and increase tangibility of FEI management. The aforementioned constraints of this thesis left that part of FEI out of scope, which much of the literature unfortunately also does. Thirdly, we call for more research regarding the involvement of non R&D employees in Innovation, as most of the literature we came across during the literature review was based on and aimed towards full time innovation work, mainly in R&D settings. To enable innovation in all parts of the company we believe that involving all coworkers is essential, but new potential problems arise. A few questions that would be interesting to pursue further in this domain are:

- How should one best account for lacking proficiency in innovation work?
  - Is a facilitator the best way to go, as suggested by this thesis, or are e.g. learning platforms better?
- How do you actually balance innovation work with daily operations, which was identified as a CSF for Operations?
- Are there distinct differences in personality types in different functions, and what impact does that have on innovation work, the management of innovation work, and the facilitation of innovation work?

Another potential way of increasing innovative output is of course utilizing internal groups with dedicated innovation resources. On one hand, this mitigates problems with lacking experience and balancing innovative work with daily operations. On the other hand, it creates a distance between coworkers and innovation, and fails in harnessing the innovative force of the entire company. Idea boxes, that have been used to bridge such distances, are always exposed to the "*Not invented here*" mentality, as described by de Vos (2019), Director of IFS Labs. That mentality ruins handovers and eliminates some of the potential power of Champions and championing. This calls for further study into the benefits and downfalls of both the *dedicated team* philosophy, and the *participation lab* philosophy that was selected for Operations, which will increase the applicability of innovation research to industry.

The final topic in need of further research that we want to highlight is whether or not *Screening for suitable innovators* is appropriate in a corporate setting. Idea champions and competent team members were mentioned as important roles as well as a CSF both in literature and by the interviewees at Operations. Despite this fact, all discussions on screening and criteria at Operations and in the studied literature revolve around finding the right *innovation* and never *innovator*. Given that the potential innovator and idea champion are seen as vital, and that e.g. angel investors frequently look at both the potential innovation and innovators (Clark, 2008), it would be very interesting to learn if this could be a strong predictor of success,

and something worth screening for in a corporate setting as well. It would also be interesting to study the potential drawbacks of such screening, e.g. that it could be deterring, seen as unfair, politically incorrect or too much of a personal attack.

8.6 Suggested Next Steps for Operations

Before implementing the Operations Innovation Lab at scale we suggest that four further steps are taken. First, we recommend Operations to find a way to make sure that coworkers are willing to participate in the process. In this thesis we defined coworkers and their ideas as exogenous input. We urge Operations to instead assess which efforts are needed to assure the level of input and engagement with the process that is desired. Operations could perhaps look at Axis' New Business' *Innovation days* for inspiration, or experiment with different incentive structures such as the one Axis' patent department successfully employs (Jönsson, 2019; Alm, 2019). Furthermore, senior coworkers will likely remember the Innovation X program, discussed in Appendix B, and may react less enthusiastically to the launch of OIL than more recent hires. Showing them that OIL is different in that it accounts for touchpoints and dependencies better will likely be of high importance. Planning for how interest and attention should be *maintained* over time will further avoid the smaller of the two pitfalls of Innovation X.

Secondly, although out the scope of this thesis, Operations should plan the implementation carefully and respect the change management efforts needed in the roll-out of Operations Innovation Lab. Both due to the fact that research shows that 50-90% of change initiatives fail (Mosadeghrad and Ansarian, 2014), and that several interviewees have emphasized that the success of the initiative is highly dependent on its implementation. Anchoring OIL and the importance of pursing innovation with line managers is critical as they will be affected when coworkers participate in OIL. This was the main point of contention with Innovation X, see Appendix B.

Thirdly, we recommend that Operations defines what success is for the Operations Innovation Lab, and then in true Front-End spirit, create an initial prototype and iteratively test it in advance of a full scale roll-out. Piloting OIL will allow early improvements to the process and perhaps the creation of a communicable success story. In conversations with de Vos, we learned that measuring performance using hard leading performance indicators, and softer lagging indicators avoid skewing innovation efforts, and could be a useful consideration in an OIL implementation (de Vos, 2019).

Lastly, we recommend Operations to take a holistic approach to their innovation efforts and integrate FEI efforts with Formal Development, and ultimately Launch. We believe that continuous efforts to ensure the follow-through of the entire innovation process is key to increasing innovative output and realizing the ultimate goal of creating a scalable and innovative Operations.

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Appendix A

Interview guides and surveys

A.1 Interview Guide for Semi-structured Interviews

Data Collection Learning Loop 1

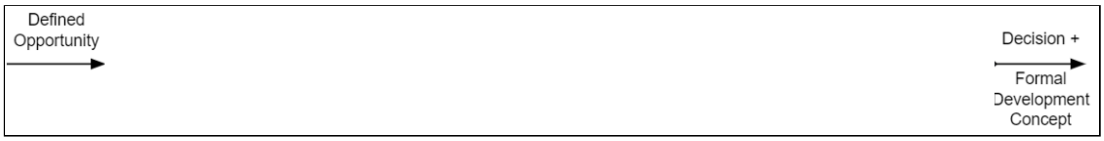
Structure

The Semi-Structured interview will have a four part agenda:

- **Context:** The thesis and the purpose of the interview is explained.
- **Qualitative questions about their view of FEI:** where the subjects show *their* understanding of important components in advance of being showed our findings.
- **Qualitative questions about their perception the suggested design:** where the subjects will be shown the suggested design, and asked to react and comment on it.
- **Quantitative questions:** Where the subjects answers 3- or 5-point-scaled questions evaluating the suggested process and the inherent design choices.
- **Conclusion:** Short conclusion, and opportunity for the subject to ask further questions or add something.

