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Systemic Causes for having Too Many Innovation Projects

Master Thesis

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Preface

You are currently reading the thesis "Systemic Causes for Having Too Many Innovation Projects." This research was conducted as the conclusion of the master's in Business Analysis and Modelling (Business Administration) I followed at the Radboud University. The carrying out of this master's complements the bachelor's in Business Administration that I carried out at the Christelijke Hogeschool Ede. I got interested in the topic "having too many projects" due to my experiences at my graduation internship of that study.

The process of writing this thesis undoubtedly was challenging and a learning experience for me. Looking back at the process, I realize I had a lot to learn. But fortunately, I pulled through. I am grateful to all who have helped and supported me in different ways. I would like to thank my supervisor, professor Meurs, for his knowledgeable guidance and the directness of his feedback. I want to thank professor van Deemen for his honest feedback on and suggestions for the research proposal. Besides, I would like to thank the case organization, and especially my contact person, for the trust in, and commitment to this research investigation. In particular in selecting the participants and making time to keep the sessions and interviews. Finally, I would like to thank my parents, brothers, sister, friends, fellow percussionists, and anyone else I might forget for listening to my concerns regarding the process, encouraging me, and being patient with me. Especially my "study buddies" – or better said: "sisters in arms" – Shea and Jennifer. I wish you the best of luck with your thesis writing and I hope you will finish soon! Next, I would like to thank Martin from the Radboud Writing Lab for his tips and reflective questions. Also, thanks to Peter, Jacob-Jan, Friso, Gerben, Jennifer, and Shea for proofreading (parts of) the thesis and providing valuable feedback.

I sincerely hope that reading this thesis benefits the case organization, other organizations that struggle with innovation project portfolio overloads, and others interested in this topic. I would like to conclude this preface with the following quote, which combines feedback thinking and faith:

"Love works in a circle, for the beloved moves the lover by stamping a likeness, and the lover then goes out to hold the beloved in reality. Who first was the beginning now becomes the end of motion." (Thomas Aquinas)

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Abstract

Organizations need to carry out innovation projects to survive and thrive. While the supply of potential innovation projects is often large, organizations have limited resources to carry them out. Most organizations have strategic solutions in place to balance the number of innovation projects with the available resources. Still, a majority of organizations struggle with an overload of innovation projects. This study explores why the issue of having too many innovation projects remains so persistent. To do this, this research used a combination of the System Dynamics method and the portfolio decision-making effectiveness framework. Accordingly, the research question of this study is: *What are the systemic causes for having a portfolio with too many innovation projects, and what is their relationship with portfolio decision-making effectiveness?*

To address the research question, a case study has been carried out. The case organization experienced an overload of innovation projects even though a formal process for project execution was in place. Group Model Building sessions were held with employees who were involved in this issue. In these sessions, the problem behavior of having too many projects was established. This input was then used to build a qualitative System Dynamics model of the problem. With this model, leverage points to effectively address the issue of having too many projects were elicited. An extra interview was held to assess the validity of the model.

The study found two main systemic causes. First, a reinforcing relationship between having too many projects, low employee morale and low commercial performance. This relation makes it difficult to counteract project overloads. Second, a balancing feedback effect between commercial performance and work pressure. This effect alleviates high work pressure. However, this effect takes too much time. Hence, more direct feedback is required. Furthermore, this study shows that having an excess of innovation projects hampers portfolio decision-making effectiveness, and vice versa. The top leverage point resulting from this study is separating innovation ideation from innovation project execution. This structurally brings down the number of innovation projects.

Scholars can build on this research by testing and expanding the model on project overloads. Practitioners can use this study to assess their situation, and employ solutions with regards to having too many projects.

Keywords: too many projects, innovation project portfolio management, portfolio decision-making effectiveness, system dynamics

Contents

1. Introduction

1.1 Context

1.1.1 Innovation projects

Organizations need to carry out *innovation projects* because, these days, they need to innovate besides making a profit if they want to survive (Meifort, 2016). Innovation projects are even more difficult to manage than ordinary business projects. This is, for instance, because they have a higher possibility of failure and their scope can change more often (Deák, 2009). Having enough ideas for innovation projects is often not a problem. The main problem is that organizations have limited capacity for innovation.

1.1.2 Too many projects

97% of organizations still report that attempting to run too many projects in relation to the available resources is their largest project management challenge (*The State of Project Management Survey*, 2021). The consequences of such overloads are not only that fewer projects are finished, but they are also less successful. Having an excess of innovation projects also has negative effects on employees (R. G. Cooper et al., 2000; Zika-Viktorsson, 2006). For example, psychological stress or a decline in morale. Having too many projects is especially problematic when it slows down the progress of strategically important projects. This can in turn hamper the achievement of core organizational goals such as customer satisfaction and profit (Vorhies & Morgan, 2005).

1.2 Research gap

A System Dynamics (SD) approach is required to shed new light on the issue of having too many projects. SD is an approach for understanding the behavior of complex problems using feedback thinking. Feedback thinking uses loops of cause-and-effect to study behavior of a system over time. Engwall and Jerbrant (2003, p. 408), state that research on this topic "has to go beyond resource allocation and start addressing incentive structures … and other deeply embedded features of the organization." Unfortunately, research has thus far not taken a true systemic view on this issue (Zarghami & Dumrak, 2020). While some systemic causes have been identified by R. G. Cooper & Edgett (2003), there still lacks an overarching model that connects the factors causing innovation project overloads.

Besides that, it is important to take a decision-making (DM) perspective on the issue of too many projects. The issue of having an excess of innovation projects has mainly been researched at the strategic level in the past two decades (R. G. Cooper et al., 2000). But organizations that have formal, strategic solutions in place still appear to struggle with this problem (Christiansen & Varnes, 2008; *The State of Project Management Survey*, 2021). Decision-makers for instance do not abide by the agreed criteria. This shows that research has to focus on what reduces the effectiveness of portfolio DM in practice instead of focusing on which solutions are best from a strategic perspective.

This research is relevant for scholars for three reasons. By looking at the issue of too many projects using SD and DM, scholars can better understand why it remains so persistent. This aids them in focusing their studies on the underlying problems and their possible solutions. Besides that, this study provides an overview of the factors that are related to having an excess of innovation projects. In doing so, researchers can place their research into perspective. The overview provided by this study can also shed light on understudied areas of this problem. Furthermore, the model that this research develops can also function as a starting point for a model of portfolio management in general. The connection of SD and portfolio DM shows how the findings relate to existing concepts around portfolio DM.

1.3 Practical Relevance

In the first place, this research is relevant for the participating organization by making a model of their issue of having too many projects. This way, they gain better understanding of their situation and specific leverage points to address it.

The results obtained by this research are also relevant for senior managers, mid-level line managers, project managers, and project portfolio managers in general. These managers are involved in the issue of having an overloaded innovation project portfolio (Beringer et al., 2013). Additionally, the research results can prove useful for innovation project portfolio consultants. These internal and external practitioners can use the lessons from this study to address having too many innovation projects. They can for example better recognize factors and relationships that play a role in the problem of having an excess of innovation projects. They will also be able to see which consequences potential interventions have on the factors related to having too many projects. The link of the systemic causes with portfolio DM shows how DM plays a role in the success of dealing with having too many projects. Furthermore,

these practitioners can get ideas from this study for effective leverage points to address their specific situation with regards to innovation project overloads.

1.4 Research Objective

This research aims to study the systemic causes for having too many projects in relation to the available resources. The concept of portfolio DM-effectiveness will be used for this. This research wants to add to the theory of innovation project portfolio management. This research also aims to aid organizations by identifying and evaluating leverage points to address the issue of having too many innovation projects.

1.5 Research Question

The main research question (RQ) that this study addresses is:

What are the systemic causes for having a portfolio with too many innovation projects, and how are these causes related to portfolio DM-effectiveness?

To help answer the main RQ, three sub-questions have been formulated:

RQ1: What are the consequences of having too many innovation projects?

RQ2: What is the relationship between these consequences and portfolio DM-effectiveness?

RQ3: What are effective leverage points to address having too many innovation projects?

RQ1 focuses on the consequences of having too many projects. This is because when the consequences of having too many projects feed back into having too many projects – or into each other – they can be considered to be systemic causes. The theoretical basis for RQ1 is a theoretical SD-model on the consequences of too many projects and ways in which this model might be expanded. RQ2 investigates the relation of the consequences of too many projects with the concept of portfolio DM-effectiveness, which consists of three outcomes. This provides a deeper understanding of how having too many projects hampers decision-making and how this can be dealt with by organizations. RQ3 aims to find more effective solutions to the problem of overloaded innovation project portfolios. The theoretical fundament of this question is a classification of leverage point effectiveness.

To answer the RQs, a single case was investigated. This case was an organization that has too many innovation projects. To gather the research data, Group Model Building (GMB) sessions were held as the case organization. In these sessions, the problem behavior was established. After that, an empirical SD- model on the consequences of innovation project overloads was built. Additionally, leverage points for addressing the problem behavior were gathered.

Each RQ had its analysis. For RQ1 – the investigation of the consequences of too many projects –, the empirical model was compared to a theoretical SD-model and its potential expansions. To answer RQ2, session transcripts were coded with the indicators of the three portfolio DM-effectiveness outcomes. The analysis for RQ3 consisted of analyzing the effectiveness of the leverage points on multiple aspects.

1.6 Thesis Outline

The next chapter reviews the theoretical background for the RQs. The third chapter elaborates on the methods used to answer the research questions. The fourth chapter presents the research results and discusses them in relation to theory. The fifth chapter concludes this research by answering the main RQ. After that, chapter five provides the implications of, reflection on, and recommendations on the research findings.

2. Theoretical Background

In this chapter, we will first discuss the academic context of this study: Innovation Project Portfolio Management (IPPM). The first part of this is defining important terms in IPPM. The second part considers the processes and goals that belong to IPPM. Next, the taking of a DM perspective on IPPM will be substantiated. Here, the concept "portfolio DM-effectiveness" will also be introduced. This is the theoretical aspect of the RQ2. Then, SD will be introduced. After that, having too many innovation projects is defined. Following this definition, an introduction of the theoretical SD-model on the consequences of having an excess of innovation projects will be given. How it might be expanded using additional literature will also be reviewed. This serves as the theoretical basis RQ1. The closing section of this chapter covers the effectiveness of leverage points – the theoretical basis for RQ3.

2.1 Key Terms in IPPM

2.1.1 Innovation

This study uses the following definition of *innovation*: "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations." (OECD, 2005). To help place the innovations that are studied further into perspective an additional classification of innovation is used (J. R. Cooper, 1998). This classification has three dimensions. First, *product* vs. *process* innovation. Second, *technological* vs. *administrative* innovation. Third, *radical* vs. *incremental* innovation. Innovations include each of these dimensions, for instance, innovations can be about a process, administrative, and radical at the same time. The case organization focuses on technological product innovations. Hence, the innovation process for new products at the case organization is called the NPD (New Product Development) process. Roughly 90% of the innovations at the case organization are incremental as opposed to radical. The dimension *radical* vs. *incremental* is most interesting for this research because having too many projects is known to lead to doing fewer radical innovation projects (R. G. Cooper & Edgett, 2003).

2.1.2 Project

A *project* can be defined as "a complex effort, usually less than three years in duration, made up of inter-related tasks, … with a well-defined objective, schedule, and budget" (R. D.

Archibald, 1992, as cited in Archer & Ghasemzadeh, 1999). The complexity of projects shows that the potential for failure in the carrying out of a project is high. This definition also brings up the objective, schedule, and budget of projects. For this study, these are relevant indicators for assessing if the execution of individual projects is hampered.

2.1.3 Innovation project

Innovation projects are innovation concepts that are in the execution phase (Mathews, 2010). They have reached this phase because they survived the first filtering process and are mature enough to become a project. An innovation project is finished when its objective is reached. Oftentimes, this is its implementation in the organization. Implemented innovations also need to be maintained, but this falls outside of the confines of an innovation project. *Innovation projects* have four outcomes (Hunt R. A. & Killen C. P., 2008). First, they embed innovations in the organization. Second, they aid organizations in meeting customer needs. Third, they help to achieve strategic aims. Fourth, they ensure long-term success. The aim of an innovation project is often less clear than for ordinary projects (Deák, 2009). This is because of their pioneering nature. This means that their objectives can also change more often.

2.1.4 Project portfolio

A *project portfolio* can be defined as "a set of projects which are managed in a coordinated way to deliver benefits which would not be possible if the projects were managed independently" (Platje et al., 1994). This definition highlights that there are benefits of managing projects as a set. These benefits are known as "synergy effects." A portfolio can, for instance, contribute more easily to the objectives of the organization (Turner & Speiser, 1992). Turner and Speiser (1992) add that projects can share deliverables, information, technology, and resources with other projects.

2.2 Innovation Project Portfolio Management

Using the definitions of the individual terms, we will consider innovation project portfolio management (IPPM). Lerch and Spieth (2012, p. 80) define IPPM as "the process of evaluating, selecting and prioritizing new or existing innovation projects, according to its main objectives of resource-fit, balance, strategic-alignment and value maximization." This definition corresponds in the main with the often-cited definition of R. G. Cooper et. al. (1999, p. 335). Additionally, it concentrates on innovation projects, which this study is about. Besides the three processes mentioned, the process of killing projects will be added. This process is

crucial to understanding how the number of projects is managed (R. G. Cooper et al., 1999, p. 335). The processes and goals of IPPM are visualized in Figure 1.

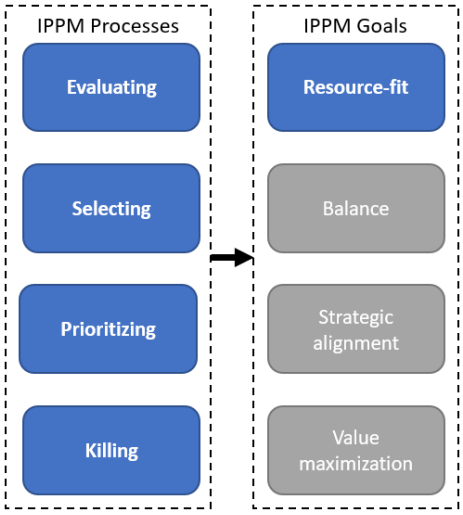

Figure 1. IPPM processes and goals (Lerch & Spieth, 2012, p. 80)

2.2.1 IPPM processes

To reach the IPPM goals, four processes are employed.

First, is the evaluation of new or existing projects. Organizations have multiple tools for this. For example, "gates" that need to be passed, portfolio reviews, or project ranking sessions (R. G. Cooper & Edgett, 2003). Evaluating is the basis for the other IPPM processes.

Second, is the process of project selection. It stands for making a selection out of all the potential innovation projects. To do this, organizations rank potential innovation projects and only select the best ones. There are numerous techniques for doing this, ranging from more intuitive, informal approaches to mathematical optimization models (Archer & Ghasemzadeh, 1999). The inputs for this process are the scores of innovation projects on several criteria of interest. These criteria differ for each company (Souder, 1975). But, in general, they indicate a trade-off between the potential costs and benefits of a project. Examples of such costs are resource requirements and risk of failure. Benefits can for instance be profit and competitive advantage.

Third, is the prioritization of innovation projects. Projects can either be prioritized or de-prioritized. Sometimes, the latter results in a project being put "on hold." This is stopping but not killing a project. The project can then be started up at a later moment. With prioritization also come resource re-allocations (R. G. Cooper et al., 1999, p. 335).

Fourth, killing a project. When a project is killed, it is formally stopped. Thus, it ceases to be part of the portfolio. With this decision, resources can be freed up for other projects in the portfolio.

2.2.2 IPPM objectives

We will now assess how the four objectives of IPPM relate to this study.

The first aim of IPPM is that the portfolio has a *resource-fit*. Reaching this aim is the focal point of this study because resource-fit is equal to balancing the number of projects with the available sources. The resources required for innovation projects can include finances, personnel, technologies, or intellectual property (Archer & Ghasemzadeh, 1999, p. 208). Projects in a portfolio need to compete for resources because they come from a shared pool (Payne, 1995, p. 163). Resources in the form of employees are often scarcest. But they are also fundamental for executing innovation projects successfully (Hendriks et al., 1999). The scarcity of employees is worsened by certain parts of innovation projects requiring the skills and knowledge of specific employees (Abrantes & Figueiredo, 2015; Hendriks et al., 1999).

The remaining goals – balance, strategic alignment, and value maximization – are less important to the issue of too many projects. This is because they are more concerned with *which* projects – instead of *how many* projects – are executed. Thus, they are greyed out in Figure 1. These remaining goals will now be outlined as they might compete with the resource-fit goal. *Portfolio balance* is a portfolio's balance on criteria that are of interest to an organization. For example, the number of projects that have a short-term vs. long-term focus. *Strategic alignment* is the degree to which the portfolio represents the strategy of the organization. *Value maximization* comes down to the profitability of the portfolio.

2.3 Decision-Making Perspective

IPPM may be approached using four perspectives. These are the optimization perspective, strategic perspective, DM perspective, and organizational perspective (Meifort, 2016).

The optimization perspective focuses on optimizing the composition of a portfolio using quantified characteristics of projects. Hence, focusing more on the evaluation of projects. The main pitfalls of this perspective are that it is unsuited for considering strategic goals and it does not fit the non-routine nature of IPPM (R. G. Cooper et al., 1999).

Unlike the optimization perspective, the strategic perspective stresses the link between project portfolio management and achieving strategic goals. It does this by analyzing matters at a more aggregate level. In doing so, it provides better results than the financial methods (R. G. Cooper et al., 1999). Yet, the usefulness of the strategic perspective is limited as it does not consider how the attainment of strategic aims using projects is carried out (Meifort, 2016).

The organizational perspective concentrates on the role of different organizational levels and dynamics between different stakeholders involved in IPPM. It is important to acknowledge that different organizational levels and stakeholders are involved in the issue of too many projects. But this is not the heart of the problem, as having an overburdened innovation project portfolio mainly seems to have to do with decisions made over time (Christiansen & Varnes, 2008).

The DM perspective is the only perspective that focuses on what factors drive portfolio DM in practice. In this way, this perspective helps to move the focus away from formalized strategic solutions (Eskerod, 1996), which is the essence of this study. The DM perspective on portfolio management also allows focusing on DM over time. For example, decisions to adjust the composition of the portfolio when the strategy changes (Meifort, 2016). Therewith, it fits the systemic view of this study, which focuses on problem behavior over time and the structure that is responsible for it. The DM perspective is thus chosen for this study

2.3.1 Portfolio DM-effectiveness

The concept of portfolio DM-effectiveness will be used to gain a deeper understanding of the relationship between DM and having too many projects. Project portfolio decisions are effective when they facilitate a *portfolio mindset*, *spend resources in a focused way*, and are *agile* (Kester et al., 2011). In other words, these are the outcomes of high portfolio DM-effectiveness. High portfolio DM-effectiveness is known to reduce innovation project overloads (Kester et al., 2014). But feedback effects – of too many projects on the DM-effectiveness outcomes – are thus far not demonstrated in the literature. This study provides an opportunity to find relationships in this direction. Other DM concepts than portfolio DM-effectiveness are available but have a less direct connection to overloaded innovation project portfolios. For example, a framework that denotes that classifies that portfolio DM can be based on evidence, power, and opinion (Kester et al., 2011).

The three outcomes of portfolio DM-effectiveness will now be discussed. First, the *portfolio mindset*. It entails that “the firm has a complete overview of the portfolio as well as

in-depth knowledge about each NPD project" (Kester et al., 2011). This helps make the right IPPM-decisions to avoid having too many projects. Second, *focused resource-spending* is defined as the firm keeping "resources focused on those short-term actions that help achieve long-term goals" (Kester et al., 2011). This also means that it should be clear which projects have priority, but also that there are no distractions. Reaching this outcome means that no resources are wasted, and that important projects are being worked on. Third, *agile* portfolio DM means that an organization can respond quickly to strategic opportunities by changing the composition of the portfolio (Kester et al., 2011). This ensures that the issue of too many projects can be dealt with speedily.

2.4 System Dynamics

SD is a way of depicting the structure of a complex problem to learn how its behavior is caused. This is done by employing causal models (see Figure 2 for an example). These models contain variables and causal relations between variables. These relationships can either be positive (+) or negative (-). A positive relationship means that the affected variable is changed in the same direction as the independent variable. For example, more "money in savings account" increases the "interest earned." A negative relationship entails that the affected variable is pushed in the opposite direction of the cause variable. For instance, in Figure 2, an increase in "expenses" decreases the "money in savings account." The relations between variables can form feedback loops. There are two types of feedback loops in SD. Reinforcing feedback loops (R) are characterized by exponential growth. Balancing feedback loops (B) counteract change. They reduce any positive or negative impulses by seeking a goal. For instance, the goal of wanting to live as luxurious as possible. This will cause more expenses to be made, reducing the money in the savings account. Hence, less expenses can be made. In this way, balancing loops can keep reinforcing feedback loops in check.

