"Organizing innovation in turbulent orderflow companies: a Hyster-Yale case study"

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CONFIDENTIAL

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Preface

This research has been written as part of the master's specialization Organizational Design and Development in collaboration with Hyster-Yale and is the concluding phase of my master's in business administration at the Radboud University. Because of a passion for the manufacturing industry and a connection to the practical field, it was already clear to me during the pre-master's program Business Administration that I should choose the Organizational Design and Development master's specialization. The excellent opportunities to put the knowledge gained directly into practice have meant that I have not regretted this choice for a single moment and truly motivated me to finish my master's thesis.

A special gratitude goes out to my thesis supervisor dr. ir. L.J. Lekkerkerk for his guidance. His support, suggestions and expertise ensured the quality of this study and allowed me to come up with a better thesis. Besides I would like to thank my company supervisors Koen Kampschreur and Niels Bongers for the opportunity to have been able to conduct this research at Hyster-Yale. At the same time, I would also like to thank the respondents who participated in this study. And also my colleagues deserve a word of thanks because of the fact that I could always ask them any question. In addition I would like to thank my family and friends, since I could always count on them while working on this thesis.

Because of the many new insights, working with Hyster-Yale and researching a topic in an industry I feel completely at home in, I have found the past period to be very enjoyable and educational. Therefore, I will definitely be pursuing my future in this direction.

I hope you will enjoy reading my master thesis and it inspires you to keep focusing on innovation.

Jeffrey Kamphuis

Nijmegen, August 2023

Abstract

Innovation is necessary for manufacturing organizations to meet customer demand and remain viable. The lift trucks manufacturing company Hyster-Yale is searching for methods to increase its success in the field of innovation and decided that it is necessary to free up capacity for innovation. With structure being one of the key elements that impact innovation, this case study aims to diagnose what the innovation structure of Hyster-Yale currently looks like and redesign the innovation structure of the company. The research was conducted using the Model Innovation and Organizational Structure, abbreviated 'MIOS', developed by Lekkerkerk (2012, 2015) and the parameters of De Sitter (De Sitter, 1994). This was followed by a literature review to describe the innovation and organizational structure of the desired situation. Insights into the actual situation of Hyster-Yale have been derived from empirical data, gathered through document analysis and semi-structured interviews. The data led to systematic descriptions of structures by describing the functions of the MIOS and De Sitter's parameters. The results of the diagnosis of the innovation structure of Hyster-Yale showed which MIOS functions require attention. The functions in question are those that are not formally assigned, inadequately performing, or a combination of both. After comparing the theoretical insights of the desired situation with the actual empirical findings, it can be concluded that a gap is present for Hyster-Yale's innovation structure. To fill this gap, opportunities for organizing innovation by redesigning the structure of Hyster-Yale are presented. The focus of these recommendations is on formalizing and improving the performance of some of the MIOS-functions. Acting on these recommendations should lead to Hyster-Yale being better able to face the competition, as well as being able to better respond to increasing customer expectations for more innovative solutions.

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Chapter 1: Introduction

1.1: Introduction to the research object and research topic

Hyster-Yale Materials Handling Inc. is one of the world's leading designers and manufacturers of high end quality material handling equipment with an annual turnover of around $3 billion. This originally American business is operating a nearly independent facility in Nijmegen, the Netherlands, since 1953. Within the holding company Hyster-Yale Materials Handling Inc., the Hyster-Yale Nijmegen facility, hereafter referred to as Hyster-Yale, can be seen as a special facility with a high degree of freedom. Because the unique big and jumbo trucks are built here, the plant has acquired its own status. With a expanding workforce of currently 750 employees, the Nijmegen facility supplies trucks to customers worldwide.