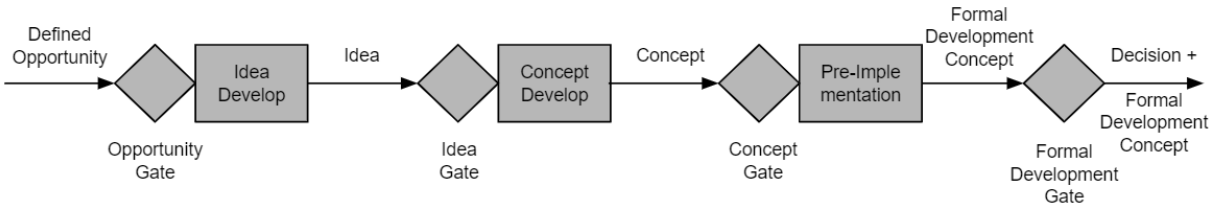
Questions

Qualitative questions:
The subjects will be shown Figure 2, and asked open questions. They will be told that, the blank space is where our process takes place, but that we want to ask what is important in their view, before we show our findings and ask for their comments.



1. What 3-5 activities are important to perform in FEI for Operations?
2. What are Critical Success Factors for managing FEI at Operations?
    a. What 3-5 problems could be encountered?
3. What 3-5 roles should be involved in FEI at Operations?
4. What are 3-5 important criteria for Operations when evaluating a new potential innovation?

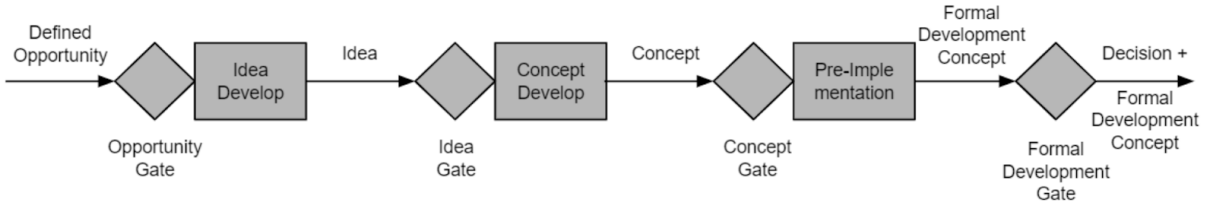
Next, to verify design choices and provide a feedback opportunity in advance of the second process suggestion, questions will be asked on the process. The subjects will be presented with the suggested process and its activities, see Figure 3:



Initially:

5. Does the flow and breakdown of these stages/gates seem logical?

Then - the subject will be shown Figure 4, and given four pens One yellow, one pink, one red and one blue pen and will be asked to indicate if they want to highlight, downplay, remove or add/move an activity or criteria. They are given roughly 30 minutes to contemplate and clarify components with the interviewer.



Opportunity Gate	Idea Development	Idea Gate	Concept Development	Concept Gate	Pre-Implementation Stage	Formal Development Gate
Strategic Fit	Opportunity	**Strategic Fit**	Market/User Involvement	**Strategic Fit**	Concept Formalization	**Strategic Fit**
Fit Goals	Further Define Opportunity	Fit Goals	VOC	Fit Goals	Make/Buy Analysis	Fit Goals
Fit Policies	Market & Trend Analysis	Fit Policies	LOFA testing	Fit Policies	Final Concept Definition	Fit Policies
			Use Case analysis		Market/User Group Sizing	
					Extended Stakeholder Analysis	
Portfolio Fit	Ideation	**Portfolio Fit**	Concept	**Portfolio Fit**		**Portfolio Fit**
Duplication	Brain storm, Explore Options	Duplication	Design Iterations	Duplication		Duplication
Diversification (risk and impact area)	Test, Validate	Diversification (risk and impact area)	Proof of Concept	Diversification (risk and impact area)	Implementation	Diversification (risk and impact area)
	Market/User Input		Benchmarking		Initial roadmap outline	
	Use Case Analysis		Stakeholder Analysis		Financial Analysis	
	Formulation of Leap of Faith Assumptions (LOFA)		Concept Requirements and Definition			
OIL Fit		**OIL Fit**	Formulation of Leap of Faith Assumptions	**OIL Fit**	Timing Analysis	**OIL Fit - Not Applicable**
Scope		Scope		Scope		
			Cross-Functional Communication			
Magnitude and novelty		Magnitude and novelty		Magnitude and novelty	Handover preparation	
Outside of normal working situation		Outside of normal working situation		Outside of normal working situation		
	Feasibility		Feasibility		Feasibility	
	Sanity Check		Prel. Competence requirements		Competence requirements	
						Formal Developement Concept
		Idea	Prel. technical assessment	**Concept**	Technical assessment	Concept Strength
		Validity	Prel. financial assessment	Validity	Financial assessment	LOFA Strength
		Feasibility		Feasibility	Internal Capability Analysis	
		Benefits for company, customer and/or end-user		Benefits for company, customer and/or end-user		Implementation
		LOFA assessment		LOFA assessment		Feasibility

6. Would you highlight as important, downplay, add or move, or remove any or activity/criteria?

Quantitative questions

To, finally, gauge the subject's preference regarding observed design dichotomies and the current design, they are asked to mark the most applicable box, and given an opportunity to ask clarifying questions and provide a comment.