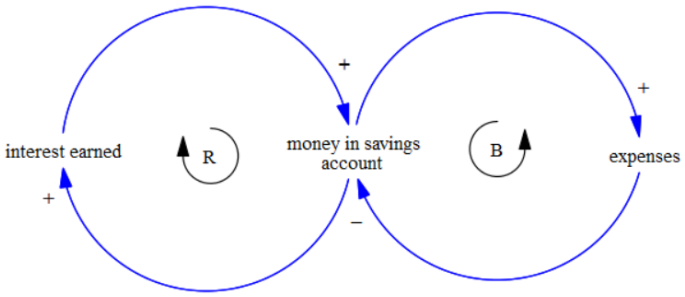

Figure 2. Example of a causal model

2.5 Too Many Innovation Projects

Unfortunately, a precise definition of "too many innovation projects" is lacking. It seems to be something that can easily be identified in practice but is difficult to define. Studies on this topic provide no definition or use a wording that approximates "too many innovation projects in relation to the available resources" (R. G. Cooper et al., 1999; Lerch & Spieth, 2012).

However, this choice of words bears the assumption that all innovation projects need the same amount of resources. This emphasizes the number of innovation projects. This is of little use, because, innovation projects can require different amounts of resources (Payne, 1995). Two smaller innovation projects can for instance use the same amount of resources as one large innovation project.

R. G. Cooper et. al. (2000) add that "there are simply too many projects and not enough resources to do them well." The latter part reveals something about the main effect of having too many projects. That is, not being able to properly execute innovation projects. This can, for example, mean that they deviate from their objective and schedule. When this happens for strategically important projects, the achievement of the strategy of the organization may be at risk (R. G. Cooper et al., 2000). But this will not be studied as this study focuses on the *resource-fit* goals of IPPM.

A better definition for having too many projects is that "resource demand by projects exceeds resource supply." One limitation of this definition is that it remains unclear what an exceeding of the resource supply means. There can be expected to be a threshold for overshoots in resource demand to be regarded as problematic. Employees can, for instance, in the short-term deal with minor project overloads by working overtime (Delisle, 2020). Some work pressure might sometimes even be needed for employees to work effectively. Moreover, this differs per organization. This makes the height of this threshold difficult to determine.

2.6 Theoretical SD-model: Consequences of Too Many Projects

A theoretical SD-model will be used as a starting point for researching the consequences of having too many projects. The model by R. G. Cooper and Edgett (2003) is chosen because it is the model that connects the most consequences of overloaded innovation project portfolios. The model has been translated into an SD model (see Figure 3). This makes comparing it with the empirical SD-model easier. For the original model, see Appendix A. The model is based on radical, technological product innovations (R. G. Cooper & Edgett, 2003).

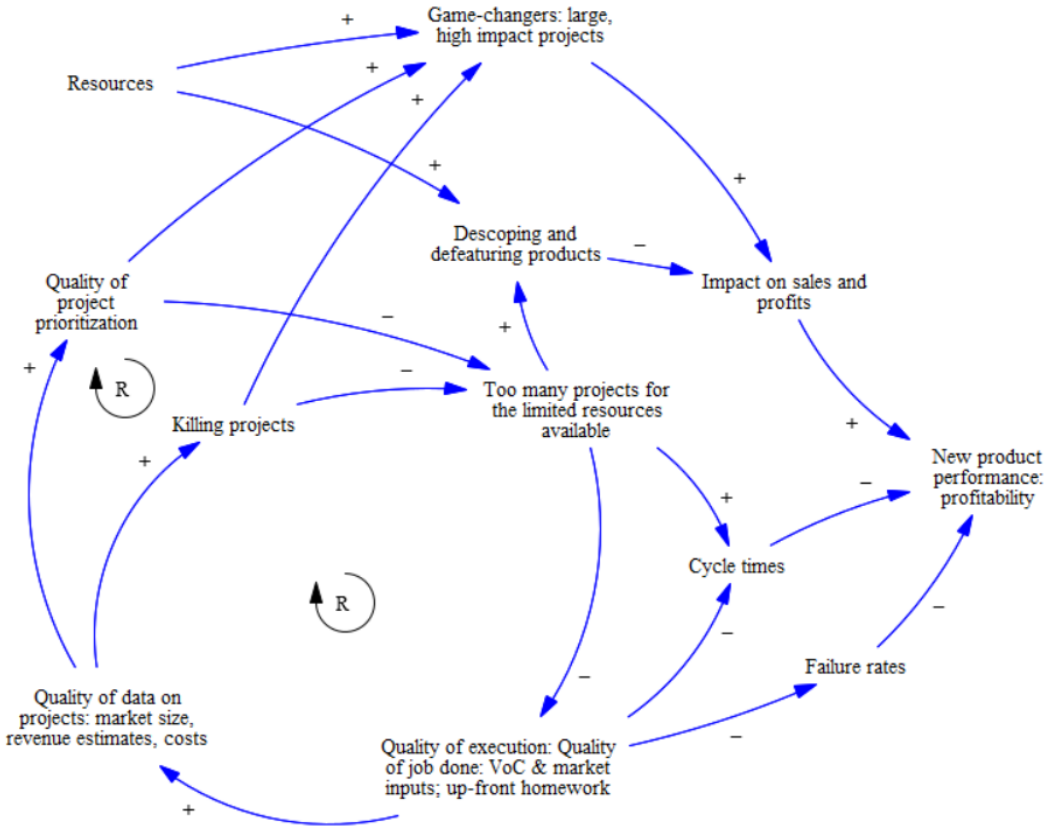

Figure 3. Theoretical SD model, adapted from R. G. Cooper & Edgett (2003)

2.6.1 Model description

At the center of the model lies the variable named "Too many projects for the limited resources available." If this variable increases, the quality of execution declines. In turn, the data on the projects, for example, on the market size or costs, is of lesser quality. This causes the quality of prioritization to be lower and fewer projects to be killed. Both effects cause there to be even more projects in relation to the available resources. This way, they connect into the two reinforcing feedback loops of the model – denoted with an "R."

Besides these feedback loops, there are several other causal relations. Too many projects and a low project execution quality lead to longer cycle times. The profitability and performance suffer under this as the market needs to wait longer for products. The quality of execution also affects the failure rates. This in turn leads to lower performance of the project in terms of profitability. Projects can also be descoped and de-featured because the projects in the portfolio require more resources than available. This hurts the sales and profits. Therewith, it is also harmful to the new product's performance. Resource availability in this model is not a consequence of too many projects. But it is still valuable to include it as it is an essential concept for this study. A final indirect effect of project overloads is missing game-changers. In other

words, radical innovations. Missing such projects can happen due to bad prioritization, low available resources, and needing to kill such projects. The effect of this is that less sales and profits are made. This is another way in which the overall project performance can be hampered.

2.6.2 Potential expansions for the theoretical SD-model

Unfortunately, R. G. Cooper & Edgett's (2003) model seems to be incomplete. When looking a set of articles central to the issue of too many projects, several of its consequences are missing in the model. These missing consequences have been converted into a set of potential ways in which the theoretical SD-model can be expanded. Appendix A provides an overview of these potential expansions. When the empirical findings confirm elements and relations from these potential expansions, they can be added to the theoretical SD-model. When these consequences feed back to the theoretical model or each other, new feedback loops can be formed.

We will now elaborate upon the potential expansions for the theoretical model. To begin with, project team morale is known to be affected by innovation project overloads. This happens via work pressure but also via how thin employees are spread across projects (Blichfeldt & Eskerod, 2008; R. G. Cooper et al., 2000; R. G. Cooper & Edgett, 2003; Hendriks et al., 1999). High work pressure due to too many projects can also lead to working hours being extended. In the long term, this can reduce the available workforce via sick leave (Delisle, 2020). Furthermore, having too many projects can lead to more mistakes being made. The resources required to correct these mistakes further decrease the available resources for executing projects (Delisle, 2020; Repenning, 2001). Another issue resulting from an overburdened innovation project portfolio is the prioritization of emergencies (Delisle, 2020; Engwall & Jerbrant, 2003). This can lead to important tasks being neglected. This causes even more emergencies later on. Project overloads can also lead to short-term resource allocation. That is the frequent redistribution of employees among projects. This can both lead to stress on employees and negative effects on other projects that are worked on (Blichfeldt & Eskerod, 2008; Engwall & Jerbrant, 2003; Repenning, 2001). As mentioned before, having too many projects causes the execution quality to be lower. Another result of low execution quality is that employees and management have a poorer overview of the portfolio of projects (Blichfeldt & Eskerod, 2008).

2.7 Leverage Point Effectiveness

This study also attempts to find how the persistence of having too many innovation projects can be reduced. To do this, leverage points are identified based on the empirical model.

Leverage points are “places in the system where a small change could lead to a large shift in behavior” (Meadows, 2008, p. 145).

To evaluate the effectiveness of leverage points, Meadows (2008, pp. 145–165) classified them into twelve levels. This classification is shown in Table 1. It is used for this study to distinguish which leverage points are most effective. A low-leverage intervention is, for example, a one-off change of a parameter (e.g., increasing resources). Such an intervention is low leverage because the system will quickly counteract them. This prevents the system from breaking away from the dynamics that cause the problem. An intervention with a higher potential is, for instance, a change in the goal of the system. Such interventions have a long-term effect on the system.

Table 1. Places to intervene in a system (Egerer et al., 2021) (12 is low leverage, 1 is high leverage)

LEVERAGE LEVEL	DESCRIPTION	SYSTEM CHARACTERISTICS
12	Parameters	Intent
11	The size of buffer stocks, relative to their flows	
10	The structure of material stocks and flows	
9	The length of delays, relative to the rate of system change	Feedbacks
8	The strength of negative feedback loops	
7	The gain around driving positive feedback loops	
6	The structure of information flows	Designs
5	The rules of the system	
4	The power to add, change or self-organize system structure	
3	The goals of the system	Intent
2	The mindset /paradigm out of which the system arises	
1	The power to transcend paradigms	

3. Methodology

The methodology of this research will be discussed in six sections. First, the overall research design is discussed. Second, the data collection methods are described. Third, how data is analyzed. Fourth, the model validation is explained. Fifth, the limitations of the chosen methodology are reviewed. Finally, the ethical aspect of this study is covered.

Before elaborating upon the research design, we will briefly return to the aim of this research. This study aimed to discover what the systemic causes are for having too many projects and how these consequences relate to portfolio DM-effectiveness. Additionally, leverage points to address innovation project overloads were sought.

3.1 Overall Research Design

Qualitative research suited the DM perspective best as it clarified what people state and how they act (Myers, 2013, p. 5). Especially useful for this research was that qualitative data could shed light on the context of these actions (Bleijenbergh, 2015, p. 14). For this research, a qualitative approach meant building a qualitative SD model. This model illustrated the context in which decision-makers make certain decisions. Furthermore, the qualitative approach fitted the SD methodology well. SD-models often consist of many factors and qualitative research is well suited for making broad statements about the coherence of a high number of factors (Bleijenbergh, 2015, p. 14).

This research has theory-testing as well as theory-building aspects. To begin with, the theory on the consequences of too many projects can be both confirmed as well as expanded. In addition to that, the effects of low portfolio DM-effectiveness on innovation project overloads are established while the other way around it is not. For these reasons, the research is also partly deductive and inductive (Myers, 2013, p. 23).

3.1.1 Case study

This qualitative research made use of a case study approach. According to Yin (2003, p. 13), a case study “investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not evident.” Studying the real-life context of a current phenomenon fits the DM perspective of this study. Moreover, the exploratory nature of this research shows that the boundaries between the problem and the context are still ambiguous. The case study approach suited this (Myers, 2013, pp. 74–75).

The choice has been made to study a single case in an intensive and holistic way. This could be done because the research is backed up by a theoretical model and potential expansions for it. Theory can not only be tested, but can predominantly be built using this approach. Hence, the analysis is only partially deductive (Gerring & Cojocaru, 2016). Researching of one case backed up by theory enables generalization of the research results to theory. The choice for studying a single case also fitted the available time best.

The choice has been made to study a "typical" case organization (Yin, 2003, p. 41). This organization will be called "organization X" from now on. Organization X experienced having too many projects even though it has a formalized IPPM process. Because of this, project delays occur, and the innovation budget often runs out during the year. Therewith, it is typical because 97% of organizations state that "attempting to run too many projects" is one of the largest IPPM challenges while 70% of organizations also say that their IPPM maturity is medium to very high (*The State of Project Management Survey*, 2021). Hence, it can represent organizations that are similar in these aspects. Also, because a typical case was studied, this study focused on the causal mechanisms within the organization (Seawright & Gerring, 2008). In this way, the research results can be informative to the organizations represented by organization X.

3.1.2 Characteristics of organization X

Organization X is a manufacturing organization that produces reusables. Drivers for innovation can be, for example, making products more sustainable. Furthermore, more than one thousand persons are employed in this organization – generating over 250 million euros of revenue. There is a dedicated innovation department that has a set innovation budget. Multi-year plans are made to divide the budget among future projects. Included in these plans are placeholders: budget reservations for unknown new opportunities. The launch of new products accounts for one-tenth of the organization's revenue. The portfolio of organization X contains over hundred innovation projects. For two years, there is a Tollgate (TG) process in place. This process helps to evaluate projects at the four stages of their execution.

3.1.3 Research activities

Figure 4 displays all the activities that were part of this research. The blue-colored elements represent the data gathering activities. The orange-colored elements represent the data analysis activities. The figure also illustrates the connection of the research activities to each

RQ. The answering of RQ1 and RQ3 drew from the SD methodology. In this, Group Model Building served as the data gathering method.

The RQs were answered as follows. To begin with, the problem behavior for the most important variables regarding too many projects at organization X was established. An empirical SD model of the structure underlying this behavior was then developed. To answer RQ1, this model was compared with the theoretical SD-model and the literature with which it can be expanded. To answer the RQ2, the transcripts of the sessions were coded on the portfolio DM-effectiveness outcomes. RQ3 was answered by eliciting leverage points from the participants and analyzing them.

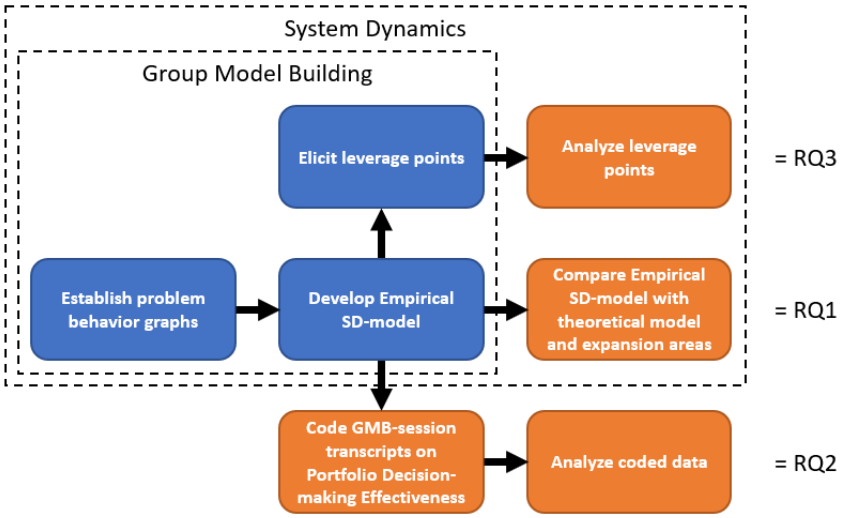

Figure 4. Research design

3.2 Data Collection

3.2.1 System Dynamics

The focus of SD exploration and the analysis of feedback is the main driver for this study (Sterman, 2000, pp. 12–13). This research took three of the five steps from the SD modeling cycle into account (de Gooyert & Größler, 2018; Sterman, 2000, p. 86). The steps used were: problem articulation, formulation of a model, and preliminary policy design. The simulation and testing components were left out as they did not fit the qualitative approach of this research.

The stock-and-flow iconography has been chosen for the empirical SD-model that was developed. This way, the modeling process could automatically take into account the system structure more strictly. While using this method takes more time, it also makes the model more detailed and meaningful. For instance, in terms of delays, inertia, and memory of the system

state (Sterman, 2000, pp. 195–197). Besides that, there was already a clear stock at the heart of the model: the number of innovation projects in the portfolio.

3.2.2 Introductory data collection

Before the main data collection, preliminary data was gathered to be introduced with the organization's employees, structures, and processes. The first step in this was an introductory interview with the head of Innovation. The interview served the goals of becoming familiar with the problem of too many projects at organization X and the stakeholders involved (Vennix, 1996, p. 116). The interview scheme can be found in Appendix B.

Besides that, two TG meetings were attended and informally observed by the researcher. This helped to gain an impression on the structure of, and the DM in these meetings. Finally, access to several internal documents was granted. For example, an outline of the TG process and the selection criteria for new innovation projects. This information helped to depict the organization of the portfolio management at organization X.

3.2.3 Group Model Building

The data for this research were collected via GMB. GMB is a technique for developing an SD-model by involving different stakeholders (Vennix, 1996). The advantage of using this method was that it provided the opportunity to learn from the different views of the participants. The GMB-sessions were held with managers involved in the issue of too many projects at the case organization. The goal of the GMB-sessions was threefold. The first aim was to gain knowledge on the problem by eliciting behavior over time graphs for important problem variables. The second aim was to build an empirical SD model. The final goal was to gain suggestions for effective leverage points. These leverage points were scored by participants on feasibility and impact. "Feasibility" entails the ease with which a leverage point can be implemented. "Impact" stands for how significant the leverage point addresses the project overload. In total, four GMB-sessions were held. A detailed description of how the GMB-sessions proceeded can be found in Appendix . The sessions were held via video-calling as half of the participants lived abroad. Additionally, an online whiteboard tool and the chat function were used to gather the participant's input

As for the participants of the GMB-sessions, they were chosen for the diversity of function and views in relation to the innovation project overloads. This helped to make the model more valuable. In total, nine persons were invited for the Group Model Building sessions.

The researcher facilitated the sessions. A co-facilitator took care of modeling the participants' input and some logistical tasks. To further structure the sessions and provide a main thread for the sessions, GMB-scripts were employed. The researcher deviated from these scripts when it became clear during the sessions that a different approach was needed.

Nominal Group Theory (NGT) was used for the elicitation tasks during the GMB-sessions (D. F. Andersen & Richardson, 1997). NGT is a systematic approach for information elicitation. It provides more equal opportunities for participants to share thoughts and to focus on the most important ideas. This is achieved by letting participants one by one share their best idea.

The GMB-sessions were recorded, and were transcribed in a clean verbatim fashion. This enabled the coding of the transcripts and helped to describe the stories behind the feedback mechanisms.

3.3 Data Analysis

3.3.1 Analysis of theoretical and empirical model

RQ1 was answered by comparing the theoretical and empirical SD-model (see Figure 5). First, the comparison enabled the *confirmation* of the theoretical model in a new context. Second, the theoretical model could this way be *expanded* by looking at the elements that were present in both the empirical model as well as in the potential expansions for the theoretical model. Third, empirical findings that were neither part of the theoretical model nor its potential expansions were *additions* to theory. The analysis will focus on interpreting and contextualizing the *expansions* of, and *additions* to the theoretical model. The theoretical model – and its potential expansions – will be the "keyhole" through which we look at the empirical model (Pickvance, 2022). Elements and relations only present in the theoretical model, or its potential expansions were not addressed as they do not contribute to theory.

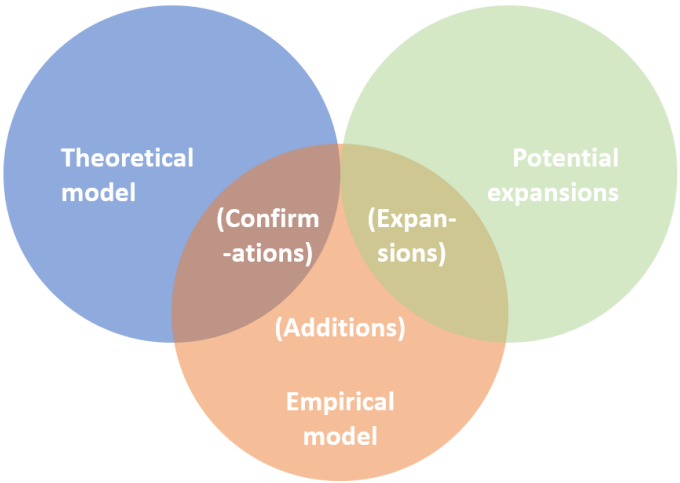

Figure 5. Comparison of theoretical and empirical SD-model

The empirical model was simplified and divided into submodels because the full model was too extensive and complex to be discussed. The first simplification step was to omit the external variables (Bureš, 2017). This did not result in limitations of the model as they are not consequences of having too many projects. After that, the model was converted from a stock-flow diagram to a causal loop diagram. This made it easier to see where the feedback loops are (Hirsch et al., 2007). A simplified version of this model was made by combining similar causal relations going to and from key factors. This simplified "overall" model was then divided into four sub-models which contain a greater level of detail.