In terms of cost price, lift trucks built in the Netherlands have not been able to distinguish themselves from lift trucks built in developing countries for years. Low wages and many raw materials such as steel are very common in these kinds of countries. In the recent past, this difference in price was largely made up for by the better quality products supplied by Western manufacturers. With manufacturing in developing countries catching up there too, the focus is shifting to the distinctive innovative strength of Western companies. In addition to the pressure of manufacturing in developing countries to be innovative, there is also lots of pressure from directly competing major players in the forklift industry such as Toyota and Jungheinrich. To remain distinctive and face both forms of competition, Hyster-Yale wants the focus in the coming years to be increasingly on innovation.

Competition is one driver of innovation for Hyster-Yale; customer demand is the other. In recent years, customers have increased expectations for the possibilities offered by the lift truck manufacturer for even more innovative solutions. Customers have various motivations for this demand. First of all, customers desire innovative solutions from Hyster-Yale to provide their own services in a more efficient way or to perform their internal process more effective. Secondly, customers demand innovation to make a positive contribution to society, because customers for example have the goal to obtain a greener image. Thirdly is it sometimes simply the case that customers and Hyster-Yale itself are both forced to innovate by laws and regulations. Some direct results of aforementioned innovation questions include: heavier lifting requirements than ever before, increased safety measures on trucks, the electrification of trucks and taking the first steps toward the transition to hydrogen fuel cell trucks.

Although these examples show that at the moment innovation definitely does occur within Hyster-Yale, the desire for business continuity by coping with competition combined with the increasing demand for innovative solutions from customers result in the fact that the company's current innovation initiatives are not enough. Therefor meaning that innovation within Hyster-Yale needs to gain more momentum. To establish and maintain this focus on innovation, Hyster-Yale decided that it is necessary to free up capacity for innovation as soon as possible.

1.2: Problem positioning in academic literature

To free up capacity for innovation and improve the focus on innovation for Hyster-Yale this research should bring clarification on what the company's innovation structure currently looks like, to subsequently describe were opportunities for organizing innovation lie within Hyster-Yale. Through a GAP analysis, the current situation of Hyster-Yale is compared to an ideal situation as described in the literature. This is done with the help of the Model Innovation and Organizational Structure, abbreviated 'MIOS', developed by Lekkerkerk (2012) and the parameters of De Sitter (De Sitter, 1994). The MIOS will serve as the basis for this research to get a deeper understanding of how Hyster-Yale's innovation structure is organized. The model builds on modern sociotechnic in which organizational structure is broken down into production and control structure. The MIOS is a systemic function model that addresses twelve functions and their relationships. The twelve functions are divided into three groups having to do with "the production" (primary process), innovation, and with the central functions, connecting the first two groups. Later on, continuous improvement was added to the MIOS as well, so this function will also be described for Hyster-Yale (Lekkerkerk, 2015). The MIOS can be used as a specific tool to research organizational structures in order to create systematic descriptions of structures and be able to compare them. Based on this comparison, characteristics of effective and efficient structures will emerge with a specific focus on the underlying innovation structures (Lekkerkerk, 2012). The next step is then to convert these characteristics into more concrete design guidelines for the innovation structure. Following these guidelines of the MIOS, this research will look at how Hyster-Yale fulfills the functions of the MIOS, by describing each function using employees' answers to the interview questions related to each function. By doing so, a description of how the innovation and organizational structure is organized within Hyster-Yale will emerge. Next, De Sitter's parameters introduced in sociotechnic about functional concentration, differentiation of operational transformations, separation between performance and regulatory activities and differentiation of regulatory activities into aspects will be used

(Achterbergh & Vriens, 2009; De Sitter, 1994). These parameters help to make an assessment of Hyster-Yale and provide information about the quality of work, quality of working relations and quality of organization. The MIOS is included in Appendix 1, figure 3 for clarification.

1.3: Objective and research question

The need for innovation and the need to structure it for manufacturing companies is clear, as well as the specific choice of research object. In short this research aims:

- To perform a single case study to investigate the manufacturing company Hyster-Yale located in the Netherlands.
- To study, in particular how innovation is organized at Hyster-Yale, using the MIOS as a basis.
- To develop opportunities for organizing innovation for Hyster-Yale based on the results found in practice compared to the situation described in the literature by Lekkerkerk and De Sitter.