Question/Valuation	Too	A little too	Well	A little too	Too
1. Flexibility vs Structure	Flexible	Flexible	Balanced	Rigid	Rigid
2. Innovator Freedom vs Management Control	Much freedom	Much freedom	Balanced	Controlled	Controlled
3. Focus on Creativity vs. Implementation (business)	Much Creativity	Much Creativity	Balanced	Much Implementation	Much Implementation
4. Number of stages/gates	Few	Few	Balanced	Many	Many
5.Vague vs Micro-Management of activities/Criteria	Vague	Vague	Balanced	Micro managing	Micro managing
6. Level of Management involvement	Low Involvement	Low involvement	Balanced	Much involvement	Much involvement

Concluding remarks
Ultimately, they may give concluding remarks.

1. Do you have any concluding remarks, questions or thoughts?

References

Höst, M., Regnell, B. and Runeson, P., 2006. Att genomföra examensarbete. Studentlitteratur AB.

Gioia, D.A., Corley, K.G. and Hamilton, A.L., 2013. Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. Organizational research methods, 16(1), pp.15-31.

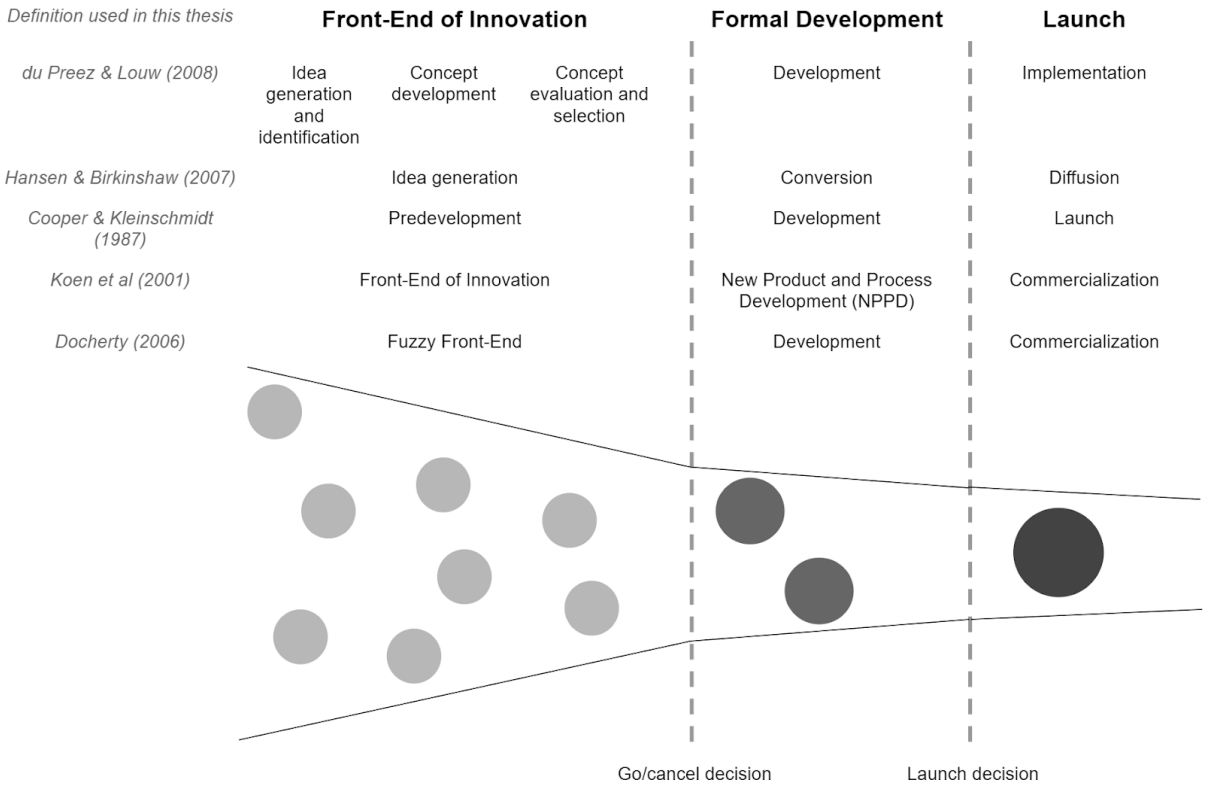
A.2 Background material on FEI

Bakgrund till intervju angående Operations Innovation Lab

Vårt arbete handlar om att främja innovation på Operations genom att föreslå en process för det blivande *Operations Innovation Lab* (OIL). Målet med OIL är att Operations medarbetare ska få en möjlighet att testa sina egna, mer radikala innovationsidéer.