3.3.2 Analysis of session transcripts

To answer RQ2, the transcripts of the GMB-sessions were analyzed using the three portfolio DM-effectiveness outcomes by Kester et. al. (2011). The analysis consisted of coding the session transcripts using an operationalization of the three effectiveness outcomes. This was the operationalization by Khachateryan (2020) – which was slightly adapted. This operationalization, and how it was adapted, can be found in Appendix D. This analysis helped to increase the understanding of how innovation project overloads are related to portfolio DM.

3.3.3 Analysis of leverage points

The leverage points suggested by the participants were also analyzed. In doing so, RQ3 was answered. These leverage points were proposed by the participants using the lessons they learned from developing the empirical model. In the first place, the leverage points were analyzed on where and how they change the empirical model. This was especially relevant for the leverage points that score on the lower leverage levels (7 to 12 in Table 1). These types of

interventions are more tangibly present in the system as compared to points of high leverage. For example, leverage level three concerns changing the goals of the system. The leverage points were also analyzed by looking at which portfolio DM-effectiveness outcomes were affected by the leverage points. After that, the impact and feasibility scores of the participants were investigated. The points of leverage were also analyzed by looking at which level of leverage they intervened in the structure of the empirical model. The leverage points analysis method, as set up by Egerer et. al. (2021), was adapted for this. This means that the leverage points were scored on the twelve levels of the model by Meadows (1999)(see paragraph 2.7). When a leverage point was scored on more than one level, an average of these scores was taken. Finally, the theoretical generalizability of the effectiveness of leverage points was reviewed.

3.4 Model Validation

After having developed the model, a disconfirmatory interview was held. During this interview, the model was presented. The interviewee was encouraged to address errors and missing nuances in the model (D. L. Andersen et al., 2012). In doing so, the explanatory power of the empirical SD-model could be assessed. It was held with an employee that had not participated in the GMB-sessions but was familiar with the problem. As a result, the validity of the study was increased during the research process itself (Morse et al., 2002).

3.5 Limitations

The chosen research method had some limitations. One limitation was that the phenomenon at hand was only studied in a single context. This hampered the generalizability of results to contexts other than those of the studied case. Therefore, the results of this research are preliminary and should be adopted with caution.

The choice for GMB as a data collection method has also had implications for the findings. To begin with, GMB is – besides a research method – also a method of addressing the issue at hand. Hence, the problem was already partly addressed during the research process itself. Participants could already learn from each other during the first GMB-sessions. This might have led to a slightly altered problem statement at the end of the research process. Additionally, the choice for GMB was expected to provide less rich research results as compared to a series of interviews.

Furthermore, the choice for making a qualitative SD-model also affected the research results. Because the SD-model could not be simulated, the assertions made on the behavior of

the model and the effectiveness of the leverage points are still preliminary. Thus, they should be handled with caution.

A final limitation was that a concept model has been used to start the modeling. This model was based on the data from the first GMB-session. It would have been better if the participants had created their model from scratch. Both for the accuracy of the model and for the participants' sense of ownership over the model.

3.6 Research Ethics

This research sought to prevent any harm to be inflicted on the participants. The participants were informed about what participation in this study entailed and what the objectives of the study were. This was done both in advance as well as during the introduction of the first GMB-session. The participants were also asked for consent to take part in the sessions. Furthermore, the participants were made aware that they had the right to withdraw from participating at any time during the research. Besides that, approval was asked to record the GMB-sessions. During the GMB-sessions, the focus was on the content of the research. The opinions and past actions of the interviewees were respected, hence, valuing their dignity.

The research data was treated carefully in this research. Firstly, the raw research data was handled confidentially. It was only shared with the supervisor and second examiner. Second, the names of the company, participants, products, and processes have been anonymized in this thesis to make the organization untraceable. This anonymization has been checked and approved by organization X.

The findings of this study have been shared with organization X to contribute back to the organization. To begin with, this thesis was handed over to the organization. In addition to that, specific recommendations for organization X have been written. These have been presented to the participants in an extra online session. After that, this presentation and the document containing the recommendations have been handed over to the organization.

Finally, the implications for practice and the academic field have been made part of the concluding chapter of this thesis. This thesis will be included, and accessible in the Radboud University Thesis Repository. Organization X has granted permission for this. This way, this research's findings reach beyond the case organization.

4. Results and Discussion

The first paragraph of this chapter elaborates on the consequences of too many projects, and how they compare to theory. This answers RQ1. The following paragraph covers the relationship between too many projects and the portfolio DM-effectiveness outcomes. In this way, RQ2 is answered. To answer RQ3, the final paragraph provides the description and analysis of the leverage points elicited in this study.

4.1 Consequences of Having Too Many Innovation Projects

To begin with, the overall empirical SD-model on the consequences of too many projects will be introduced. Its comparison to theory will then be briefly demonstrated. After that, the more detailed submodels and how they compare to theory will be discussed.

4.1.1 Introduction of the empirical model

The overall empirical model shows the consequences of having too many projects in organization X (See Figure 6). To focus the modeling effort on the problem, participants in session one drew behavior over time graphs for indicators of having an excess of innovation projects. These graphs can be found in Appendix E. The original empirical model can be found in Appendix F. Figure 6 also demonstrates how the overall model is divided into four submodels. The first submodel we will discuss is called “work pressure” (in orange). After that, we will discuss the submodel named “performance spirit” (green). Next is the “customer impact” submodel (given the blue color). Finally, the submodel called “performance feedback” is covered (red).

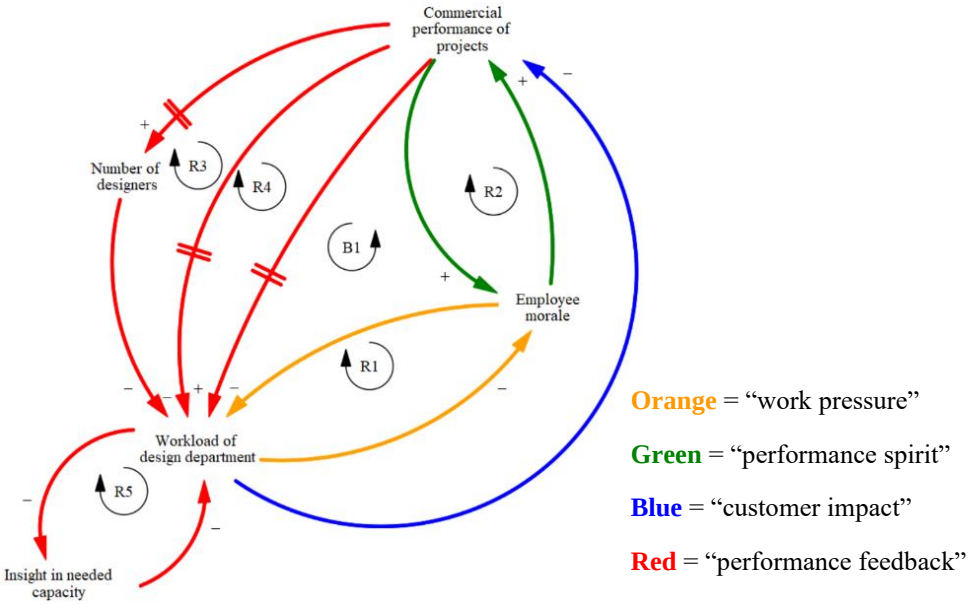

Figure 6. Overall empirical model

4.1.2 Description of the overall empirical model

To begin with, the reinforcing feedback loops present in the model will be discussed. There are two reinforcing effects connected to employee morale. One is related to the workload (R1). When employee morale decreases, the workload will increase. For example, due to mistakes. This decreases employee morale even more. The other feedback effect concerns the commercial performance (R2). If employee morale is low, the quality of the project drops. This decreases the commercial performance, which in turn decreases morale. There is also another reinforcing feedback loop at play. This is the loop of workload, commercial performance, and the number of designers (R3). This loop can increase or decline exponentially. The latter can, for instance, happen by a high workload lowering commercial performance, which decreases the number of designers and increases the workload further. An additional reinforcing feedback loop is present (R4), in which the workload negatively affects commercial performance. This causes the number of projects to increase. Due to this, the workload is increased automatically. This can happen either via employee morale or via other effects. Finally, the workload also has negative effects on the insight in capacity. This hampered insight increases the workload again. For example, by making the suboptimal IPPM decisions. Hence, another reinforcing feedback loop is formed (R5). So, a high workload can reinforce itself via lower employee morale, fewer designers, and less insight in capacity. Thus, either the workload is increasingly easier to manage, or it spirals out of control. The latter seems to be the case more often for organization X.

Besides reinforcing feedback loops, there is also a balancing feedback effect present (B1). The feedback loop is called “performance feedback.” It entails that an increase in workload can cause low commercial performance. This causes less extra budget to be made available for doing new projects in the following year. Therewith, the initial increase in workload is reduced. However, when this feedback comes into force, the damage to the commercial performance of projects is already done. Therewith, this loop stresses the importance of proactively keeping the workload at a manageable level.

4.1.3 Overall confirmations of and additions to the theoretical model

Figure 7 reveals the similarities between the theoretical and the overall empirical SD-model. The parts confirmed by the empirical model have been given the blue color. The grey variables and arrows represent the parts that have not been confirmed by empirical observations.

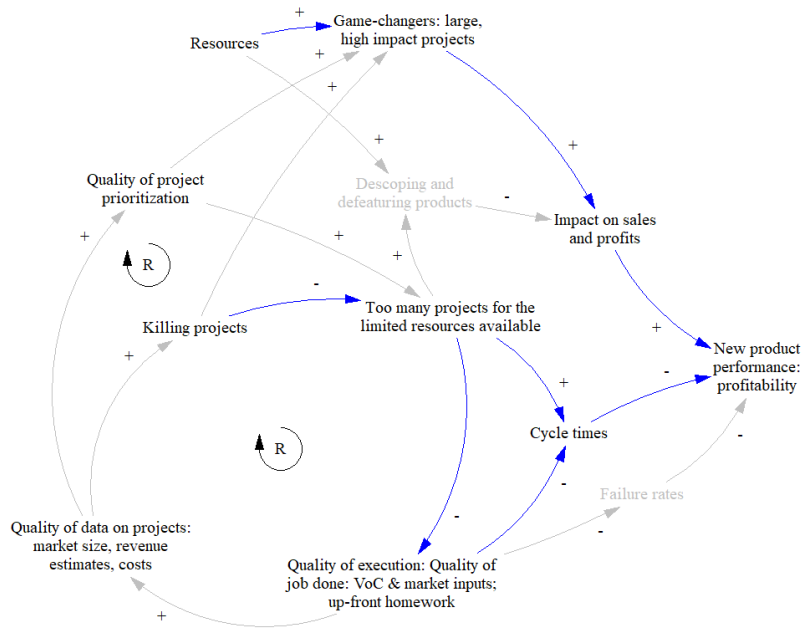

Figure 7. Overall confirmation of the theoretical model[1]

The overall empirical additions to the theoretical model can be found in Figure 8. The blue elements stand for the theoretical model. Conversely, the green elements show the confirmations of its potential expansions, and the new additions to theory. Paragraph 4.1.4 covers these confirmations and additions to theory in more detail.

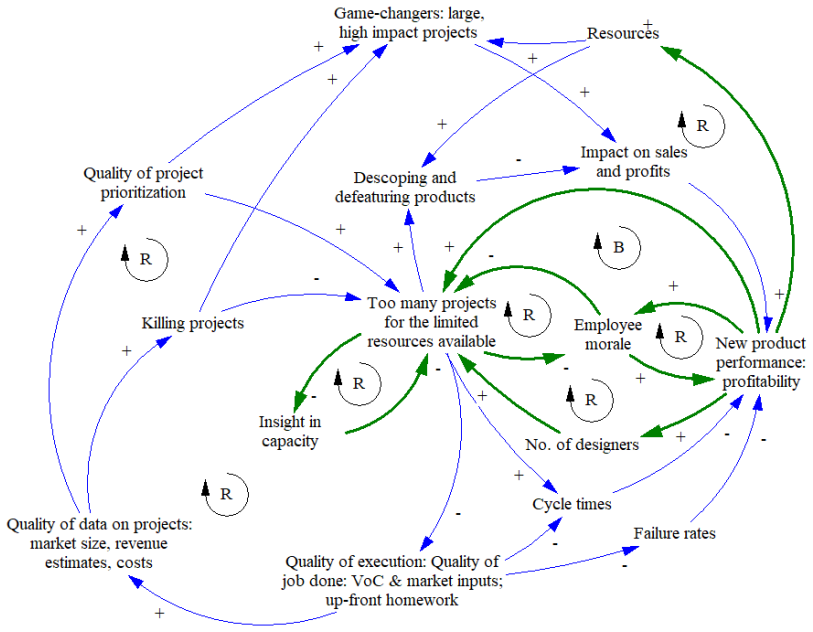

Figure 8. Overall additions to the theoretical model[2]

[1] The relations "Resources" to "Game-changers" and "Game-changers" to "Impact on sales and profits" have been mentioned in the GMB-sessions. But, because they have not been made part of the empirical model, they have not been discussed in the comparison of this study.

[2] Note that "Too many projects for the limited resources available" in the theoretical model is equal to the "Workload" in the empirical model.

4.1.4 Confirmations and additions per submodel

We will now go through the submodels one by one. Quotes from the GMB-sessions will be used to add to their descriptions. After a submodel is covered, it is compared to theory. The confirmations of the potential expansions and the additions to theory will be interpreted and contextualized for each submodel.

4.1.4.1 Submodel 1: "work pressure"

The following is a description of the first submodel (Figure 9). This submodel is interesting as it contains many reinforcing feedback loops of its own. It therewith shows why having a high workload is so damaging. In addition to that, it connects the workload to employee morale. This can best be seen in the overall model.

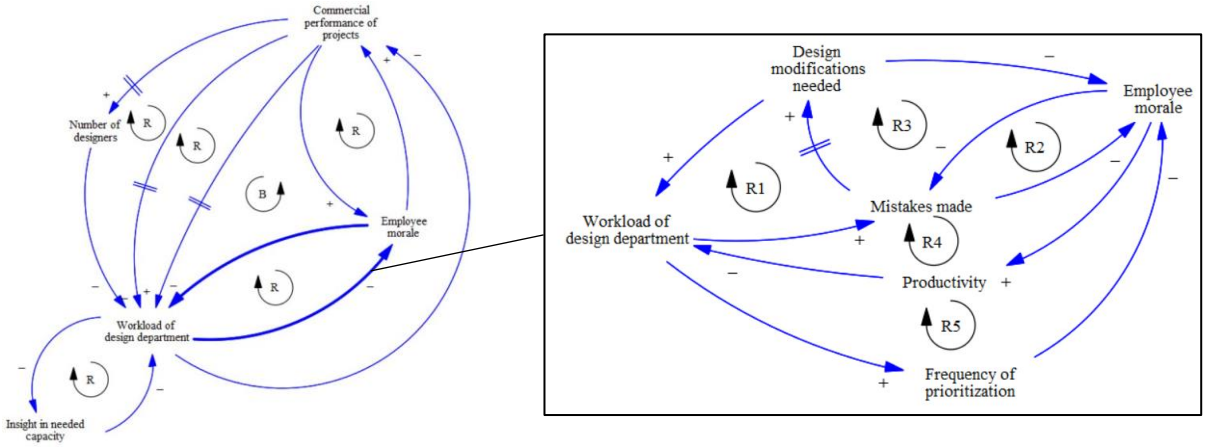

Figure 9. Overall model (left) & "work pressure" submodel (right)

One of the crucial variables in the "work pressure" submodel is the workload. High workload is the main indicator of having an innovation project overload. Especially the workload of the design department. Not only was it said to be high, but it was also indicated to be fluctuating. One manager indicated that the workload alternates between "nothing" and "twice as we can handle."

We will now discuss the first feedback loop of this submodel (R1). When the workload of the design department rises, the quality of the designs is reduced. The mistakes in the designs due to this are only noticed months later. Modifications need to be made to correct these mistakes. The actions needed to address these mistakes again increase the workload as more design hours are required. On its own, this loop would increase the workload indefinitely.

Another factor that is closely tied to the mistakes made, is employee morale. Mistakes reinforce a decline in employee morale (R2). Low employee morale in turn can lead to more

mistakes being made. Besides the modifications needed, making mistakes also directly affects employee morale negatively (R3). When employee morale declines, the productivity of employees will also be lower. This decline increases the workload. Thus, these variables constitute another reinforcing feedback loop (R4).

Priorities need to be changed more often when the workload increases. So, a portfolio decision is directly affected by having too many innovation projects. This is especially the case for the projects that are in the conception and development phase. The resource requirements and viability of projects in that phase can vary greatly: "We have volatile priorities at this moment in time, … we prioritize frequently, but they don't always stick." However, prioritizing emergencies too often can lead to employee morale suffering. For example, employees sometimes put work into projects that have been stopped before or are likely to be stopped again. This further reinforces an increase in workload (R5).

When we compare the "work pressure" submodel with theory, three confirmations and four additions come up. They are shown in Table 2. The table shows comments on where the empirical observations confirm or add to existing theory. The confirmations and additions will be discussed in more detail below.

Table 2. "work pressure" submodel: confirmations and additions to theory on consequences

EMPIRICAL OBSERVATION	CONFIRMATION OF POTENTIAL EXPANSIONS
Workload and making mistakes reinforce each other	A similar finding is present in theory (Repenning, 2001). Delisle (2020) also mentions making mistakes, but this is due to employees being tired from extending working hours.
Productivity suffers under lower employee morale	Productivity has been shown to decrease in a reinforcing fashion (Delisle, 2020)
Having too many projects causes prioritization of emergencies	Emergencies are known to be prioritized when having too many projects (Delisle, 2020; Engwall & Jerbrant, 2003).
EMPIRICAL OBSERVATION	**ADDITION TO THEORY**
Fluctuations in workload are perceived as problematic.	This is an addition because theory only mentions chronic high workload with regards to project overloads (Delisle, 2020).
The negative effect of workload on employee morale – via making mistakes.	A mediating effect is added to a known direct effect of workload on employee morale (R. G. Cooper & Edgett, 2003; Hendriks et al., 1999).
The negative effect of workload on employee morale – via	A mediating effect is added to a known direct effect of workload on employee morale (R. G. Cooper & Edgett, 2003; Hendriks et al.,

modifications needed to correct mistakes.	1999).
The frequency of prioritization negatively affects employee morale.	Frequent prioritization – of emergencies – is known to cause important tasks to be neglected (Delisle, 2020; Engwall & Jerbrant, 2003). It is also known to be negative for projects in itself as they do not get the chance to prove themselves (Lerch & Spieth, 2013). This observation adds to this by showing that it can also be the cause of lower employee morale.

4.1.4.1.1 Confirmations of potential expansions

Three elements of the potential expansions can be connected to the theoretical model with regards to the "work pressure" submodel. To begin with, the reinforcing effect between workload and making mistakes. Repenning (2001) has done a similar finding. However, his finding is limited to yearly releases of single products. This research shows that this effect can also be present at the portfolio level.

After that, the observation that low morale can lead to lower productivity comes up. The study by (Delisle, 2020) has shown that productivity can decrease as a result of a defensive reaction to project overload. This study shows that productivity also decreases due to innovation project overloads via lower employee morale.

Finally, the issue of prioritization of emergencies due to overburdened innovation project portfolios (i.e., high workload). The empirical results on this subject are similar to those found in the expansion area literature (Delisle, 2020; Engwall & Jerbrant, 2003). Resources are frequently re-allocated to the most urgent projects. Engwall & Jerbrant (2003) state that this has "negative effects on unanticipated places in the project portfolio." The empirical model clarifies this by showing that low employee morale and its consequences can embody these "negative effects."

4.1.4.1.2 Additions to theory

The first possible addition to theory is that fluctuations in the workload can be experienced as problematic. This can be an addition to the problem statement of having too many projects. This addition could help to find other systemic causes for innovation project overloads. Balancing feedback loops that contain a delay are for example known to cause oscillating behavior. An explanation for the fluctuations in workload may be the yearly recurring stops in investment in innovation projects. These cause surges in the workload which

leave a trail of fluctuations. These stops are initiated by higher management when overall revenue is lower than planned.

Next, the negative effect of workload on employee morale – via making mistakes. Making mistakes can be demoralizing. As for this effect, the research data does not suggest that it is specific to this organization.

There is also another negative effect of workload on employee morale. This is the effect that goes through the modifications needed to correct mistakes. The strength of this effect might be higher in organizations in which mistakes require much rework – which can be more demoralizing.

The final addition is that too frequent prioritization can lead to a decrease in employee morale. This partly answers the call by Delisle (2020) to investigate how employees handle prioritization. This effect is expected to be present more often when projects are financed by and carried out for specific customers. The reason for this is that prioritization was said to be "almost always attached to a customer".

4.1.4.2 Submodel 2: "performance spirit"

As can be seen in Figure 10, employee morale is also connected to commercial performance in two directions. Hence, this submodel is called "performance spirit". Besides connecting feedback loops in the overall system, it also contains two feedback loops that reinforce any increase or decrease in the system. This submodel will now be discussed.