To conduct this research, the following research question was formulated:

"How is innovation organized within Hyster-Yale?"

The sub-questions that help answer the research question are:

- *"How does Hyster-Yale Nijmegen fulfill the functions of the MIOS?"*
- *"How does the innovation and organizational structure at Hyster-Yale compare to how it should be according to the literature?"*
- *"Where do opportunities arise to improve organizing innovation within Hyster-Yale Nijmegen?"*

In the literature, a clear link is visible between innovation and business continuity in general. About how innovation is organized in innovative Dutch-based manufacturing organizations little distinctive knowledge can be found. This is due to the specific type of serving the customer, the fact these companies often sell their products in a niche market and the need not to reveal too much information regarding their innovations in order to stay ahead of the competition.

1.4: Practical relevance

It has become visible that there is a great variety of reasons that lead to innovation and how these are dealt with. But how this proceeds in detail within Hyster-Yale is unclear. This clarity, however, must come. This brings to light the practical relevance of this research. Practical relevance holds an key role for me personally as well. Because of the more practical approach that was central at my previous study at the university of applied sciences and the practical experience gained during internships and jobs, I have noticed how important a final practical solution to a business administration problem is. The focus of this research is therefor to determine what the innovation structure currently looks like, to subsequently describe were opportunities for organizing innovation lie within Hyster-Yale.

In this single case study, the results of this research provide an overview of the innovation and organizational structure for Hyster-Yale based on Lekkerkerk (2012) and according to the theory based on De Sitter's parameters (Achterbergh & Vriens, 2009; De Sitter, 1994). Opportunities for organizing innovation are then developed based on the results found in practice and the situation described in the literature. Based on this overview and assessment of the structures and the proposed opportunities for organizing innovation, Hyster-Yale can become better organized allowing capacity for innovation to be cleared more easily. Reorganizing (parts of) the innovation structure to a more effective and efficient structure creates increased and improved focus on product and process innovation. In practice, this will result in Hyster-Yale being better able to face the competition, as well as being able to better respond to increasing customer expectations for more innovative solutions. Therefor this research provides a solution to the practical problem that Hyster-Yale is facing.

1.5: Academic relevance

De Sitter himself already mentioned the gap that is present in modern sociotechnic regarding solid guidelines for the design of an organizational structure for development or innovation within an integral structure design. A solid basis was provided by Lekkerkerk to fill this gap (Lekkerkerk, 2012). This study attempts to reproduce to some extent the research of Lekkerkerk (2012), by studying how innovation is organized in practice and applying the guidelines for the design of an organizational structure for development or innovation within an integral structure design. It is done by focusing on a new case organization of a Dutch-based innovative manufacturing company. This research will retest the scientific relevance of the MIOS a decade

later in order to determine the extent to which the model is still up-to-date and useful. In doing so, it will contribute to the validity of research done previously. Simultaneously, a case study is added to the literature by applying the model to the Hyster-Yale business environment.

1.6: Thesis outline

Chapter 2 will cover and select relevant theories and perspectives regarding innovation and structure. In addition, key concepts, central assumptions and conditions will be described in this chapter using the academic literature. The 3rd chapter contains the methodology. This covers which research methods, forms of data collection and analysis have been used. Validity, reliability, limitations and research ethics are also discussed in this chapter. The findings of the functions of the MIOS and the parameters of De Sitter can be found in chapter 4. The 5th chapter summarizes the findings into a conclusion. Furthermore, this chapter will highlight the opportunities for organizing innovation arising from the GAP analysis between the current situation at Hyster-Yale and the situation described in the literature. The 6th and final chapter presents the discussion of the theoretical, practical and methodological part, along with the limitations.

Chapter 2: Theoretical background

2.1: What does innovation entail?