Allmänt om innovation

Innovation är någonting substantiellt nytt, som tas i bruk av en användare eller kund. En innovationsprocess består ofta av tre stora faser (enligt skissen nedan): The Front-End of Innovation (FEI), Formal Development och Launch.



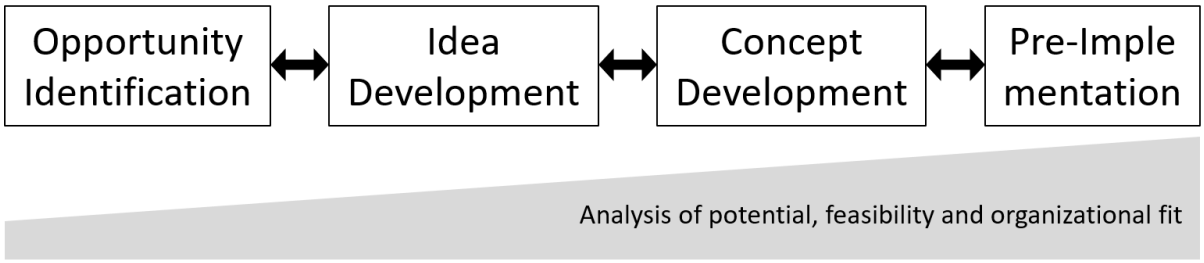
FEI är den första fasen av en innovationsprocess och man kan säga att målet är att komma fram till *vad som ska utvecklas eller förändras* och *ungefär hur det kan göras.* FEI karaktäriseras oftast av kreativitet och brist på information, och här analyseras möjligheter och idéer samt koncept tas fram och utvärderas.

När man väl hittat vad som ska utvecklas eller förändras, samt ungefär hur det kan göras påbörjas fasen *Formal Development*. Likt namnet antyder är detta den formella utvecklingsprocessen, där ett större team tillsätts och en budget allokeras till projektet.

Formal Development avslutas när organisationen upplever att den nya innovationen är redo att lanseras, och då påbörjas *Launch*. Under *launch* ser man till att den nya innovationen sprids till rätt målgrupp, exempelvis en kund eller den egna organisationen.

Vårt fokus: The Front-End of Innovation

Som vi skrev i mailet har vi valt att fokusera på den första delen av innovationsprocessen - FEI, vilken i sin tur kan delas upp i följande steg: *Opportunity identification, Idea development, Concept development* och *pre-implementation*.



De fyra faserna går ut på att man hittar en möjlighet till innovation (*Opportunity identification)*, kommer på en lösningsstrategi på hur man kan ta tillvara på innovations-möjligheten (*Idea development),* varefter man konkretiserar innovations-möjligheten till ett koncept (*Concept development),* och slutligen förbereder för ett eventuellt kommande utvecklingsprojekt (*Pre-implementation).* Under hela FEI analyserar man ofta den potentiella innovationens potential (*potential)*, genomförbarhet (*feasibility)* samt huruvida det är rätt val för den egna organisationen (*organizational fit)*. För vidare förtydling av FEI, och för att Hannes vill skryta om att han har åkt vasaloppet, har vi försökt illustrera FEIs olika delar med hjälp av ett fiktivt scenario om hur stationerna med blåbärssoppa kan ha kommit till. Om du är intresserad finns den längst ner.

Frågor att fundera kring innan intervjun:

- **Vad tror du är viktigt för Operations att tänka på när det gäller en process för Front-End of Innovation?**
- **Vilka utmaningar ser du för en sådan här process?**
- **Vad tror du är viktiga aktiviteter i FEI?**

A coworker in the race organization noticed that participants needed extra energy during the long grueling race. This opportunity seemed interesting and the need for additional energy was therefor verified with friends who had completed the race. Thus ***Opportunity Identification*** *was complete. Next,* ***Idea development*** *began with discussions in the organization and with recurrent participants about how to solve the problem. Suggestions that perhaps the organizers could arrange something for competitors at various stages of the race came up. With this broad direction of what needed to be done, the* ***Concept Development*** *phase started, where organizers interviewed competitors and found out that energy supplements during the race indeed was a good idea and that it should be easily absorbed, quick to consume and not hamper their performance. Multiple possible concepts were tried, but blue berry soup at different stations during the race was the most popular and thus a viable concept was created. Now, the organization conducted analyses, as part of the* ***Pre-Implementation*** *phase to make sure that if they would pursue the blue berry soup stations they would afford it, and be able to supply it, thus creating a Formal Development Concept i.e. a viable concept with a semi-clear implementation plan. The Formal Development Concept was ultimately presented to the board, and it was decided to develop the innovative solution, find the best recipes, talk to suppliers of tents and launch the innovation the next year; which concluded the FEI part of the Innovation Process.*

A.3 Agenda for the Goup Interview

Learning Loop 2 - Group interview

Objective

Find design input on first gate screening

Structure

The group interview will have a 3-part agenda.