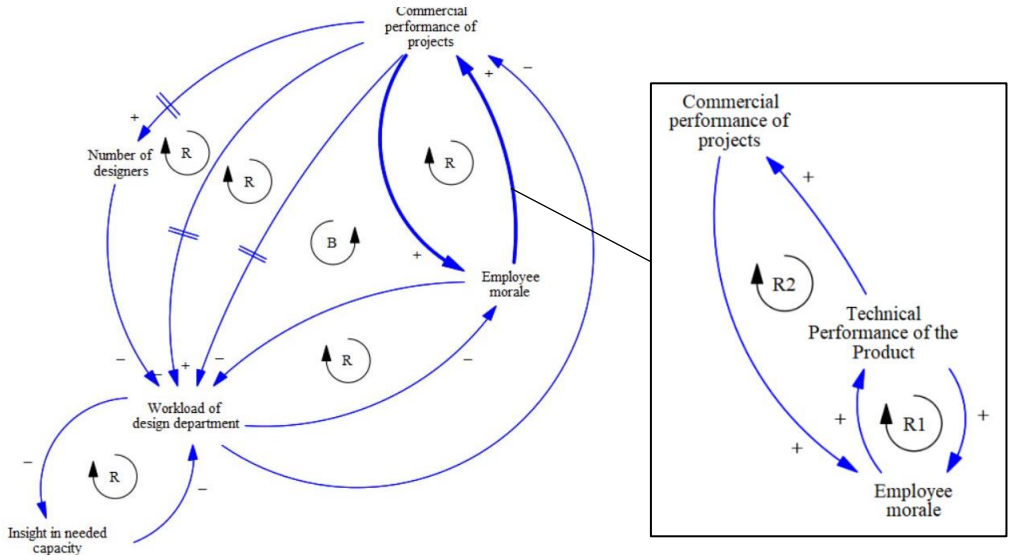

Figure 10. Overall model (left) & "performance spirit" submodel (right)

The commercial performance of projects is an umbrella term for how well an innovation project delivers on its promised time, margin, production volumes, revenue, and quality.

Commercial performance influences employee morale positively: “If it's successful, then yeah, the whole team … has a higher morale.”

Besides the commercial aspect, there is also a technical facet to the feedback of an innovation project’s performance. A project’s technical performance means how well the promised product specifications and production criteria are attained. For example, how quickly the product can be produced. While commercial performance must be communicated dedicatedly, “the technical performance is there for everyone to see.”

The amount of morale that employees have, stands in a reinforcing relation to the technical performance (R1). The participants also suggested that technical performance increased commercial performance. Commercial performance in turn positively affects employee morale. This way, feedback loop R2 is constituted.

Compared to theory, all findings in the “performance spirit” submodel are new to theory. They are displayed in Table 3.

Table 3. “performance spirit” submodel: confirmations and additions to theory on consequences

EMPIRICAL OBSERVATION	ADDITION TO THEORY
Commercial performance affects employee morale positively.	Blichfeldt and Eskerod (2008) only state that working on one’s own project can have beneficial effects on employees.
The technical performance of the product has a positive effect on employee morale.	Blichfeldt and Eskerod (2008) only state that working on one’s own project can have beneficial effects on employees.
Employee morale has a positive effect on technical performance.	Technical performance is not mentioned as a factor in having too many projects in the theoretical model or its potential expansions.
Technical performance has a positive effect on commercial performance.	Technical performance is not mentioned as a factor in having too many projects in the theoretical model or its potential expansions.

4.1.4.2.1 Additions to theory

The first observation adds to theory by showing that employee morale can be reduced by low commercial performance. This takes place via the feedback employees receive on how well the product they have worked on performs. Therewith, it might be more strongly present in organizations that have this feedback mechanism in place.

The second addition to theory is that technical performance positively affects employee morale. This effect might depend on how large an employee’s share in a project is. The designers in organization X could, for example, be responsible for the complete design of a

single product. Blichfeldt and Eskerod (2008) state that this can give employees self-realization and self-respect. Both for product innovations and process innovations there can be a continuum between excellent and poor performance. Therefore, all these effects are not expected to differ for these two types of innovations.

The final three additions to theory might be more applicable to technological innovations than to innovations of an administrative nature. This is because technical performance is expected to play a greater role in companies that mainly carry out technological innovations.

4.1.4.3 Submodel 3: "customer impact"

The "customer impact" submodel represents the direct relationships of workload on commercial performance (see Figure 11). It does not contain any feedback loops. Therefore, it is on its own perhaps of lesser interest. It does however connect the feedback mechanisms of the overall model. The "customer impact" submodel will now be described per variable and relation.

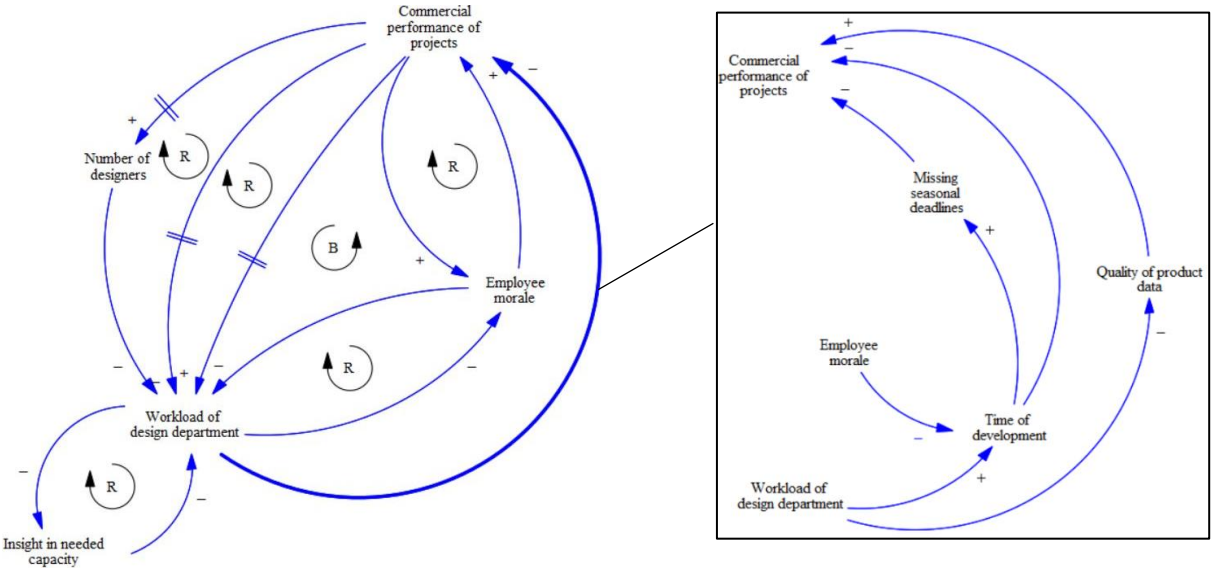

Figure 11. Overall model (left) & "customer impact" submodel (right)

First, a high workload can lead to a longer time of development. Projects are for example getting in each other's way: "then we have irrevocable delays because [manager X's] department just can't test certain [products]." This has a direct negative effect on commercial performance. For example, by not being able to create turnover earlier. A high workload can also lead to seasonal deadlines being missed. For example, a customer that mainly needs products during a single season. The time of development is besides also influenced by employee morale. When employees have low morale, projects can take more time to finish.

Second, a too high workload can hinder designers in keeping the product management department up to date on the latest data of the product that is being developed. For example, product specifications and unique selling points. As one participant put it: "how on earth are we going to communicate it to sales if we don't even know about it?". This in turn also decreases the commercial performance of new products.

The comparison of the "customer impact" submodel to theory brings up six topics. They can be found in Table 4.

Table 4. "customer impact" submodel: confirmations and additions to theory on consequences

EMPIRICAL OBSERVATION	CONFIRMATION OF THEORETICAL MODEL
High workload increases the time of development	This finding corresponds to the theoretical SD-model (R. G. Cooper & Edgett, 2003). Having too many projects for the limited resources available increases the cycle time.
Time of development negatively affects commercial performance.	This observation confirms the finding by R.G. Cooper & Edgett (2003). The time of development, or cycle time, has a direct negative effect on commercial performance – "New product performance" in the theoretical model.
EMPIRICAL OBSERVATION	**ADDITION TO THEORY**
Time of development negatively affects commercial performance via missing seasonal deadlines.	In addition to a direct effect, this shows that there is also an indirect negative effect of time of development on commercial performance: via missing seasonal deadlines (R. G. Cooper & Edgett, 2003).
A decrease in employee morale causes the time of development to be longer.	Scholars have identified the time of development to increase when having too many projects (R. G. Cooper & Edgett, 2003). This finding sheds light on how that exactly happens.
Workload negatively affects the quality of product data.	This effect is not mentioned in the theoretical model and its potential expansions.
The quality of product data has a positive effect on commercial performance.	This effect is not mentioned in the theoretical model and its potential expansions.

4.1.4.3.1 Confirmations of the theoretical model

The comparison of the "customer impact" submodel with theory brings up two ways in which the theoretical model is confirmed. First, the finding that a high workload increases the time of development. More specifically, the notion by R. G. Cooper & Edgett (2003) that especially the waiting time increases, is confirmed. The research data does not suggest this effect to be specific to product innovations or process innovations.

Secondly, both models show that a long time of development hurts commercial performance. Herewith, these theoretical relationships are confirmed for product innovations of a technological nature. These findings seem to be able to apply regardless of whether an organization is primarily carrying out emergent or radical innovations.

4.1.4.3.2 Additions to theory

Four original additions to theory result from the contrasting of this submodel. Firstly, the time of development hurts commercial performance via missing seasonal deadlines. This finding is expected to apply to other organizations that must deal with seasonal tendencies in customer demand.

Second, the effect of lower employee morale causes the development time to be longer. The research data does not suggest this effect to be necessarily specific to a situation of this organization.

Third, the notion that workload negatively affects the quality of product data. This effect is expected to be especially relevant for innovation projects that can deviate from the specifications and unique selling points that were determined at their start. Such deviations are expected to happen more often in radical innovation projects than in incremental innovation projects.

Fourth, the quality of product data has a positive effect on commercial performance. This effect is most relevant in the case of innovation projects that are aimed to be sold to customers.

4.1.4.4 Submodel 4: "performance feedback" submodel

In addition to the effects from the workload on commercial performance, there are also effects in the opposite direction. These relations make up the "performance feedback" submodel as represented in Figure 12. This submodel is where the negative side effects of high workload feed back into the portfolio DM and the workload. It also contains the two main levers that decision-makers can use to influence the number of projects – approving and killing projects. With the insight in needed capacity, this submodel also represents a part of the evaluation process of IPPM. Therewith, it might be the most important submodel. In general, it is interesting to see that – apart from the increased prioritization in the "work pressure" submodel – there seems to be no direct feedback from the workload to the portfolio DM to reduce the workload. This can cause the negative side effects of an overloaded innovation project portfolio to keep on growing.

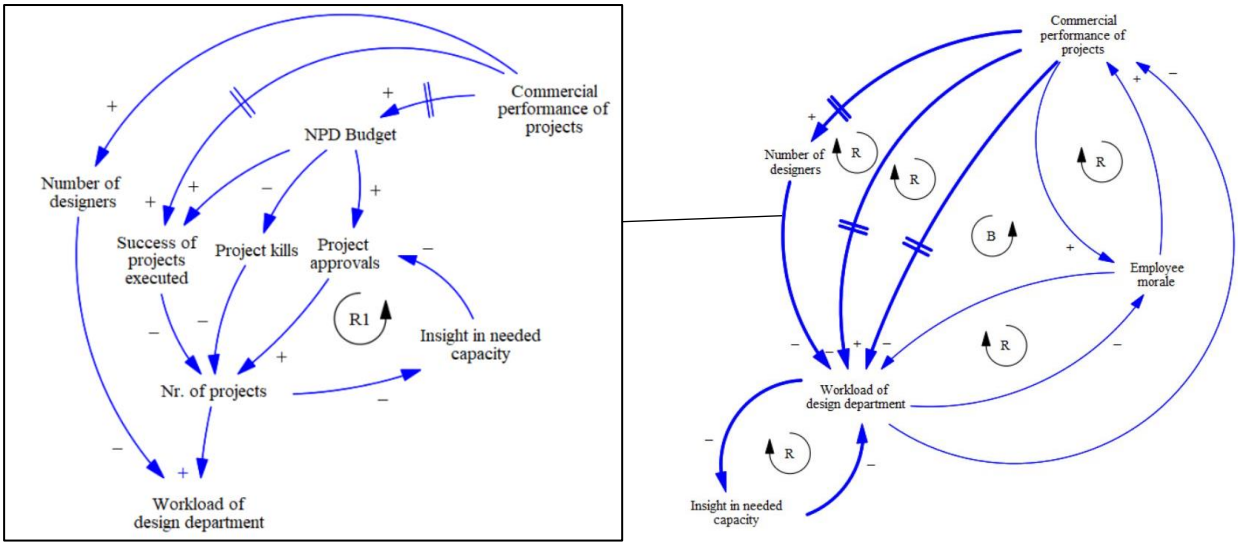

Figure 12. "performance feedback" submodel (left) & Overall model (right)

To begin with, poor insight into the current and future available capacity can contribute to a higher number of projects because "if you don't have clear insight in capacity then you might pull too many projects through TG1." This increase in the number of projects in turn reduces the insight even more. Feedback loop R1 of the submodel represents this.

One main effect of the commercial performance is that on the number of designers. When projects are well-performing commercially, the chance that there will be relatively more designers in the future becomes higher: "If our commercial performance on the NPD projects would be much better, we would not have been forced to have a headcount reduction". This effect is delayed by at least one year.

Additionally, commercial performance can increase the success of projects executed. Lessons can be learned from which projects have a high commercial performance. These lessons are considered when preparing next year's budget. This way, the budget for next year will contain relatively more successful projects. In doing so, the number of projects is reduced. This is because they will be executed more swiftly and progress through the TG process without getting stuck.

Commercial performance can also influence the yearly budget allocation for NPD. The management team of organization X is willing to increase the budget when commercial performance is high for several consecutive years. However, such budget increases were indicated to be minor.

Furthermore, the budget is an influence on how many "go" and "kill" decisions are made. This means that during the year – as the budget runs out – projects are added less easily,

and more projects need to be killed. By contrast, when there is still ample budget left, projects are approved more easily, and fewer projects need to be killed. This effect helps to reduce the number of projects. But, it does not benefit the profitability of the portfolio because important projects are not able to receive a "go", or need to be killed due to low budget.

Participants also mentioned to sometimes deviate from the criteria for making decisions. For example, by adding projects that did not fully meet criteria or by not killing projects that should technically have been killed. This was due to them not wanting the innovation department to become the "Sales Prevention Department." However, the dynamic behind this has not been further discussed and modeled during the GMB-sessions. For this reason, we will not discuss it.

Table 5 shows how the "performance feedback" submodel confirms theory and adds to theory.

Table 5. "performance feedback" submodel: confirmations and additions to theory on consequences

EMPIRICAL OBSERVATION	CONFIRMATION OF POTENTIAL EXPANSIONS
Having too many projects reduces insight needed capacity.	This observation corresponds with a notion by Blichfeldt and Eskerod (2008).
EMPIRICAL OBSERVATION	**ADDITION TO THEORY**
Commercial performance influences the number of designers positively.	The workforce has yet only been found to be negatively affected by workload (Delisle, 2020).
Reduced insight in the portfolio can cause too many projects to be added to the portfolio.	Scholars have identified that taking in too many projects can in itself be a cause for the persistence of innovation project overloads (Blichfeldt & Eskerod, 2008; Payne, 1995). This study adds to this by showing that having too many projects can reinforce itself.
Commercial performance increases the success of projects executed.	This effect is not mentioned in the theoretical model and its potential expansions
Financial resources are affected positively by commercial performance.	Financial resources are thus far merely seen as a static constraint by R. G. Cooper & Edgett (2003). This study clarifies how insufficient budget and cuts in the budget can reinforce each other (R. G. Cooper et al., 2000).
A low remaining budget reduces the number of "go" decisions and increases the number of "kill" decisions made.	This effect is not mentioned in the theoretical model and its potential expansions.

4.1.4.4.1 Confirmation of expansion area

When comparing the "performance feedback submodel" with theory, one confirmation of an expansion area comes up. This is the notion that innovation project overloads obstruct the insight in the portfolio. The research data shows that this effect can have two aspects. Firstly, the insight into the capacity that the portfolio requires can be reduced. Second, there can be less insight into the progress of projects – on which "kill" decisions are based. Both aspects enrich the statement on this effect by Blichfeldt & Eskerod (2008). These scholars also note that not only the number of projects but also the poor execution quality plays a role in this (Blichfeldt & Eskerod, 2008). This is not confirmed by the research data. Organization X had a digital system in place to see the progress of each project. But the sheer number of projects still made it difficult to get an overview. Hence, we can expect this effect to be present in organizations with similar or less comprehensive project management tools.

4.1.4.4.2 Additions to theory

Five novel additions to theory originate from the contrasting of this submodel with theory. To begin with, the above-mentioned reduction in insight in the portfolio can cause too many "go" decisions to be made.

Another addition to theory is the feedback of commercial performance on the number of designers. This mechanism is important to the overall feedback of having too many projects. This effect is expected to be more present in private equity owned firms as those seem to try to reduce costs – and therewith the size of the workforce – even more than other organizations. However, it is likely present to some degree in many other organizations.

Now we will discuss the effect of commercial performance on the success of projects. This effect is expected to be present to some degree in virtually all organizations with an innovation project portfolio. This is because it is one of the fundamental learning mechanisms of project selection.

Next, perhaps one of the most important findings of this study in comparison to the literature on overburdened innovation project portfolios. This is the feedback of commercial performance on financial resources. It can be expected to be present in many other organizations. Especially in organizations that are owned through private equity which tend to be even more careful with large investments.

A final addition to theory is that a low budget means fewer "go" decisions and more "kill" decisions. Neither the theoretical model nor its potential expansions mention such an

effect, or an effect closely related to it. This effect might be stronger for radical innovations as these take up larger chunks of the budget.

4.2 Relation of Too Many Projects with DM-Effectiveness

The relations of the consequences of too many projects with the three portfolio DM-effectiveness outcomes have been analyzed. This was done by considering the empirical model and by coding the transcripts of the GMB-sessions with the indicators of portfolio DM-effectiveness. See Appendix G for the coding table. We will discuss the relations of innovation project overloads with portfolio DM-effectiveness one at a time for each outcome: agility, portfolio mindset, and focused resource-spending. First, the effects of too many projects on an outcome will be discussed. After that, the effect of an outcome on having too many projects will be reviewed.

4.2.1 Agility

4.2.1.1 Effects of too many projects on agility

To begin with, it became apparent from the analysis that having too many projects influences portfolio *agility* via the frequency of prioritization. As described in the "work pressure" submodel, a project overload can cause a need for frequent prioritization. This need contrasts with prioritizing to let the portfolio better reflect strategic opportunities and threats (Kester et al., 2011). This study's finding adds an extra dimension to the drives for agility.

Furthermore, the research data shows that less available budget also means less agility. This is represented in the "performance feedback" submodel. There is less room for changing the composition of the portfolio when financial resources are low. For instance, at TG3, the following question is asked: "how much money do we still have in our wallets, … can we do this project, or can we not do this project?" This notion might be an addition to the deciding factors for agility in portfolio DM that are currently recognized (Kock & Georg Gemünden, 2016). This finding stresses the importance of spreading out budget evenly over a year as agility can be hampered by having a low budget.

4.2.1.2 Effects of agility on too many projects

Swift implementation of portfolio decisions – such as adjusting priorities – is generally indicated to be advantageous for keeping the number of projects manageable (Kester et al., 2011). However, the research results suggest that too much agility can also play a role in getting

too many projects. Excessive prioritization can have negative consequences on employee morale. Eventually, the commercial performance could even suffer due to this. Therefore, when in in an innovation project overload, it is important to bear in mind the employee morale and to prevent employee morale from dropping via other means. Perhaps it is also advisable to proactively mitigate the detrimental effects of low employee morale.

4.2.2 Portfolio mindset

4.2.2.1 Effects of too many projects on portfolio mindset

Having too many projects in the conception phase will severely reduce the ability to have a *portfolio mindset*. Refer to the "performance feedback" submodel for this. This finding sheds light on how exactly having a *portfolio mindset* can be troubled by having an overloaded innovation project portfolio (Kester et al., 2011). Scholars have stated that project overloads obstruct the insight in the portfolio (Blichfeldt & Eskerod, 2008). This study confirms this notion and connects it to the theoretical model. This finding shows that practitioners need to realize that the overview of a portfolio can be impeded by having too many projects.

4.2.2.2 Effects of portfolio mindset on too many projects

Lack of portfolio overview was also indicated to cause too many projects to be added to the portfolio – again, the "performance feedback" submodel. Herewith, the negative effect of poor portfolio insight on innovation project overloads is confirmed (Kester et al., 2014). This realization can help practitioners in being cautious with adding too many projects when portfolio overview is inadequate.

4.2.3 Focused resource-spending

4.2.3.1 Effects of too many projects on focused resource-spending

One effect of project overloads is that financial resources – in the form of a yearly budget – are rapidly depleted. This is especially problematic near the end of the year. These *resources* can thus be spent in a *less focused* way. Projects take up larger parts of the remaining budget when it is depleted during the year. This is another new way in which having too many projects affects the portfolio DM-effectiveness (Kester et al., 2011). Its location in the empirical model is within the "performance feedback" submodel. Bearing this finding in mind, organizations should spread out the spending of the budget throughout the year. In doing so, resources can be spent with more focus – also towards the end of the year.

4.2.3.2 Effects of focused resource-spending on too many projects

Lower commercial performance due to not focusing resources on important projects can reduce the available resources. Especially in the long term "The fact that … in the coming years we will only have about [X euros] to spend on NPD per year, that is because there has indeed been considerable underperformance, commercial underperformance, on the investments within the last few years."[3] This effect is also part of the "performance feedback" submodel. This outcome emphasizes the effect that not being able to *spend resources* in a *focused* way has on the persistence of project overloads. Hence, this study suggests a two-way effect between too many projects and not spending resources with focus. The framework by Kester et. al (2014) only contains a relation from portfolio DM-effectiveness in the direction of portfolio performance. Thus, this finding is an addition to theory.

4.2.4 Mediating effects

The coding of the research data also revealed some effects between the three portfolio DM-effectiveness outcomes. These effects seem to mediate the effects of too many projects on the portfolio DM-effectiveness outcomes. This is illustrated in Figure 13. One effect was that of *agility* on the *portfolio mindset*. *Agility* seemed to influence the *focus with which resources were spent*. Another effect was that of having a *portfolio mindset* on *focused resource-spending*. These mediating effects confirm, and specify the notion that all three portfolio DM-effectiveness outcomes should be achieved simultaneously to increase IPPM performance (Kester et al., 2014). Also, since all mediating effects end up affecting f*ocused resource-spending*, it might be most hampered by project overloads. Because these effects fall outside the scope of this research, a more elaborate description of these effects can be found in Appendix H.

[3] Original quote: "het feit dat … wij de komende jaren maar [X euro's] te spenderen hebben aan NPD per jaar, dat komt omdat er inderdaad een behoorlijke underperformance, commerciële underperformance is geweest op de investeringen van de laatste jaren."

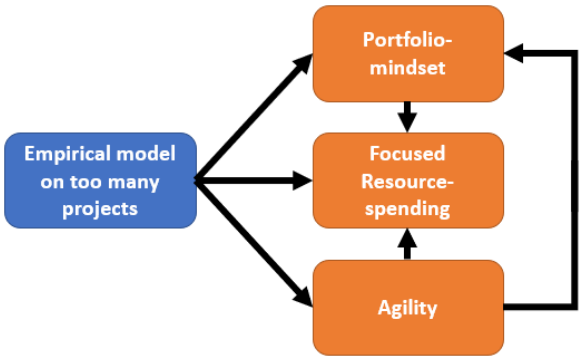

Figure 13. Mediated effects of having too many projects (blue) on the three portfolio DM-effectiveness outcomes (orange)

4.3 Effective Leverage Points

During the third GMB-session, twenty-nine leverage points have been elicited from the participants. These leverage points and how they were processed can be found in Appendix I. The eight leverage points that were discussed during the fourth session can be found in Table 6. The second column shows the average of the participants' scoring of the leverage point on impact and feasibility[4]. The following column shows the normalized leverage score[5] on the twelve-level model by Meadows (1999). The final column contains the average of column two and three – the overall score of the leverage point. The list is ordered from high to low on the overall score.

[4] The impact and feasibility scores are put between brackets
[5] The leverage scores have been normalized from a scale of 1 – 12 to a scale of 1 – 10. The formula with which this has been done can be found in Appendix I. The original leverage scores are put between brackets.

Table 6. Analysis of leverage points (1 - 10, higher is better)

LEVERAGE POINT	AVERAGE OF IMPACT & FEASIBILITY	LEVERAGE SCORE	OVERALL SCORE
Making a distinction between tollgate process and ideation phase	$\bar{x}$ (8, 6.5) = **7.25**	(10) = **8.4**	**7.8**
Implementing process for strategic choice, including criteria	$\bar{x}$ (8, 9) = **8.5**	(8) = **6.7**	**7.6**
Gain insight into capacity	$\bar{x}$ (8, 7) = **7.5**	(7) = **5.9**	**6.7**
Assess technical feasibility of projects in TG2	$\bar{x}$ (5.5, 7) = **6.25**	(8) = **6.7**	**6.5**
Marketing insights (for creating customer momentum)	$\bar{x}$ (10, 4) = **7**	(7) = **5.9**	**6.4**
Better insight/critical view on size project (TG2) + update during process	$\bar{x}$ (8.5, 3.5) = **6**	(6, 8) = **5.9**	**5.9**
Reduce Time of Development	$\bar{x}$ (7.5, 2.5) = **5**	(1, 10) = **4.7**	**4.8**
More designers to increase capacity	$\bar{x}$ (7.5, 4) = **5.75**	(1) = **1**	**3.4**

The three most effective leverage point ideas – based on the scoring of participants on impact and feasibility and their leverage score (Meadows, 1999) – will now be discussed. Each leverage point will be reviewed by looking at four aspects. First, how the leverage point impacts the empirical SD-model, second, which portfolio DM-effectiveness outcome it improves, third, what its feasibility, impact, and leverage scores are and, finally, whether the potential leverage is expected to be specific to organization X or not.

4.3.1 Making a distinction between TG-process and ideation phase

The most effective leverage point elicited was making a distinction between the TG process and the ideation phase. The TG process concerns the execution of innovation projects while the ideation phase concerns the development of innovation ideas. The goal of this leverage point is to significantly decrease the number of innovation ideas that become innovation projects.

On the one hand, this leverage point affects an essential part of the "performance feedback" submodel – the number of projects (as can be seen in Figure 14). This directly enhances the insight in the portfolio (R1). The reduction in the number of innovation projects also structurally reduces the workload. This prevents employee morale and commercial performance to reinforce each other in a damaging way. On the other hand, this leverage point

helps to embrace the iterative nature of the development of innovation concepts. This is expected to increase the success of the portfolio (Kock et al., 2015). Innovation projects can thus be completed in a more streamlined fashion. This means that decision-makers can *focus resources* on the most important projects (Kester et al., 2011).

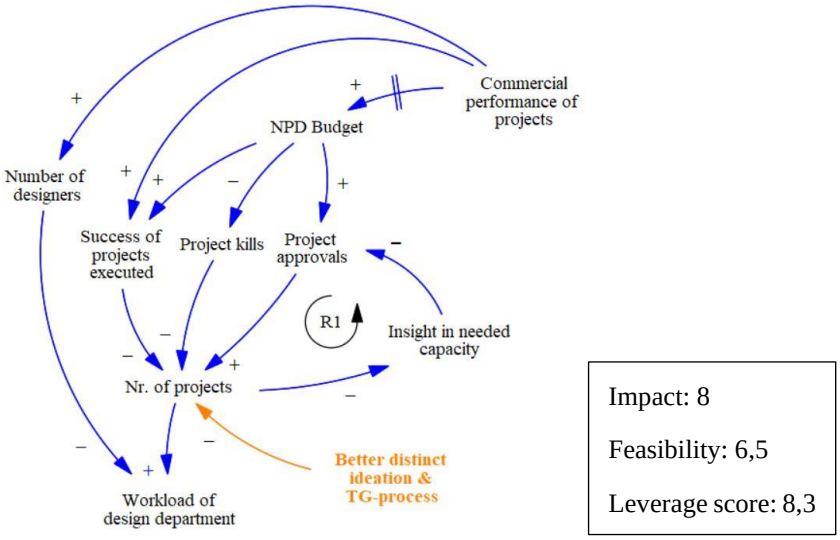

Figure 14. Leverage point 1 - better distinct ideation & TG-process

Feasibility is only medium, but the impact of this leverage point is high according to the participants. The high impact is confirmed by the leverage score on the classification by Meadows (1999)(see paragraph 2.7). This leverage point changes the goal of the system by focusing on developing innovations instead of putting out projects.

This leverage point has been shown to be successful for other organizations that do product innovations of a technological nature (Mathews, 2010). It can be expected to work best in organizations that focus on radical innovation. The development of radical innovation ideas takes longer and needs more iterations. Hence, there will be more to gain by making a clear distinction between the TG process and ideation phase.

4.3.2 Implementing process for strategic choice, including criteria

The second-best on the list of leverage points is implementing a process for strategic choice. The idea of this leverage point is to make more strategic choices on which projects to do. This can be implemented by involving the correct decision-makers and using the right criteria. In doing so, the success of the projects executed is increased. This causes the throughput of projects to be higher which effectively reduces the number of projects in the portfolio.

This leverage point is also located in the "performance feedback" submodel (see Figure 15 for this). Firstly, it positively affects commercial performance. This is helpful for both increasing employee morale (see the "performance spirit" submodel) as well as reducing the workload. Second, it can help to kill more projects. Third, approval of projects might be stricter. Besides that, this intervention was indicated to be able to increase the consensus on the IPPM-decisions made. Therewith, this leverage point is most closely related to improving the *focus of the resource-spending* (Kester et al., 2011).

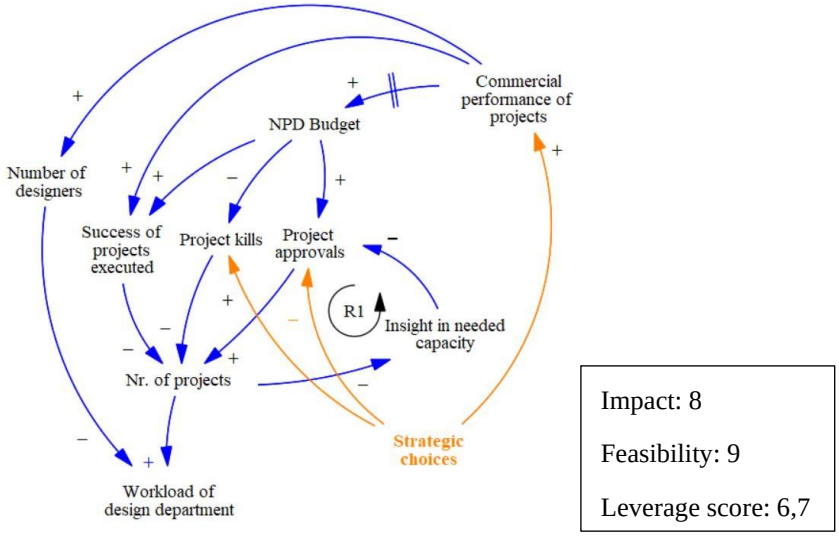

Figure 15. Leverage point 2 - strategic choices

The impact and feasibility of this leverage point are both high. Moreover, system rules are changed by this leverage point. Such interventions are generally expected to be of medium leverage (Meadows, 2008). This confirms the participant's assessment of its impact to some degree.

This leverage point is expected to be most effective when portfolio management is yet to be formalized. But there is already a formalized TG process at hand for executing innovation projects at organization X. This is also the case for many other organizations (*The State of Project Management Survey*, 2021). Hence, the impact of this leverage point is reduced.

4.3.3 Gain insight into capacity

Another leverage point of interest is gaining insight into the available capacity. This can be done, for example, by employing a capacity planning tool.

This intervention influences the DM at the core of the "performance feedback" submodel, see Figure 16 for this. There are two profound ways in which this can happen. On the one hand, it can proactively help in preventing too many innovation projects to be added to

the portfolio. Decision-makers can do this by basing their decisions on predictions of a too high upcoming workload. On the other hand, it can help reactively – when an innovation project portfolio is overloaded. The insight can help to stop harmful project approvals from being made. Hence, this leverage point can improve the *portfolio mindset* of the decision-makers (Kester et al., 2011). The insight in capacity can then help to add fewer projects – or perhaps even kill more projects – when needed.

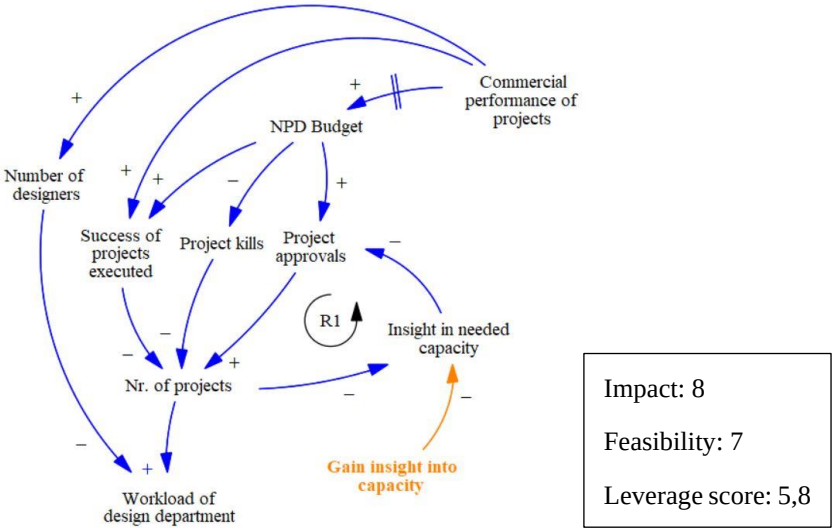

Figure 16. Leverage point 3 - gaining insight into capacity

As for the feasibility of this leverage point, it was indicated to be medium to high. The impact was said to be high. When we look at the model by Meadows (1999), this leverage point's effectiveness is probably only moderate. It changes the information flow in the system which provides decision-makers with an opportunity to make better decisions.

This leverage point is especially relevant when information feedback from the workload to the portfolio decisions is missing in an organization. Then it can help to prevent or reduce the negative side-effects of having a too high workload.

5. Conclusion

This study aimed to investigate the systemic causes for having a portfolio with too many innovation projects. The research took place at an organization that struggled with innovation project overloads. An introductory interview, four GMB-sessions, and a disconfirmatory interview were held.

This chapter first presents the conclusions drawn from this research by highlighting the systemic causes for having a portfolio with too many innovation projects and by illustrating how these causes are related to portfolio DM-effectiveness. After that, the theoretical and practical implications will be discussed. Next, a reflection on the limitations of the research results and the role of the researcher are provided. Finally, theoretical and practical recommendations will be given.

5.1 Systemic Causes for Too Many Innovation Projects

This research has identified two important systemic causes for having too many projects. In the first place, having too many projects, low employee morale and low commercial performance of projects are mutually reinforcing. This means that an adverse shock to one of these elements can lead all three to spiral out of control. In the second place, low commercial performance – due to innovation project overloads – alleviates high work pressure. However, this relief of work pressure comes too late because the damage to commercial performance has already been done by then. Low commercial performance leads to less extra budget and personnel. Hence, there is less leeway to successfully execute next year's innovation projects. There seems to be a lack of feedback from high workload to the making of portfolio "evaluation", "selection" and "kill" decisions to lessen. Not considering the workload in these decisions can cause the workload – and thus the number of projects – to become even worse.

5.2 Relation of Systemic Causes with Portfolio DM-Effectiveness

The relationship of the systemic causes for too many projects with the effectiveness of portfolio DM was found to be two-way.

First, having an overloaded innovation project portfolio hampers all three portfolio DM-effectiveness outcomes (agility, portfolio mindset and focused resource-spending). Overly frequent prioritization – due to a project overload – restrains the *agility* with which the portfolio can be adapted to reflect new opportunities. As for having a *portfolio mindset*, it is especially made difficult by having too many projects in the conception phase. *Focused resource-spending*

is negatively affected for the most part by the scarcity of resources that comes with project overloads.

Second, low portfolio DM-effectiveness also appears to facilitate having too many projects. To begin with, not being able to *spend resources in a focused way* is the portfolio DM-effectiveness outcome that fuels innovation project overloads most. This happens mainly via having less resources to spend. Next, s*pending resources without focus* decreases the commercial performance of the portfolio. In turn, this leads to even more resource deficiencies. At last, not having a *portfolio mindset* can cause too many projects to be added to the portfolio. Frequent prioritization is generally a sign of high *agility*. However, overly frequent prioritization seems to be able to increase an overload of projects because it negatively affects employee morale.

5.3 Effective Leverage Points to Address Having Too Many Innovation Projects

Three leverage points have been identified as crucial for addressing an excess number of innovation projects. First, it can be helpful to make clearer distinction between innovation ideation and project execution. This can help to shift the focus from translating every innovation idea into an innovation project to doing fewer projects with more success. This way, the number of innovation projects is brought down structurally. Another effective leverage point is improving the strategic choice process, including the criteria used for portfolio decisions. In doing so, projects that enter the portfolio will better fit the strategy of the organization. Thus, the success of the projects executed will be improved. Hence, the project throughput is increased and the number of projects that need to be in the portfolio is decreased. A third point of leverage is increasing insight into capacity. Having insight into capacity helps to assess whether the portfolio has room for a new project. This prevents innovation projects for which there is no capacity to be added to the portfolio.

The “performance feedback” submodel is where innovation project overloads can be addressed most effectively; all three best leverage points are located in this submodel. This submodel contains the feedback of low commercial performance on the IPPM-decisions, resources, and workload. The leverage points show that it can allow for more proactive management of the number of projects.

5.4 Implications

5.4.1 Theoretical implications

First off, this research shows that looking at a portfolio management issue using the SD approach can be valuable. This is an important demonstration; taking a systemic view on portfolio management issues might prove to be the way to move this research field forward.

Next, the systemic causes for innovation project overloads that this study has found have some interesting theoretical implications as well. To begin with, the systemic causes provide an explanation for the persistence of overloaded innovation project portfolios. This clarification is a primer in IPPM literature. Furthermore, the comparison of the empirical and theoretical model shows that there are both similarities with as well as additions to theory on this subject (R. G. Cooper & Edgett, 2003). The similarities between theory and the empirical SD-model show that theory is far more interconnected than hitherto indicated. As for the additions to theory, there are three main ones. First, frequent prioritization – to deal with having too many innovation projects – affects employee morale negatively. Second, scarce financial and human resources are used up because of bad performance due to innovation project overloads, contradicting the current view, that sees resources merely as a constraint for executing innovation projects. Third, a poor overview of the portfolio can cause decision-makers to add too many projects to a portfolio.

Besides that, the research results indicate an interdependence between ineffective portfolio DM and having too many projects. Not only do they confirm that ineffective portfolio DM is a cause for having too many projects (Kester et al., 2014), overburdened innovation project portfolios also seem to reduce the three portfolio DM-effectiveness outcomes. The latter effects are an addition to theory.

The results also suggest that there are three effects at play between the portfolio DM-effectiveness outcomes. Both a poor *portfolio mindset*, and *low agility* can reduce the *focus with which resources are spent*. Additionally, low *agility* can worsen the *portfolio mindset*. These effects might mediate the effect of too many projects on other portfolio DM-effectiveness outcomes. These mediating effects confirm and specify the notion that all three outcomes should be strived for simultaneously (Kester et al., 2011). However, the studying of these mediating effects falls outside the boundary of this research.

As for the leverage points that were elicited, these can clarify how innovation project overloads might be addressed. The fact that the three most effective points are located in the

"performance feedback" submodel suggests that further research in this area might be useful. At last, the leverage points can inspire scholars to further research the effectiveness of individual leverage points.

5.4.2 Practical Implications

The empirical model developed in this study provides organizations that find themselves in an innovation project overload with an overview of the most important systemic causes and potential solutions. Organizations can with this model also see the feedback mechanisms that may be at play. The disconfirmatory interview approved the usefulness of the empirical model for organization X since there were only some minor disconfirmations pointed out. Appendix J provides a report of this interview.

Furthermore, the findings implicate that feedback from the workload to portfolio decisions might be missing in organizations that experience project overloads. The lack of such feedback seems to play a vital role in causing overloaded innovation project portfolios. Investigating the presence of such feedback – and improving it – might be a quick win for organizations.

Another implication of this study is that organizations can use the empirical SD-model to understand and improve their portfolio DM-effectiveness. This can increase the success of their portfolio.

This study has also found that having too many projects hampers portfolio DM-effectiveness the most on the *focused resource-spending* outcome. Decision-makers involved in the IPPM of organizations should be aware of this. This awareness can help identify and address future project overloads. Furthermore, the results show that to improve the *focus of the resource-spending*, the *portfolio mindset* and *agility* should also be improved. Additionally, practitioners wanting to improve their *portfolio mindset* should also enhance *agility*.

Finally, the leverage points suggested by this study can stimulate practitioners to identify their own leverage points by adapting the model to their own context.