- **Current state discussions:** The interviewees will be asked to discuss where innovation takes place at Operations today, and where Operations Innovation Lab fits in and how it is different from current structures.
- **Update on process model:** Iteration 1 will be shown and the feedback from previous interviews summarized. After which iteration 2 will be shown, and the changes explained.
- **Discussion on selection criteria for OIL:** First a discussion on what constitutes good criteria will be held, and then the participants will be divided into small groups and asked to come up with suiting criteria for OIL. After the discussion in the small groups, a final discussion will be held where everyone participates in hopes of finding a consensus on which criteria to use to determine if a potential innovation is eligible for Operations Innovation Lab.

A.4 Final Validation

Final validation - Survey

Four questions will be asked to verify if the suggested process has met its initial design parameters.

To your understanding, will the process...:	Don't know	No	Maybe	Yes
1. engage and enable coworkers in innovative work?				
2. enable development of *radical* innovation, better than before?				
3. enable progression to *evaluable concepts*, better than before*?*				
4. increase innovative output, compared to before?				

Appendix B

Innovation X

Excluded due to confidentiality.

Appendix C

Gioia analyses

C.1 What are 3-5 important for criteria for Operations when evaluating a new potential innovation?

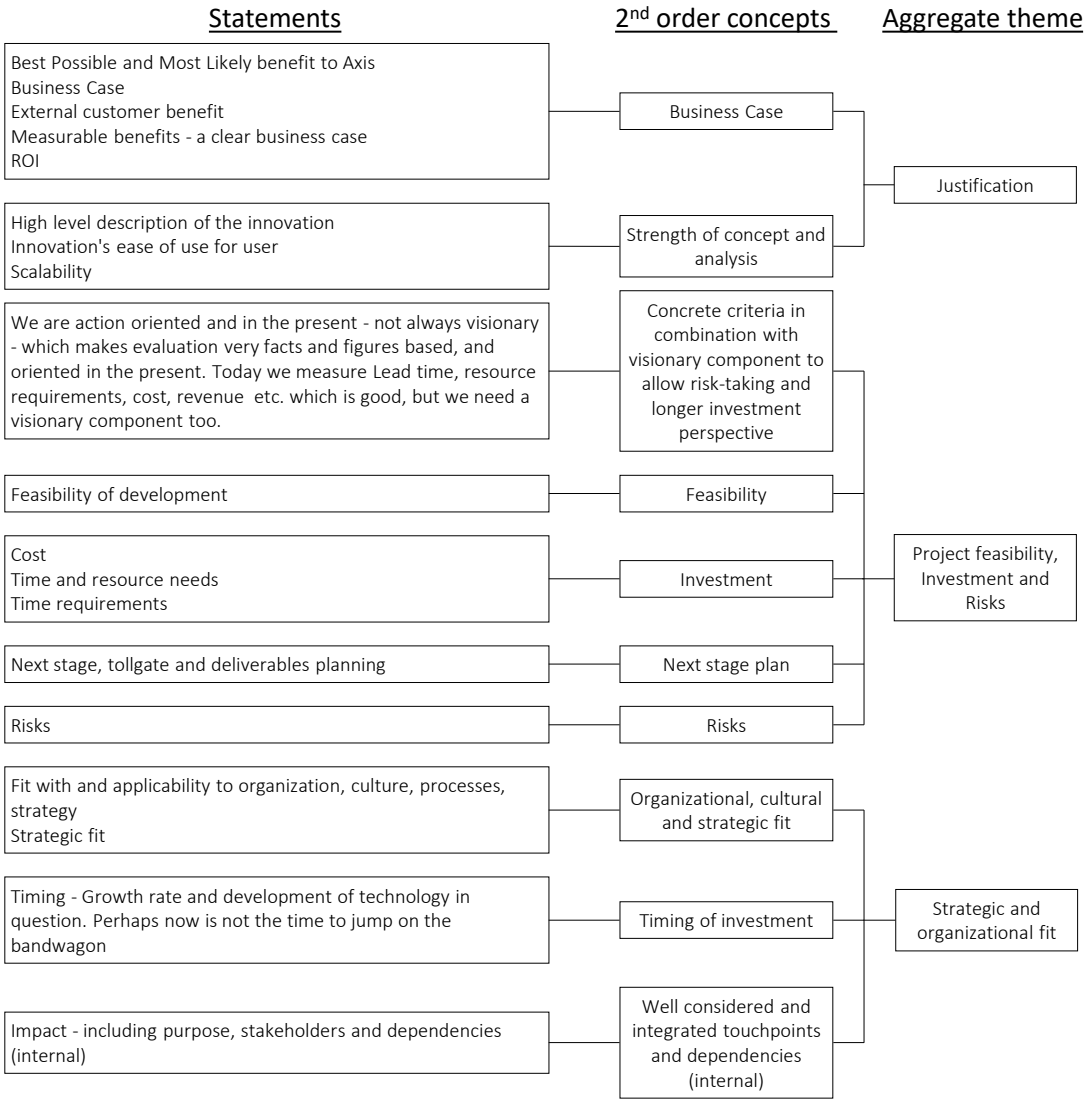


Figure C.1: Gioia clustering of answers regarding important criteria for Operations

C.2 What 3-5 roles should be involved in FEI at Operations?