5.5 Reflection

5.5.1 Limitations

To start with, the limitations of the chosen research approach will be reflected upon. The results of this study should be adopted with care as only one case was studied. Additionally,

the choice for GMB-sessions as a data-gathering method might have hampered the depth of the results. Furthermore, the assertions on the behavior that the structure of the SD-model generates are preliminary as the model has not been quantified. Lastly, the use of a concept model to start the development of the empirical model – instead of starting from scratch – may have hampered the grounding of the model in practice.

Four limitations emerged during the research itself. One issue was that, because of the summer break, there were fewer participants than intended at the first session. This was unfavorable because not all the participants were involved in establishing the behavior over time graphs of key problem variables. Due to the summer break, there was also a three-month time interval between the first and second session. This was not beneficial for the involvement of the participants in the research project. To counteract the negative effects of this break, an elaborate recap of the first session was given at the start of session two. Additionally, the research results were hampered by organization X being owned by a private equity firm. This was because an indicator for *portfolio mindset*[6] and an indicator for *focused resource-spending*[7] considered the relation of projects with the long-term goals of the organization. The private equity firm however attached more value to short-term profit. In this way, these indicators were less applicable for organization X. At last, acting upon new opportunities appeared to play a lesser role in the portfolio DM of organization X than expected. Therefore, one indicator for *agility*[8] was less suitable for this study.

5.5.2 Role as a researcher

To begin with, I was both a data gatherer and an analyst of the data. In the main, I experienced this to be beneficial. It helped in representing the data and analysis authentically. However, it also made it more difficult to objectively analyze the data. It was for instance difficult to suppress issues that seemed important in the earlier sessions but later turned out to be unimportant.

Furthermore, the research results were potentially hampered significantly at three moments during the GMB-sessions. During the first session, there seemed to be a slight hesitation by participants to share confidential information. To counteract this, I stressed at the beginning of session two that the research abided by organization X's code of conduct. How

[6] "Understanding of the relationship of each innovation project to the achievement of the firm's long-term goals"
[7] "Having clarity on how innovation projects in the portfolio help achieve the firm's long-term goals"
[8] "Having the flexibility to be able to change and implement the composition of portfolio in response to new strategic opportunities"

the research data would be treated was also explained in further detail. Another limitation was that the explanation of the behavior over time assignment could have been clearer. One participant thought that the issue of too many projects was discussed in general – instead of for organization X. Another participant had drawn "hoped for" behavior instead of expected behavior. A final limitation that came up during the GMB-sessions, was that the co-facilitator needed to take over the facilitator role for the second half of the third session. This was because of technical difficulties with the video-calling software. The co-facilitator was not as well acquainted with the situation of the organization as the main facilitator. Hence, the quality of the group discussion during this session might have been lower.

5.6 Recommendations

5.6.1 Theoretical recommendations

The research results bring up several directions for future research on too many innovation projects. Many reinforcing feedback mechanisms have been found. This makes it interesting for future research to focus on what balancing loops are in place. It is especially interesting to study this in organizations that do not experience innovation project overloads. Such organizations might have certain balancing feedback mechanisms in place which help to prevent project overloads. Besides that, the SD model that this study developed also enables scholars to investigate individual feedback loops. These feedback loops can then be contextualized within the model. The effects of having an excess of innovation projects on portfolio DM-effectiveness might also be a fruitful area for future studies. This study has confirmed that there are effects from portfolio DM-effectiveness on having too many projects. But it has also found effects in the opposite direction. Future studies should study these effects to gain more certainty on their nature. The research results also suggest that there are three effects between the portfolio DM-effectiveness outcomes themselves. Scholars can investigate these suggested effects irrespective of innovation project overloads. In doing so, the factors responsible for effective portfolio DM might be better understood.

The limitations of this study can also guide future research on this topic. First, this study has focused on product innovations. The study should be repeated with process innovations to gain more complete comprehension of the systemic causes for too many projects. This allows the comparisons of product innovations and process innovations for this topic. Second, the choice to gather data using GMB-sessions limited the depth of the data that could be gathered. A similar study using in-depth interviews will be able to test the research results more

profoundly. Third, future studies should develop a model from scratch to verify the empirical grounding of the SD-model. Fourth, quantifying a part of the empirical SD-model can help to solidify the connection between the model and the behavior it generates. Fifth, it might be valuable to do a similar study in an organization that is not owned via means of private equity. This may shed more light on the influence of a long-term strategy in portfolio DM.

5.6.2 Practical recommendations

Having too many projects has many negative side-effects that keep commercial performance low. In the long term, this further worsens the issue. To prevent this, organizations should focus on long-term commercial performance. This can only be achieved by keeping the number of projects manageable. Organization X – and other organizations – can use the three most effective leverage point ideas to try to attain this.

The first leverage point to implement is making a distinction between the innovation ideation and the project execution phase. Making this distinction can, for example be done by setting up a distinct ideation process in addition to the project execution process. This is a profound change to the innovation process. It will take much planning and preparation but it is also the most effective means for reducing innovation project overloads. To further distinct these processes, their financial and personnel resources process can be separated. This is a low effort action that will have an additional structural impact.

The following leverage point to consider is the improvement of the strategic choice process. An example of how this can be done is by giving strategic criteria more weight than financial criteria in the TGs that projects need to pass. In addition, it is advisable to start using “strategic buckets”. This is a way of determining in advance what part of the annual budget can be spent on which strategic area. This enhances the focus of resource-spending.

The third most effective leverage point is gaining insight in personnel capacity. This is especially important when the signs of excessive workload are not fed back to the portfolio DM. Implementing this leverage point can be done, for instance, by setting up a capacity planning tool with which the supply and demand of resources for projects can be clarified. This also enables the integration of the available personnel capacity as a “budget” in the TG-process. Considering how portfolio decisions will affect the remainder of this budget aids portfolio decision-makers in keeping more capacity available towards the end of the year. Setting up a capacity planning tool involves considerable financial and time investments, but the benefits are also significant.

An additional step to safeguard good future commercial performance, can be using a metric for evaluating innovation projects that takes commercial performance into account. Currently, the Net Present Value[9] (NPV) metric is used in organization X. It merely assesses whether a project is worth the investment. A better metric would be Expected Commercial Value[10] (ECV). This metric helps to focus on the actual commercial value that a project is expected to provide. It also stimulates the organization to increase the chance of commercial success. Implementing the ECV metric entails that an adjustment is made to the formal requirements of one or more TGs. Moreover, additional data and estimations (e.g., probability of commercial success) are structurally required to calculate the metric. Besides that, some schooling will be needed to interpret the new metric in the initial phase.

[9] $NPV = Today's\ Value\ of\ Expected\ Cash\ Flows - Today's\ Value\ of\ Invested\ \ Cash$
[10] $ECV = (NPV \times Probability\ of\ Commercial\ Success - Commercialization\ Cost) \times Probability\ of\ Technical\ Success - Product\ Development\ Cost$

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Appendices

Appendix A

Original theoretical model on too many innovation projects

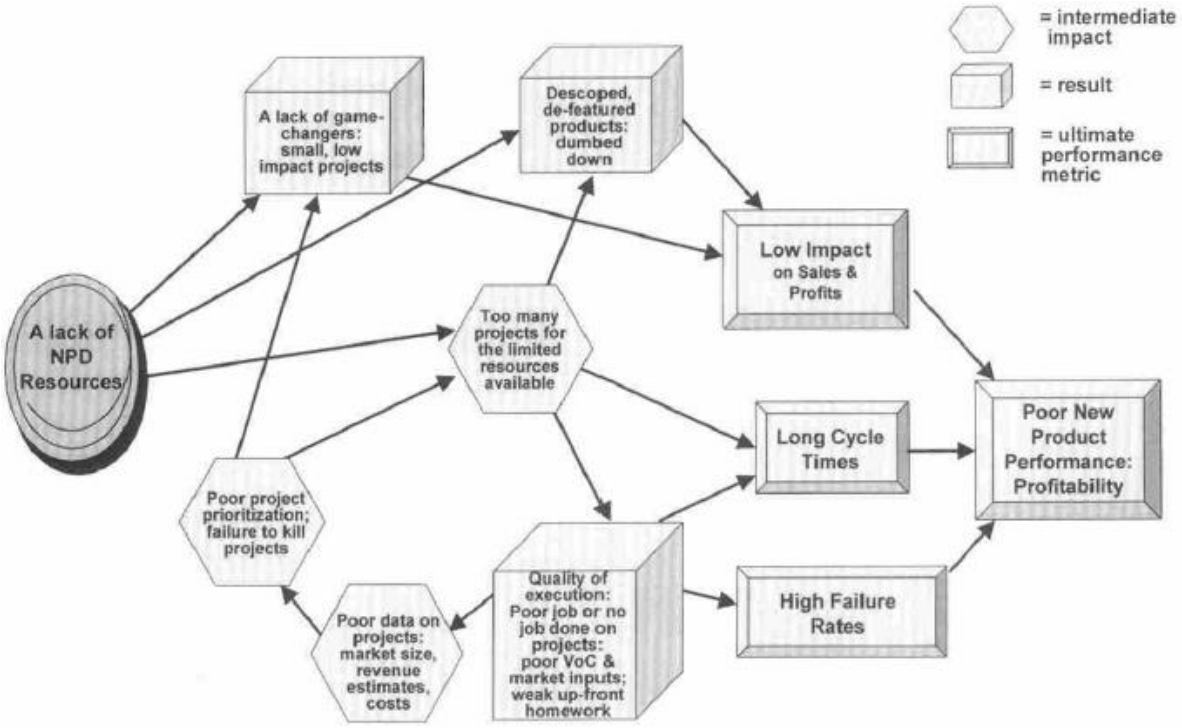

Figure 17. Original model by R. G. Cooper & Edgett (2003)

Overview of potential expansions for the theoretical model

Table 7. Potential expansions for the theoretical model

POTENTIAL EXPANSIONS	REFERENCE
work pressure, employees spread thinly across projects, worse team morale	(Blichfeldt & Eskerod, 2008; R. G. Cooper et al., 2000; R. G. Cooper & Edgett, 2003; Hendriks et al., 1999)
work pressure, workforce reduction	(Delisle, 2020)
making more mistakes	(Delisle, 2020; Repenning, 2001)
prioritization of emergencies	(Delisle, 2020; Engwall & Jerbrant, 2003)
short term resource-allocation	(Blichfeldt & Eskerod, 2008; Engwall & Jerbrant, 2003; Repenning, 2001)
poor overview of portfolio	(Blichfeldt & Eskerod, 2008)

Appendix B

Introductory interview scheme[11]

Soort innovatie

- Hoe ligt de verhouding tussen productinnovatie en procesinnovatie?
- Wat is de verhouding tussen incrementele (geleidelijke) of radicale innovatie?
- Is er meer sprake van technologische of administratieve (management) innovatie?

Innovatieprojecten

- In welke mate is er sprake van synergie tussen projecten?
- In welke mate kunnen projecten incompatibel met elkaar zijn?

Stakeholder-rollen

- Wat is de rol van projectmanagers?
- Wat is de rol van de project portfolio manager?
- Wat is de rol van het senior management?
- Wat is de rol van de afdelingsmanagers/ het middelmanagement?
    - Hoe verhouden zij zich tot de resources?
- Wat is het spanningsveld tussen stakeholders?
    - Zijn er verschillende discussies en perspectieven?

Tollgates

- Wat zijn de criteria of is de business case die nodig is voor een project?
- Welke besluiten kunnen er genomen worden? “Go”/ “kill”/ “hold”/ “prioriteren”?

Portfolio meetings

- Hoe vaak worden portfolio meeting gehouden?
- Wie zijn er aanwezig bij de portfolio meetings?
- Wat is de input voor portfolio meetings?
- Wat is de output voor portfolio meetings?

Te veel innovatieprojecten

- Wanneer zijn er "te veel" innovatieprojecten?

[11] This interview scheme was set up in Dutch because the interviewer and interviewee both spoke Dutch.

- Wanneer wordt er hinder door ervaren?
- Kunt u hier een voorbeeld van geven?
- Welke resources zijn van belang?
- Wat is volgens u de grootste oorzaak van het hebben van te veel innovatieprojecten?

Appendix C

Session reports

Session 1

The goal of the first GMB-session was to explore the characteristics of the problem of too many projects. Mainly due to the summer break, only five participants were present. The following departments were represented: innovation, development engineering, engineering, NPD and the project management office. This session had a duration of two hours.

To begin with, the purpose of the research and the outline of the GMB-sessions were presented shortly. Then, the "graphs over time" script (D. F. Andersen & Richardson, 1997, p. 118; *Scriptapedia*, 2020) was employed. An example of a graph over time was illustrated to guide the participants in drawing their graphs. Participants were asked to come up with problem indicators of having too many innovation projects. After that, they were asked to draw graphs with the behavior of the most important variables with regards to project overloads. The participants were asked to present their graphs over time, and, through discussion, consensus was sought on what the graphs over time meant, and what was behind them. The co-facilitator clustered the graphs discussed and presented the clustering, which was shortly remarked upon, and then approved.

Initially, the idea for the first session was to elicit problem cause variables after that. However, the researcher chose not to do this as there were already variables implicitly mentioned and there was a lack of time.

Session 2

The second session aimed to develop a model structure and identify feedback loops. The second session was attended by eight persons. They were part of the innovation, engineering, development engineering, project management office and NPD departments. This session lasted two and a half hours, as some extra time was included for most of the modeling effort.

The session started with a brief recap of the previous session. Then, the "structure elicitation" script was used. The nature of stocks, flows, and causal links were explained by the facilitator during the process. The stock and flow structures in Figure 18 and Figure 19 were used as a starting point. These structures were mainly constructed from the outcomes of session one, with details and nuances added from internal documents on the TG process and the informal observations of a TG meeting. While the innovation process at the company has

several stages and departments associated with them, a choice has been made to employ a simplified stock and flow structure (see Figure 18). This was done to keep the model easy to understand and build upon.

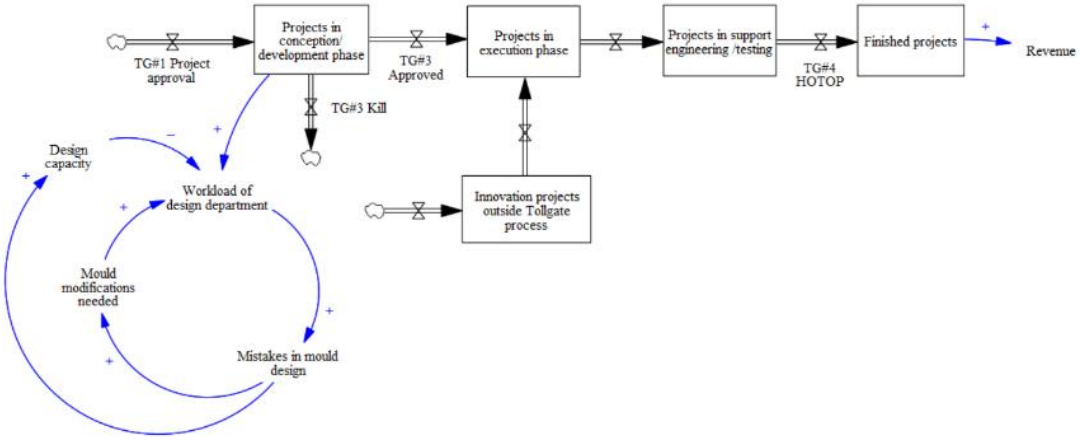

Figure 18. Innovation project portfolio stock and flow structure

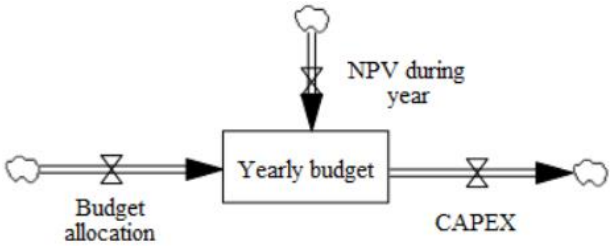

Figure 19. Yearly budget stock and flow structure

Then the group was asked what variables influence the inflows and outflows. These variables and causal relationships were added to the model. The previously elicited variables, but also new variables that came up were used for this. When the modeling stagnated, the facilitator focused on under-explored areas in the model. This was on the one hand done by bringing up variables that had no ingoing or outgoing arrows. On the other hand, participants were asked about previously elicited variables that were still unused.

After a short break, the participants were facilitated in identifying feedback loops. This is the most difficult part of a GMB process. To support this process, the focus was on variables that either had no causes or no consequences. This is done because such variables provide the highest potential for finding new relations between variables (Vennix, 1996, p. 199).

Session 3

The objective of the final session was to round off the modeling and gain ideas for leverage points in the system. The third session was attended by six participants. Several different functions were present: innovation, engineering, development engineering and

material engineering. As opposed to the other sessions, which were held in English, this session was held in Dutch as the participants of this session could all speak it.

During the recap, several interesting feedback loops were discussed. After that, the modeling continued. The participants were asked what was still missing from the model or what should be changed. Several points of focus, which arose from reviewing the second session, were used to further guide this process. As the finishing of the modeling took more time than expected, it was in consultation with the participants to keep an extra session. That session could then fully focus on generating leverage points. At the end of the session, the model was sufficiently complete and agreed upon.

Session 4

During the fourth GMB-sessions, participants were asked to come up with interventions to alter the problem behavior beneficially. Seven persons from the following departments attended this session: innovation, engineering, development engineering, material engineering, project management office, and NPD. The "places to intervene" script was the basis for this (*Scriptapedia*, 2020). Beforehand, a short introduction was given on the different places at which can be intervened in a system. The participants made lists of interventions including a score of one to ten on impact and feasibility. The most important intervention points were presented by the participants. They also stated their scores on impact and feasibility. It was interesting to see that there was a great overlap between the intervention points that the participants mentioned.

Appendix D

Operationalization Portfolio DM-effectiveness

Khachateryan's (2020) operationalization of the portfolio DM-effectiveness outcomes has been slightly adapted. The first two indicators of *focused resource spending* are the result of splitting up a single indicator. All indicators originate from the concepts as described by Kester et. al. (2011).

Dimension	**Indicator**
Agility	(1) Being able to implement portfolio decisions quickly
	(2) Having the flexibility to be able to change and implement the composition of portfolio in response to new strategic opportunities
	(3) Portfolio decision-making processes are speedy enough to assure quick acting upon new opportunities
Portfolio mindset	(1) At all times having an overview of all innovation projects in the portfolio
	(2) In-depth knowledge about each innovation project in the portfolio
	(3) Understanding of the relationship of each innovation project to the achievement of the firm's long-term goals
Focused resource spending	(1) Focusing resources on the achievement of innovation portfolio priorities
	(2) Having clarity on how innovation projects in the portfolio help achieve the firm's long-term goals
	(3) Working in a focused manner and not easily distracted from executing priorities
	(4) Having clarity on which innovation projects in the portfolio have priority

Appendix E

Behavior over time graphs

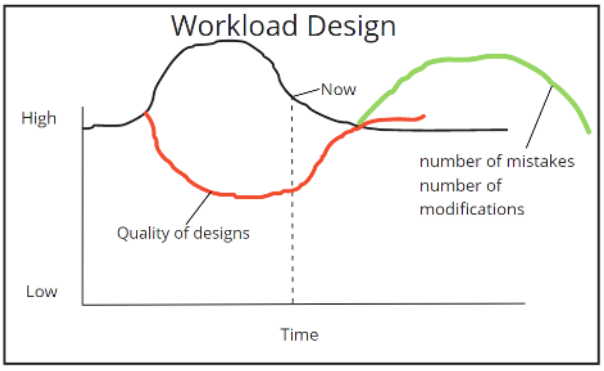

Figure 20. Behavior over time for Workload Design ("work pressure" submodel: R1)

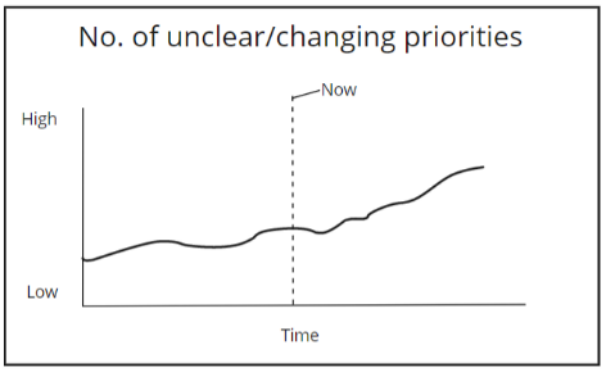

Figure 21. Behavior over time for the no. of unclear/changing priorities ("work pressure" submodel: R5)

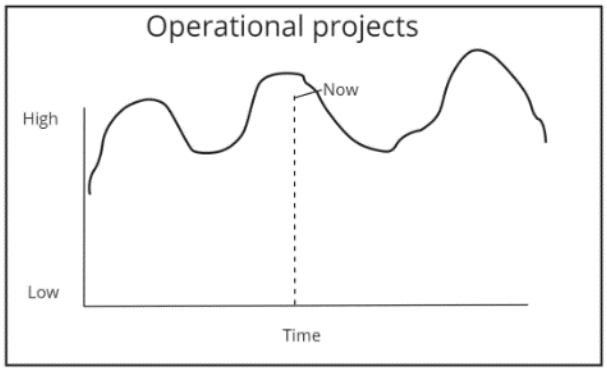

Figure 22. Behavior over time for the number of Operational Projects ("work pressure" submodel)

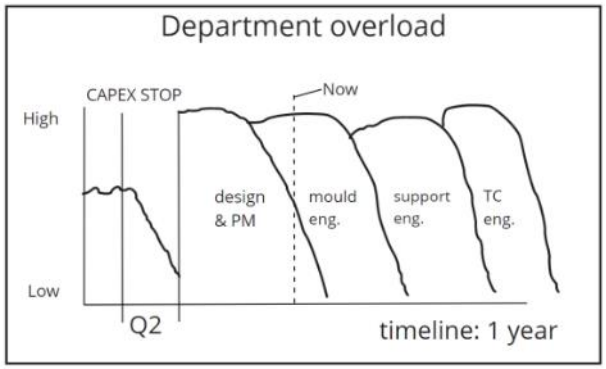

Figure 23. Behavior over time for the yearly recurring stop on investments (exogenous cause for fluctuating workload)

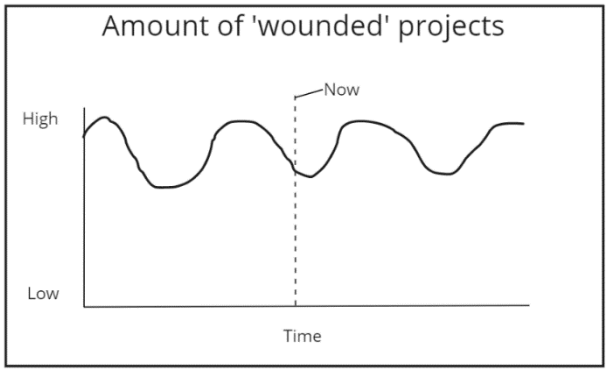

Figure 24. Behavior over time for the no. of wounded projects (inactive projects that should have been killed)

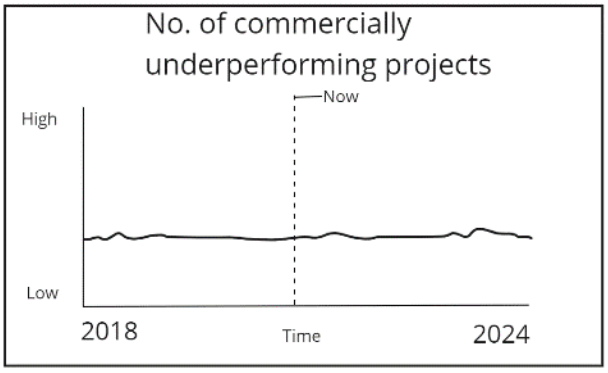

Figure 25. Behavior over time for the no. of commercially underperforming projects

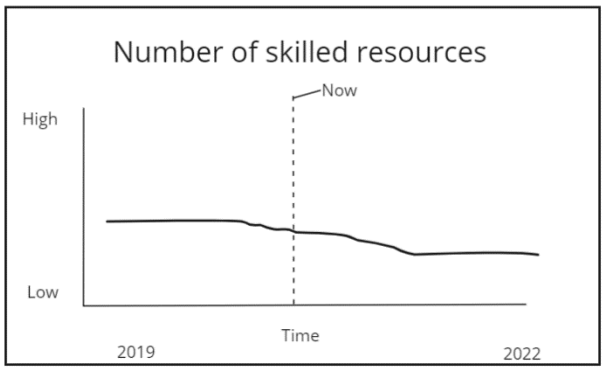

Figure 26. Behavior over time for the no. of skilled resources

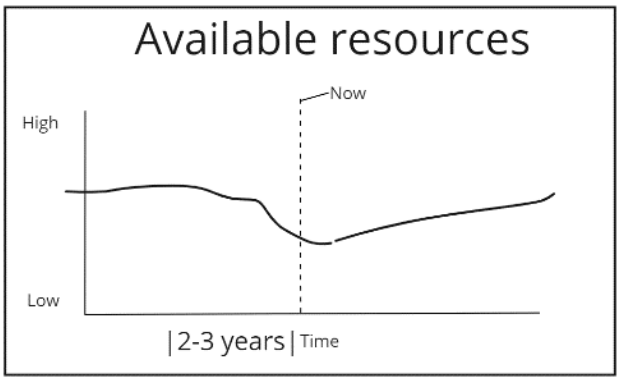

Figure 27. Behavior over time for the available resources

Appendix F

Final empirical model

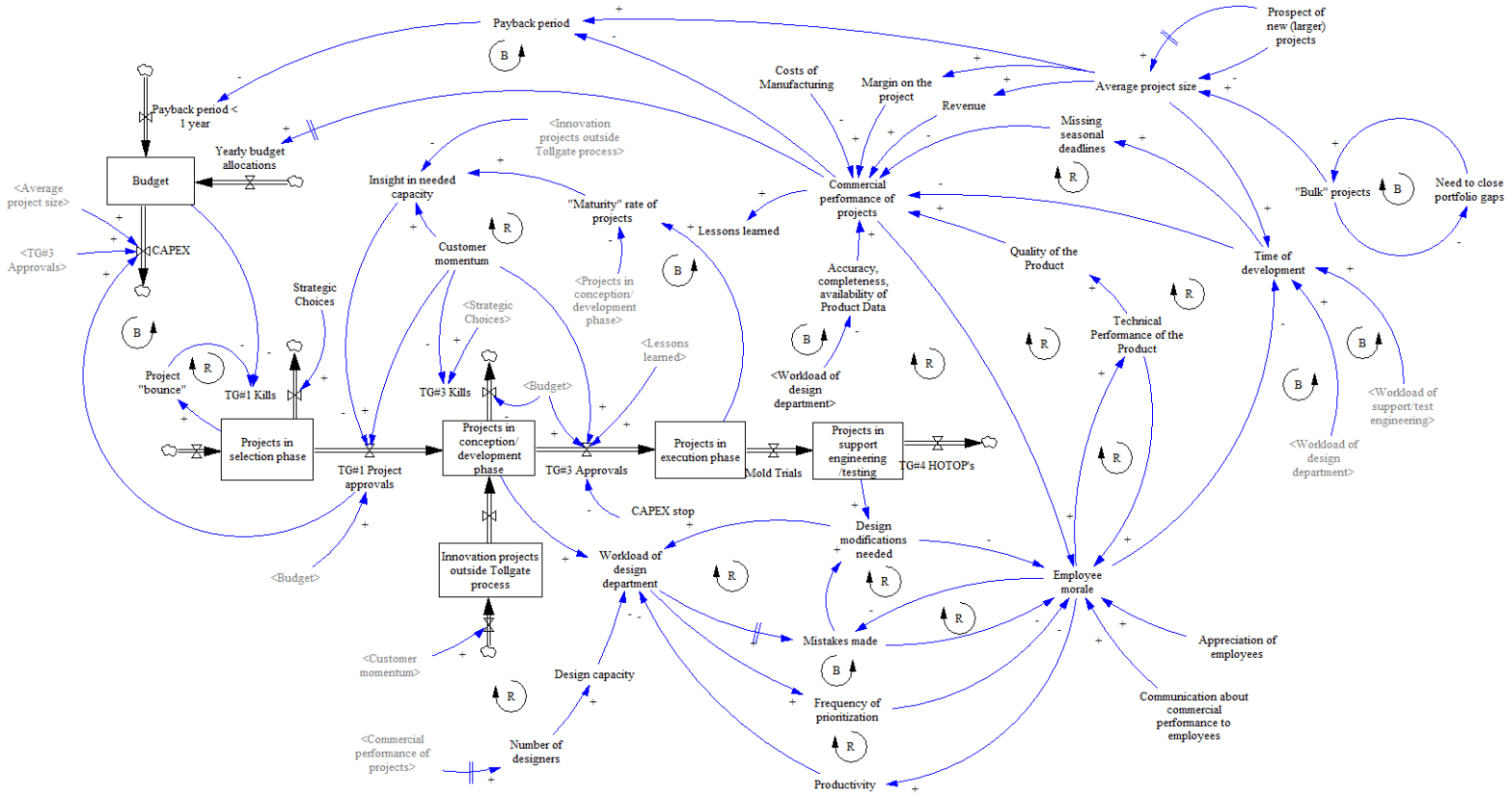

Figure 28. Final empirical model[12]

[12] The four consecutive stocks at the heart of the model represent the TG-process. This process helps to define the projects increasingly better. The information needed for TG1 is provided by a salesperson and a project manager. The main question asked is if the organization wants to invest a significant amount of time in the project. TG2 is the transition from concept to the development phase. This means that the designing of the product will start. TG3 is the moment for deciding if the organization still wants to invest in the product. In TG4, the designed product is handed over to production. This happens only when there is enough trust in the quality of the design.

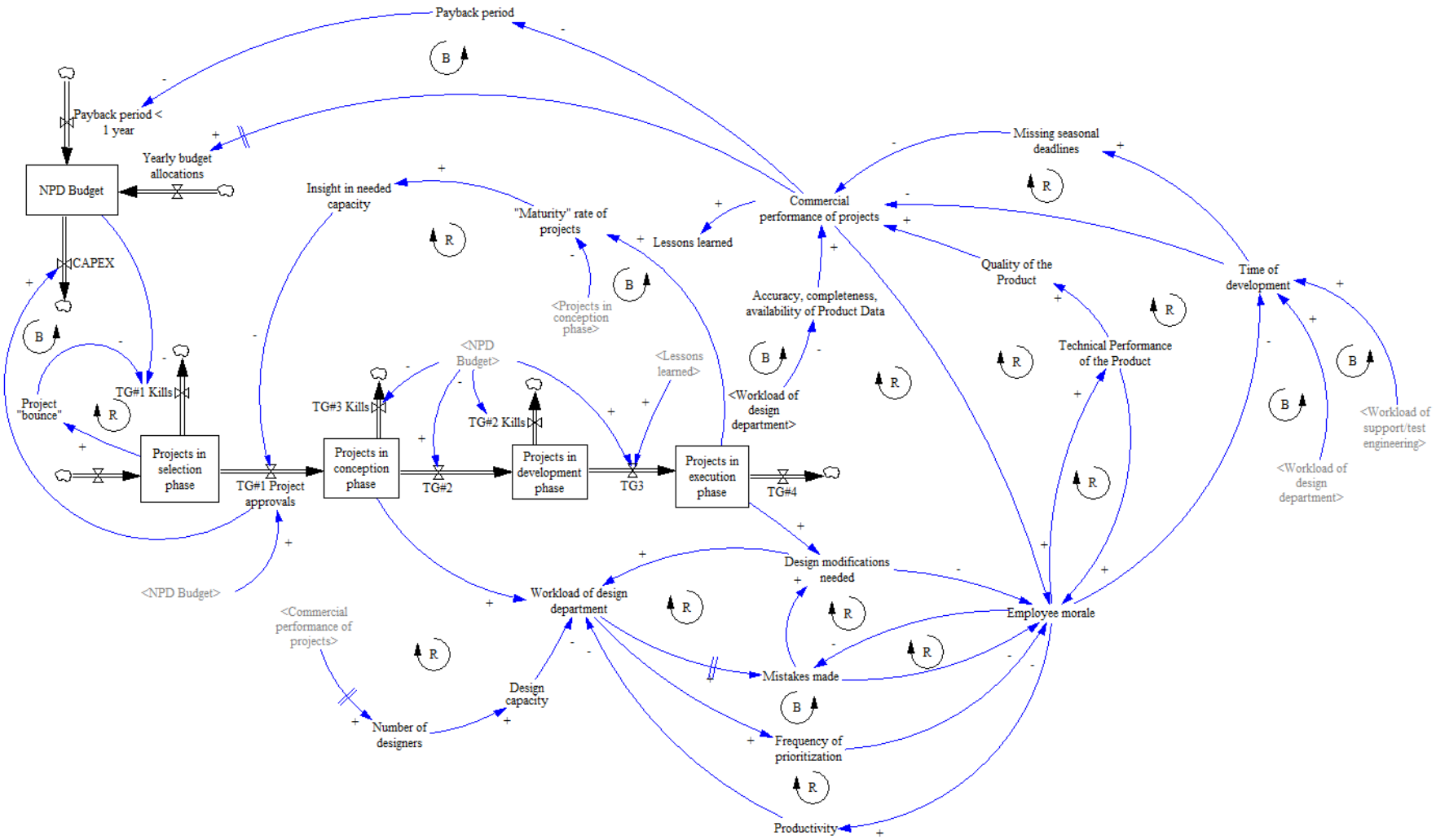

Figure 29. Final empirical model (external causes omitted)

Appendix G

Quotes per portfolio DM-effectiveness outcome

When a quote applies to more indicators, these are stated in bold after the quote (See Appendix D for the numbering). As stated in Appendix C, session three was held in Dutch. Hence, a part of the quotes is in Dutch.

Table 8. Coding table for Agility

AGILITY: INDICATOR	**QUOTE**
(1) Being able to implement portfolio decisions quickly	"we have volatile priorities at this moment in time, so, not only do we, we do prioritize, and we prioritize frequently, but they don't always stick."
	"I think the actual problem statement here is that there are volatile priorities."
	"we don't close our projects well, or, as well as what we should do, in my opinion."
	"want bij TG1, weet je nog niet, doe je maar een ruwe inschatting hoeveel geld het kost. En bij TG2 kan het wel eens zijn dat je voor een heel ander concept gaat - daarom doe je ook een TG2, soms, dat je je concept helemaal op de kop gooit - en dan kan het maar zo zijn dat je bij TG3, dat je een hele andere [investment sum] hebt dan dat je bij TG1 had ingeschat."
	"En bij TG3 is het wel heel zwart-wit. Dan kijken we echt van: hoeveel geld hebben we nog in onze portemonnee en hoeveel, kunnen we dit project doen of kunnen we dit project niet doen? En dan begin ik ook zo'n TG3 altijd met een overzicht van: joh. Dit is de headroom die we nog hebben in onze NPD budget. Dus, alle aanvragen die nu volgen passen wel of niet binnen dat budget, en daar refereer ik dan ook altijd aan. Dat is een hard criterium, ja."
	"Als je meer capaciteit hebt kan je natuurlijk meer dingen doen waardoor je minder vaak hoeft te prioriteren"
	"Wat, wat we nu in het model zien, is als je dus heel vaak die priorisering verandert, waardoor je de ene keer die, en de volgende keer die, ja op een gegeven moment heb je ook zoiets van: ja, wat is het nou, en daarom heeft het er een negatief effect op de moraal."
	"in Tollgate 1 zou je het liefst eigenlijk zeggen: er komt een projectaanvraag, ik doe hem of ik doe hem niet. Dus: goedkeuren of killen. Hup, weg, hup, weg. En dan, dan weet je precies waar je aan toe bent. Maar wat er inderdaad in Tollgate 1 inderdaad gebeurt, is: nee, we doen hem op dit moment niet, maar we zouden hem wel willen doen als, als de marge van 15% naar 25% gaat. Ja, wat gebeurt er dan?

	Die verkoper die krijgt dat natuurlijk niet voor elkaar bij zijn klant, dus dan klopt hij weer aan bij [designer], of bij [designer] en dan zeggen ze van: ja, maar kun je dat product niet wat lichter maken, dat hij wat goedkoper wordt he, want dan krijg je ook grotere marge natuurlijk he, verkoopprijs hetzelfde laten, product proberen goedkoper te maken, meer marge. Nou ja, dan krijg je elke keer van die iteratieslagen van "wounded" projects."
	"Het is een beetje een stuiterbal he, je gooit die bal terug van: nee, het is niet goed en dan gaan ze toch hun best doen en dan gooien ze die bal terug van: we willen hem toch nog een keer naar TG1 he."
	"Yeah, yeah. But, but those, those. All those projects - and don't underestimate how many there are -, sometimes we try to kill, and kill and kill to get them out, to get it more transparent." **(1) portfolio mindset**
(2) Having the flexibility to be able to change and implement the composition of portfolio in response to new strategic opportunities	"Yeah, so, in my opinion it's also all about setting priority yeah. Of course, we can do a lot of things if we want to, but you need to decide on what you do want to do the most. And also choose what you're not going to do."
	"What I sometimes feel is that we are not, yeah, "critical enough" is maybe not the, the right words for it, but not, not firm enough sometimes eh. And wounded, it's, I think it's the perfect word for it because we don't approve them, but we also don't kill them, but we, wound them. And then we have wounded projects in a grey area and we don't do anything with them, but sometimes we do and, but we shouldn't. You know, so yeah. It's also, and I think many of us have the same feeling. We also don't want to be the "Sales Prevention Department."
	"we know very well that our salary is paid by successful projects. So, and that's why we have the tendency not to kill projects immediately and still try to resurrect them, keep them alive, try to do it. If we do this, maybe then it will be profitable enough et cetera"
	"Ja, vooral budget. Ik zie inderdaad heel erg dat, zowel bij TG1, als bij TG2, als bij TG3, dat wij meer, dat wij de neiging hebben om meer projecten te killen als het budget op aan het raken is."
	"Wat je inderdaad ziet, is dat we toch altijd wel de neiging hebben om in H2 he - de tweede helft van het jaar - kritischer te zijn op nieuwe projecten dan in H1 - in de eerste helft van het jaar - omdat je daar nog je portemonnee nog vol hebt, zeg maar."
	"Kan nog zo zijn dat het helemaal niet meer binnen onze strategie past, bijvoorbeeld. Stel he: een, nou moet niet iedereen hier in de paniek schieten, in de stress schieten. Maar stel nou dat bijvoorbeeld wij, dat, in de [strategische vergadering] besloten wordt dat … we gaan helemaal niet meer investeren in

	[productcategorie], om die reden, ja dan gaan we al die [product]-projecten killen. En dat, ja om die redenen hebben we dat wel eens gedaan. Dus ook strategische redenen zou wel een "kill"-trigger kunnen zijn." **(3) Agility, (2) Focused resource spending**
	"Dus het is niet zo dat hij helemaal niet langs Tollgate 1 gaat, helemaal niet langs Tollgate 2 gaat, en in een keer opduikt voor Tollgate 3. Dat gebeurt niet … Dat gebeurt soms wel, maar dan met hele strategische projecten waarvan wij vinden dat ze niet langs tollgate 1 of 2 hoeven." **(3) Agility, (2) Focused Resource-spending**
	"het feit dat wij in de situatie zitten dat wij de komende jaren maar [bedrag] - en dat is niet veel hoor, voor ons bedrijf - maar dat we maar [bedrag] te spenderen hebben aan NPD per jaar, dat komt omdat er inderdaad een behoorlijke underperformance, commerciële underperformance is geweest op de investeringen van de laatste jaren. Dus, dus stel nou dat we elk jaar precies hadden verkocht en dat precies al die investeringen hadden opgebracht wat ze zouden moeten hebben opgebracht, dan hadden we meer dan [bedrag] [investment sum] gehad voor de komende jaren." **(1) Focused Resource-spending**
	"Als je nu bijvoorbeeld weet dat we volgend jaar [bedrag] [investment sum] hebben, ja dan ga je niet zeggen: we doen wel even een [groot project] erbij, want dan heb je gewoon de helft van je budget kwijt. Zo'n project kost gewoon [bedrage]. Dus dan ben je de helft van je budget kwijt. Dus wij zijn veel eerder geneigd om een [product-categorie] project, he, dus een klein product - wil niet altijd zeggen dat het een klein project is het - maar een klein product goed te keuren dan dat we een heel groot product goedkeuren qua project." **(1) Focused Resource-spending**
	"Ja, dat is zeg maar een acceptatie dat we ons budget overschrijden. Omdat we weten dat we dat geld binnen een jaar weer terugkrijgen." **(1) Focused Resource-spending**
(3) Portfolio decision-making processes are speedy enough to assure quick acting upon new opportunities	"So, please now do this, because that customer expects an answer tomorrow, or the day after you know? And, and that project has much less revenue, but is more urgent, has a time-constraint behind it."
	"you probably need to prioritize more often if you have too, too many projects."
	"Het is inderdaad vaak als er, een van die jongens gewoon kijkt, en die ziet: volgende week moet dit klaar, en dit klaar, en dit klaar, ja, dat kan gewoon alle drie niet. Ja, dan moet er een keuze gemaakt worden, en dan ben ik inderdaad vaak degene die zegt: naja, dan moet deze als eerste klaar, en dan moeten we bij de, aan de stakeholders van het andere project melden dat we een week vertraging hebben op het design. Maar, dan, dan doe je inderdaad, dat doe je dan aan de hand

	van strategische belangen, of soms ook iets banaals als omzet, of wat dan ook, ja.”
	“That's for me always, it's not very two-dimensional, it's always very three-dimensional. With customers behind it, importance, urgency.” **(2) Focused Resource-spending**