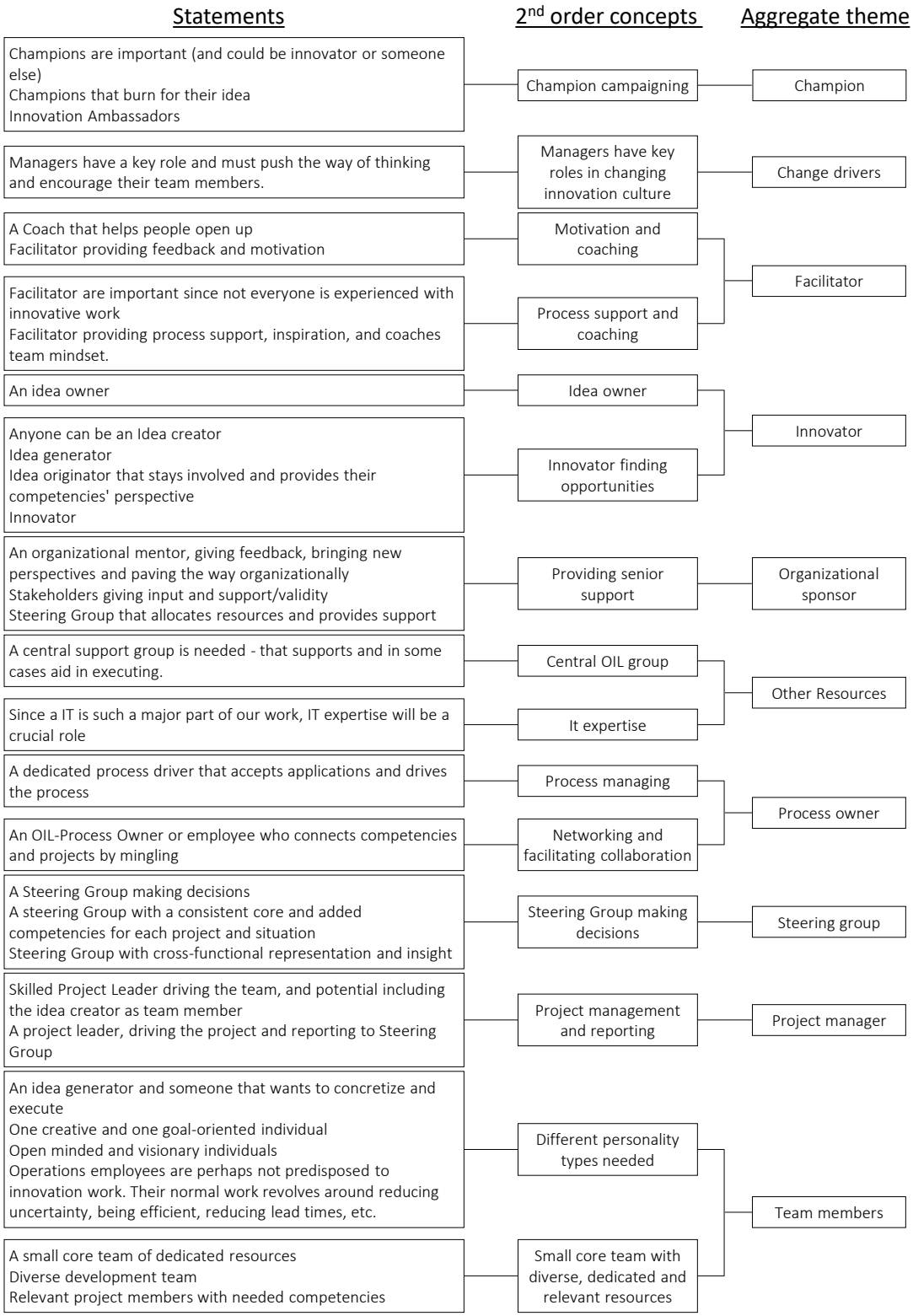


Figure C.2: Gioia clustering of answers regarding roles involved in FEI at Operations

C.3 What 3-5 activities are important to perform in FEI for Operations?

Figure C.3: Gioia clustering of answers regarding important activities to perform in FEI for Operations

C.4 What are Critical Success Factors for managing FEI at Operations?