Table 9. Coding table for portfolio mindset

PORTFOLIO MINDSET: INDICATOR	**QUOTE**
(1) At all times having an overview of all innovation projects in portfolio	“What I. [participant] is spot-on when he says: well, we are not looking that much on how much capacity do we really have? That's also because we never had the real insight in it”
	“so, for instance for the TG1, so the Tollgate number one, whether we want to do a project or not, nowhere in that list it says something. None of the acceptance criteria is: do we still have enough capacity to do this project? Nowhere. Because we don't have the insights, yet. We just have, sometimes people complain, and sometimes they don't complain. That's the trend that we see.”
	“The projects in "conception/development phase." That's for me where we have the most variation, where we have the most unknown”
	“Some [projects] go very quickly, very high priority, very urgent, some of them in that phase of conception or development are in that phase for a year, of for two years before they go into TG 3. And that makes it also so difficult, and that's then probably the one on the right, eh, ehm, maybe the insight in capacity, that's also making it so difficult for us to make a good insight of the capacity. Because if we would only have the projects in execution where, you know: here is where it starts, here is where it's ready. Then you could rather easily make a capacity planning. That would not be that big of a problem.”
	“Yeah, everything in that phase is really effort driven you know. You cannot really plan ahead. If you put on 50 hours now, we will finish? No, it depends. It depends on the intermediate results.”
	“we have projects, which go through TG 1, have momentum, then the momentum drops and it's held within this database at this moment in time, which is very difficult to understand whether the momentum is going to come again, at what pace, you know, whether it's ever going to come”
	“there is a bank of projects which sit in this ehm, sit in this database with, with no clear knowledge to the direction of them. And actually, they are the wounded

	projects, as I see them, they're the ones that have - for some reason - ehm, are not, do not have the momentum."
	"if you have a lot of that projects in conception/development where, where you are uncertain of the outcome, ehm, that makes it difficult to get that insight."
	"Yeah, if you have a lot of projects in execution, then you have a clear insight in needed capacity. Ehm, the more projects you have in, in conception and development, probably you have less insight in the needed capacity because if it's really through development, then, yeah, you don't know when you will get the answer when you solve the puzzle."
	"Yeah, I think to, for TG1-approval, he, if you don't have clear insight in capacity then you might, yeah, pull through too many projects through TG1 because you cannot estimate how many capacity you have. And, yeah, then again, you could end up having too many projects for the resources available."
	"Ja, en bij die projecten in execution is het niet alleen duidelijk, veel duidelijker hoeveel capaciteit je nodig hebt, maar daar heb je je deadlines ook veel duidelijker. Omdat je dat in een investeringsaanvraag beloofd hebt."
	"Ja, en ook is daar gewoon veel meer zeker. Je weet gewoon als je een [onderdeel] bestelt dat het zo veel weken duurt voordat je hem hebt."
	"En als jij nog een product moet bedenken en maken, en bewijzen dat het gaat werken, ja dan zitten er heel veel onbekenden, dat is ook de reden waarom dat moeilijk te plannen is."
	"Dan ben je meer geneigd om te zeggen van: nou doe maar, want ik heb weinig inzicht, ja precies."
	"Als wij namelijk 100% inzicht zouden hebben in de capaciteit en de vrije capaciteit, dat namelijk ook die factor capaciteit veel zwaarder zou wegen in de TG-1 approval."
	"als je een gekozen concept hebt, kun je natuurlijk, dan kun je eigenlijk gaan plannen ja tot, en dan heb je al die stappen."
	"Maar, ja, als je dan kijkt naar het aantal projecten in je hele pijplijn, ja, dan lijkt het net alsof je [het] helemaal niet zo heel druk hebt terwijl, terwijl heel veel mensen het juist wel heel druk hebben met al die projecten die nog voor TG1 zitten."
(2) In-depth knowledge about each innovation project in the portfolio	"It's the ones in-between which we've maybe signed off for TG1, so we signed off that the idea is good. We've moved into a project stage, we apply resources to it, and then everything goes quiet. Because I, for one of many reasons. That could be the customer's cooled on it, COVID happened, it could be, it could be a wealth of

	reasons as to why that occurs. Genuine reasons, but then the question is: what do we do with those projects?"
(3) Understanding of the relationship of each innovation project to the achievement of the firm's long-term goals	"But, but not always he. We have for instance also a project that we're doing: the [project]. Where we said at a certain moment: well, let's get it through TG 1, it's, it's not likely that we will get … euro for [investment sum] any time soon, but still because we think it's the future of our company, let's do a project on it. And it's an important project but not urgent. And I can already predict that that project will knock on the door of TG3 in two years."

Table 10. Coding table for *focused resource-spending*

FOCUSED RESOURCE-SPENDING: INDICATOR	**QUOTE**
(1) Focusing resources on the achievement of innovation portfolio priorities	"No, available resources. What's described here of course, is that we have, we had a head count reduction over the last years because we have, we want to spend a bit less on new [parts], on [investments], for Innovation department. So, then we said: If we have less money to spend, then we also need less people. And that's what we've rolled out over the last years."
	"I miss a part where we already make concepts for ideas, even before TG1, because that's also a heavy burden, especially on designers whenever a sales rep or a CEO gets a crazy idea."
	"And then you get a loop back to the designers again because they have to redesign"
	"Ja, but for example when it's not, the product release is not okay, we have to modify the product design, they have to redesign again, and then you will do a new test … you will test it again in the [test-location] and see if it's working then."
	"the commercial performance or the theoretical commercial performance really determines whether we approve the project or not."
	"isn't the yearly budget also related to the commercial performance of projects? Depending on how the projects perform, the next year budget is depending on that."
	"I would have the commercial performance of projects as an input to the yearly budget, because it influences how much budget we want to spend next year. If we have very profitable projects, then probably next year. We want to do more of

	those projects, we want to do more projects."
	"the amount of designers that we have is also influenced by decisions also in the board, eh, in structure, restructuring - those kinds of things of course he.
	"If we have a good revenue and, and NPV, then you can probably invest in more innovation and, and increase the size of your innovation department."
	"als je puur kijkt van jaar op jaar, is het meer zo van ja, [product A], gaf ik als voorbeeld, [product A] weten we gewoon van dat dat iets is waar je relatief weinig hoeft te investeren he, de matrijzen zijn niet zo heel duur. Maar wat een enorme Return On Investment heeft. Dan zie je dat er van [bedrag], dat er dus een groter gedeelte A gaan doen binnen [bedrage]. Dus dan krijg je een verschuiving. He, we gaan niet investeren in [product B], daar weten we dat de Return On Investment heel slecht is, [product A] heel goed, dus gaan we investeren in [product A] en niet in [product B]"
	"als hij dan uiteindelijk wel goedgekeurd wordt, heb je er wel weer een goed project bij. Het enige grote probleem dat ik hierbij zie, is nog geen eens dat we er veel werk aan hebben, maar dat je er eigenlijk werk aan hebt in een fase dat we eigenlijk met elkaar hebben afgesproken er met elkaar nog geen werk aan te spenderen. He, want we hebben, wat we gezegd hebben, is dat we werken aan projecten die zijn goedgekeurd. En dat we projecten die nog in de evaluation phase zitten, he dus voor TG 1 zitten. Dat we daar maar een paar uurtjes aan spenderen hooguit."
	"En juist omdat je die iteraties krijgt, heeft [designer] er wel projecten bij zitten die nog niet door Tollgate 1 zijn, waar hij al dagen aan gespendeerd heeft, Hoort eigenlijk niet zo"
	"ze spenderen gewoon veelt t' - met hetzelfde resultaat trouwens he - maar, het is wel, ze spenderen veel te veel tijd aan een nog-niet-project en als dat kratje al helemaal uit geconstrueerd is, dan kloppen ze pas aan de deur van Tollgate 1."
	"Ja, bij TG1 natuurlijk ook he, ik ga bij TG1 niet een project goedkeuren [bedrag] kost, terwijl ik zeker weet dat we daar gewoon het geld de komende jaren niet voor hebben. Dat heeft geen zin. Maar, zo zwart-wit is het niet altijd." **(2) Focused Resource-spending**
	"But there are a lot of projects in that conception phase, in that development phase and they also consume a lot of capacity and it's very difficult to plan them, very difficult to estimate how many hours we need et cetera et cetera. That's for me one of the most, yeah eh, one of the points in our whole process where we have the least grip on them."
	"bij Tollgate 1 is inderdaad de, het criterium van: "hebben we er capaciteit voor of

	hebben we er geen capaciteit voor" is maar heel beperkt. Het wordt maar heel beperkt meegenomen. Omdat dat ook vaak zo'n momentopname is he. En omdat het zo moeilijk inzichtelijk te krijgen is op dit moment: wat we bij die Tollgate 1 veel meer meenemen, is: hebben we dit jaar nog geld beschikbaar om dit te doen: ja of nee."
(2) Having clarity on how innovation projects in the portfolio help achieve the firm's long-term goals	"And, because there can be very high priority projects. A very important project in terms of: that project will generate a lot of revenue and a lot of SPC, but on the other side it's not urgent"
	"I think we do have too many tactical and commercially under-performing projects. So, what I mean by tactical, is non-strategic, so, generally customer-led, external customer-led projects. For me, if we had more of a strategic approach, and that's not to say we don't have a strategic approach, we do. But if we had more of a strategic approach to certain categories we could then do a lower number of higher value projects rather than a higher number of lower value projects, if that makes sense."
	"Any deviation from what's been previously agreed or been agreed with the customer ehm, can have an effect on the commercial return"
	"It's probably, it's probably more the, the communication around, he, the product design develops and at the beginning we had maybe some, some unique selling points but it could be that they added some additional ones and that is not communicated anymore."
	"bijvoorbeeld dat we wel kleinere projecten zoals bij [klant] hebben gedaan, om ook een beetje onze relatie met [klant] te verbeteren zodat we hoopten dat we de [project] gingen krijgen, en dat is uiteindelijk ook gebeurt weet je wel. We hebben toen eerst een paar kleinere projectjes gedaan in de hoop dat we de "big fish" zouden krijgen - en dat is wel gebeurd."
	"Maar dat betekent, dat zowel die designers daar, maar ook wij heel veel met: "wil je dit niet eens even aanvragen", "wat kost dat?", [part-change], eh gaat allemaal heel erg informeel en een beetje rommelig - de opstart van alle [product]projecten. "
	"We developed a [product]. After the product was launched, all of the sudden a designer came up to me: eh, yes, this was also in. Didn't you know? And then I had to go back to this guy telling him: where did you ever put this information? And that's the kind - no blame to you guys or [designer] - but, I'm really struggling with this part. From the beginning, when a product has been designed and developed; we need to have that information with all the USP's from the start because how on earth are we going to communicate it to sales if we don't even

	know about it?”
	“And the accuracy of product data, because that's, this is never mentioned here, but is so, so crucial for sales. Because when Sales is hitting the road and needs to sell a product, first, thing the customer will ask, is: can you show me your product specification sheet. And if that is missing and they don't have the right information from the beginning, then it all falls back to the same question: what are we selling? This, we are going to deliver whatever the customer is asking, yes or no?”
	“wij kunnen ook niet zeggen: "ja, is dit nou wel een belangrijk project", of "moeten we daar wel wat aan doen"? Wij, wij liften ook altijd mee, wij gaan er ook altijd in mee. Ik denk ook niet dat het aan ons is om te zeggen van: ja, heeft dit wel prioriteit, geen prioriteit?” **(1) Focused Resource-spending, (4) Focused resource-spending**
(3) Working in a focused manner and not easily distracted from executing priorities	“what happened very recently is: a huge project, a lot of hours put into it. Went to Tollgate number three. Oh no, that was still the tollgate number one. So, are we going into the right direction? And then, the management board together said: well, let's go for this direction, and we did a lot of different things, and then right before TG3, even after TG3, we said: well, we are a little bit light on cash at the moment. Can we not postpone the project for a year?”
	“Ja, uiteindelijk ook inderdaad de beslissing van de klant is een externe natuurlijk he. Of die klant bereid is meer te betalen, of bereid is meer customer contribution te doen, of aan de [investment sum] meebetalen. Dat zijn externe pijltjes die daar in gaan. Dan draait hij rond, dus de designer is aan het finetunen, Herman die wordt nog eens lastig gevallen door de jongens van: ja, kun je nou echt niet die matrijs in China gaan kopen? Dan is de [investment sum] lager. Misschien krijgen we hem dan wel door Tollgate 1 heen. Nou dan moeten Herman zijn jongens die moeten weer in China matrijzen gaan aanvragen, dus dan, zo hou je dan wel een hele boel werk aan projecten die "wounded" zijn.” **(1) Focused Resource-spending**

Appendix H

Effects between portfolio DM-effectiveness outcomes

There were three effects between portfolio DM-effectiveness outcomes which may mediate effects of too many projects on portfolio DM-effectiveness.

Firstly, the effect of *agility* on having a *portfolio mindset*. This effect is located in the "performance feedback" submodel. Low *agility* in making project "kill" decisions can lead to a poor overview of the state of the portfolio: "those projects – and don't underestimate how many there are –, sometimes we try to kill … to get them out, to get it more transparent." This underpins the importance of addressing issues with *agility* before addressing an inadequate *portfolio mindset*. Therewith, it adds to the findings by Kester et. al. (2011) by stating that *agility* can precede having an overview of the portfolio.

Second, the overly frequent prioritization – *agility* required to deal with too many projects – can weaken the *focus with which resources are spent* on certain important projects. Frequent prioritization can make unclear which projects have priority: "there are some specific projects that have been carried over the last four years. Suddenly, they're a priority, and then they're dropped to the bottom of the list. And then they're back at the top again and." This effect is located in the "work pressure" submodel. This study adds to the framework by Kester et. al. (2011) by suggesting that *agile* DM can mediate the effect of too many projects on *focused resource-spending*. This finding has important implications for addressing a lack of *focus when spending resources*. It might thus be interesting to also look at improving *agility* when addressing this issue.

Third, having a *portfolio mindset* also seems to mediate the effect of too many projects on *spending resources in a focused way*. The *portfolio mindset* helps decision-makers to make the right "go" decisions (as can be seen in the "performance feedback" submodel). But it also helps to *spend resources in a focused way* as more resources are available due to not adding too many projects. This mediating effect is also an addition to current theory on this matter (Kester et al., 2011).

Appendix I

Leverage points from GMB-session 4

The leverage points that were discussed – and therefore analyzed – are underlined. There are also redundant leverage points included in the overall list. Hence, of those, only the leverage points discussed during the session are underlined.

Table 11. "Raw" list of leverage points (scores from 1-10, higher is better)

LEVERAGE POINT	IMPACT	FEASIBILITY
Strategic Project	8	10
Time of Development (in hours)	7	2
Customer requests	9	5
Better market potential/competitor information	10	4
Customer momentum (or Market Insights, to be added)	10	4
Clear strategy → "Strategic Choices"	9	10
Frequency of prioritization	5	5
More capacity/Insight in needed capacity	8	7
Design Capacity / Number of Designers	7	6
Time of Development	7/8	2/3
Better information flow coming from customer[13]	2*	4*
More (Physical) meetings with customers[13]	8*	6*
Hire more designers	8*	4*
Buy faster laptops[13]	10*	10*
Make use of planning tool to better use available time	6*	2*
Make sure most important actions are done first	3	1
Make use of independent NPD Budget Pool (Innovation Budget beginning of the year)	2	5
Reject/stop projects if the already have been started once/twice before	2	2
Let designers know changed sales priority on time (sales numbers decreased, priority can be lower)	4	1
Strategic choices → who decides? What are the criteria?	8	9

[13] One participant scored intervention points on 1 – 5 scale instead of on a 1 – 10 scale. These scores are indicated with an "*". They have been normalized by doubling them. Note that these scores are less accurate due to this.

Customer momentum → clear agreements w/ customer	9	6
Time of Development → realistic expectations	8	4
Time of Development	7.5	2.5
Strategic choices	8	8
Customer momentum	9	4
Streamlining capacity to the number of projects by making choices	n.a.	n.a.
Size (volume/margin) of projects	8.5	3/4
Taking technical feasibility into account	5.5	7
Treating Innovation ideas differently to NPD projects	8	6/7

Scoring of leverage points discussed in session three

The "raw" leverage points have been given more usable and specific names by the participants during the discussion in the third GMB-session.

Table 12. Leverage points discussed during GMB-session three (scores from 1-10, higher is better)

LEVERAGE POINT	IMPACT	FEASIBILITY
Marketing insights for creating customer momentum	10	4
Gain insight into capacity	8	7
More designers to increase capacity	7.5	4
Implementing process for Strategic Choice, including criteria	8	9
Reduce Time of Development	7.5	2.5
Better insight/critical view on size project + update during process	8.5	3.5
Assess technical feasibility of project in TG2	5.5	7
Making a distinction between tollgate process and ideation phase	8	6.5

Graph of discussed intervention points

The leverage points discussed during session three have also been plotted in a graph. This graph made the impact and feasibility scores more insightful for the participants.

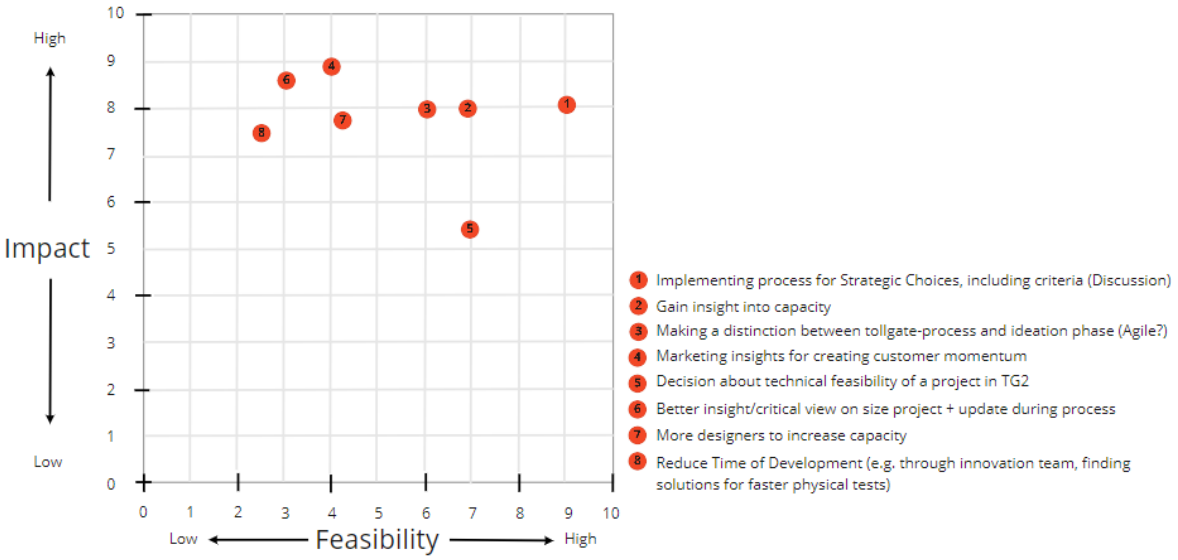

Figure 30. Graph of discussed intervention points

Normalization of the leverage scores

The leverage scores have been normalized with the following formula.

$$NewValue = \frac{(OldValue^{14} - OldMin) * (NewMax - NewMin)}{(OldMax - OldMin)} + NewMin$$

Hence, when converting a 1 – 12 scale to a 1 – 10 scale, the formula is as follows:

$$NewValue = \frac{(OldValue - 1) * (10 - 1)}{(12 - 1)} + 1$$

Further simplified, it is:

$$NewValue = \frac{(OldValue - 1) * (9)}{(11)} + 1$$

For example, a value of 5 on the scale of 1 – 12, the new value becomes 4.27:

$$NewValue = \frac{(5 - 1) * 9}{11} + 1$$

$$NewValue = \frac{4 * 9}{11} + 1$$

[14] When a leverage point had two leverage scores, their mean was taken for the "OldValue".

$$NewValue = \frac{36}{11} + 1$$

$$NewValue = 3.27 + 1$$

$$NewValue = 4.27$$

Appendix J

Disconfirmatory interview report

A disconfirmatory interview was held to validate the model. The interview primarily confirmed that the model was an adequate representation of the issue of too many projects at the organization. Only minor revisions or remarks were proposed. First, TG3-kills with a strategic reason was to never be made. Kills in that phase were either related to the high investment needed or to commercial reasons. Second, cultural, or personal differences were indicated to possibly play a role in how effective the appreciation of employees would be. Third, the interviewee mentioned that besides celebrating commercial or technical success it is also important to learn from mistakes. This sheds some new light on the "lessons learned." These lessons can thus also come from failures instead of merely from commercially successful products. Also came up that technical performance is more easily and fed back to the employee than commercial performance. This is the case because technical performance is more internal, tangible, and directly problematic. Fourth, the projects that enter the TG process at a later stage often have high top-down momentum. However, they are difficult to get traction with when the project team starts on it. Finally, some comments on the wounding of projects were made. It was said to primarily depend on the account manager involved in the project. This manager is responsible for making a project's business case and must deal with the customer and the market. The project bounce was indicated to happen more often when there is no lead customer. A project bounce also happens not due to commercial reasons and rarely due to technical reasons.