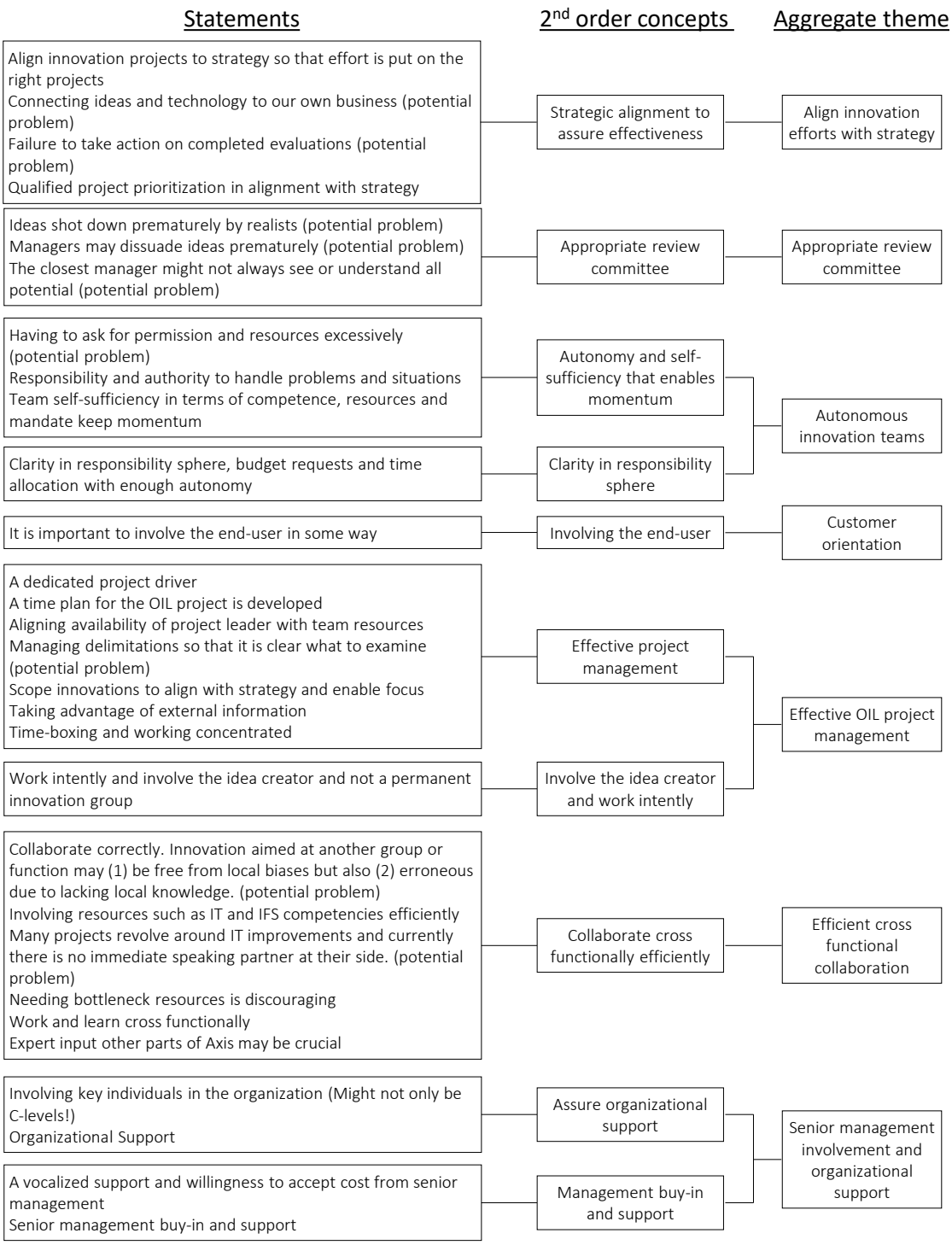


Figure C.4: Gioia clustering of answers regarding CSFs for managing FEI at Operations (1/3)

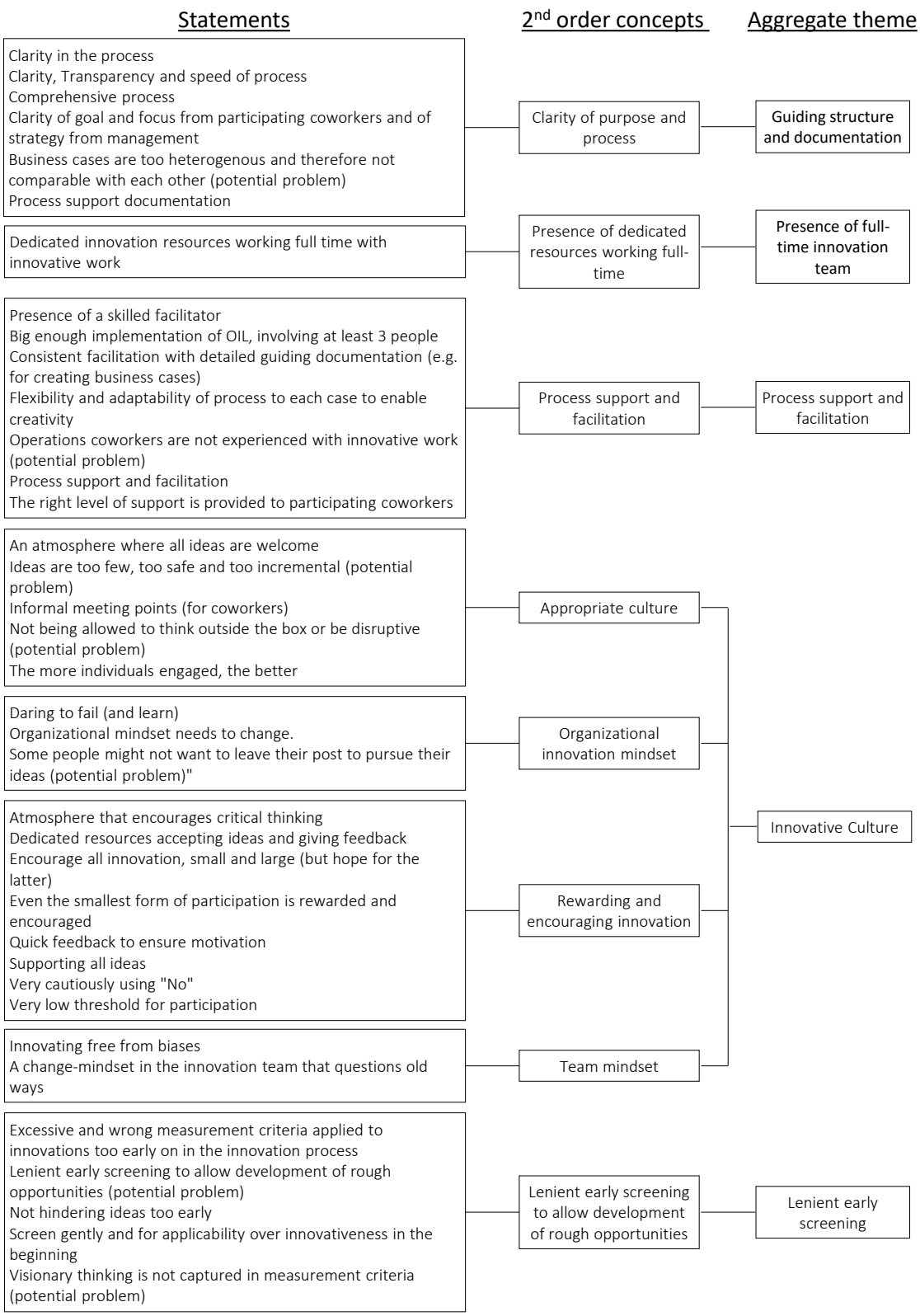


Figure C.5: Gioia clustering of answers regarding CSFs for managing FEI at Operations (2/3)

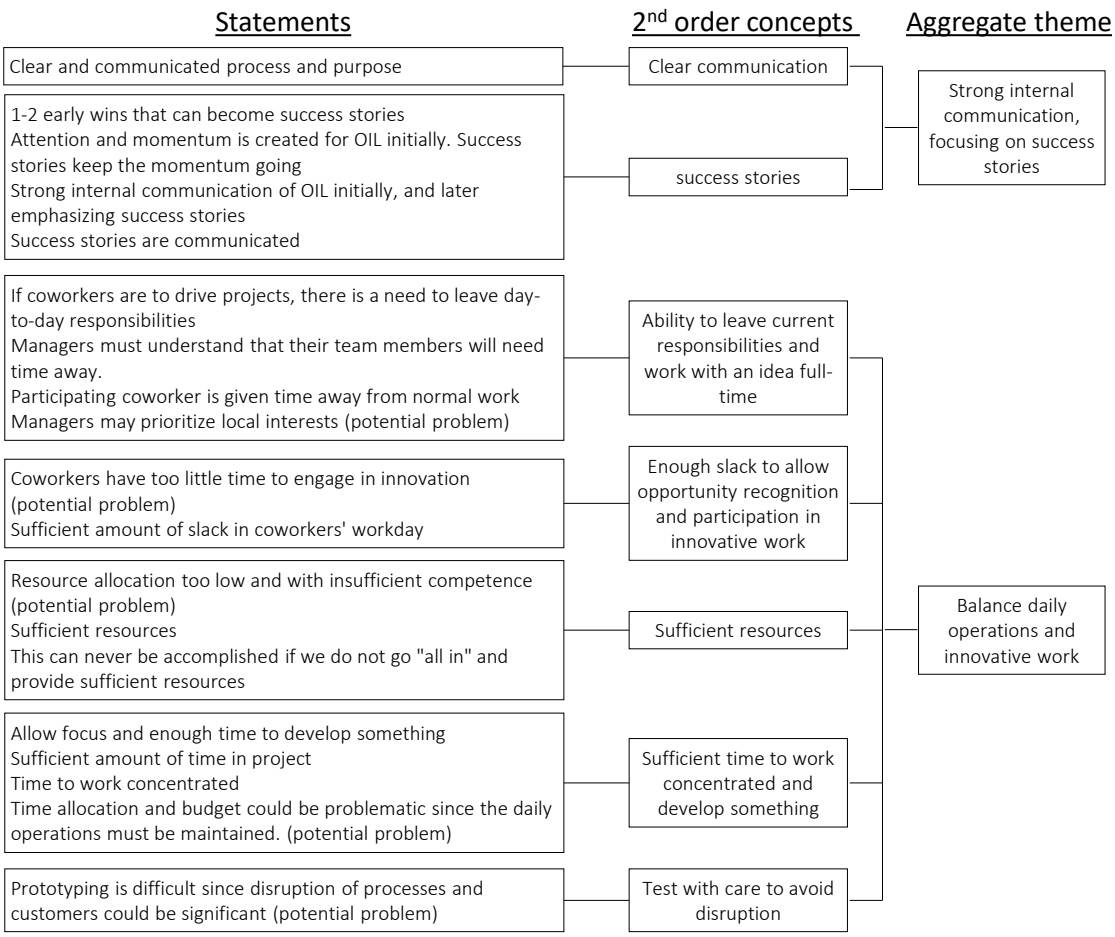


Figure C.6: Gioia clustering of answers regarding CSFs for managing FEI at Operations (3/3)