Companies have to be innovative, as innovation is a key element for a business to survive and thrive (Rosenberg, 2009). It enables them to tackle challenges, seize opportunities, adapt to changing circumstances and is a crucial incentive for competitiveness (Porter & Stern, 1999). The Organization for Economic Co-operation and Development (OECD) defined innovation as follows: “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” (Organisation for Economic Co-operation and Development, 2009, p. 11). This definition bears many similarities to that of scientists. For example, Thompson (1965) defined innovation early on as: “Innovation is the generation, acceptance and implementation of new ideas, processes, products or services”. Today, that definition has changed a little, but the key elements are the same as this definition shows: “Innovation can be defined as the effective application of processes and products new to the organization and designed to benefit it and its stakeholders” (Baregheh et al., 2009).

While these definitions portray how innovation is viewed in the literature, they miss the perspective of structure design that is so important to this very research. Fortunately, Lekkerkerk (2012) provides a solution here. Therefore, his definition is considered guiding in this study. He specifies three main types for innovation in and by organization: product and/or service innovation, (technical) process innovation, including ICT and organizational innovation ('administrative'). As an overall definition, in the context of structuring an innovating organization, he defines innovation as the (intended) outcome of an innovation project in the form of new knowledge, a new product, a new service, a new process or an organizational innovation and almost always a combination of those (Lekkerkerk, 2012). An innovation project has achieved its purpose when value is added and it contributes to the continuity of the organization. To which Lekkerkerk (2012) points out that it cannot be guaranteed in advance that this intended goal will be achieved.

2.2: Structuring innovation: Model Innovation and Organizational Structure

As stated above, innovation is necessary for companies to make a difference over the competition. Structured processes, employees accustomed to working with innovative ideas, and capturing innovation processes in internal information systems are crucial requirements for

realizing innovation and thus achieving competitive advantage (Lendel et al., 2017). If a company wants innovation to be successful, proper organizing is needed to create coordinated structures; there has to be a logical idea and structure behind it. This organizing task is done by a company's management since they specify fundamental resources: employee tasks, financial means, technologies et cetera. Lendel et al. (2017) defined organizing as creating structure within an organization. The purpose of clarifying these structures, is to accomplish the set company goals (Lendel et al., 2017). So organizing innovation and creating a decent innovation structure is critical, as well as a difficult process, with multiple steps to be taken.

For providing a good overview of how the structure of an organization is constructed overall, Mintzberg described five well-known configurations in the 1980s. Those types distinguished here are the simple structure, machine bureaucracy, professional bureaucracy, divisionalized form and adhocracy (Mintzberg, 1980). First, the contingency factors age and size, technical system, environment and power are described. Next come eight design parameters: job specialization, behavioral specialization, training and indoctrination, unit grouping, unit size, planning and control systems and (de)centralization (Mintzberg, 1980). And out of this ultimately emerges one of the five configurations. However, Mintzberg's structures lack a clear description of how the innovation structure should be built. Making his theory not the most fitting way to map the situation at Hyster-Yale.

The modern sociotechnic (MST) also provides tools to look at the structure of an organization. The main founder of modern sociotechnic, De Sitter, describes organizational structure as: the way, in relation to the flow of orders, activities are grouped and coupled into a network of tasks. (De Sitter, 1986). By making an organizational structure, the amount of internal disturbances and the autonomy of workers can be influenced. The goal of changing an organizational structure is to have as minimal internal disturbances as possible and to create as much autonomy of workers as possible (Achterbergh & Vriens, 2009). Within the organizational structure De Sitter distinguishes a straightforward production structure (PS) and a control structure (CS) (De Sitter, 1986). The PS is about the way performance activities are grouped and coupled into tasks. The CS defines the way control activities are grouped and coupled into tasks. Once the PS and CS have been diagnosed, MST describes seven design parameters as starting points for the redesign of the PS and CS. The first three are related to the production structure, the fourth is about the relationship between PS and CS. The last three parameters are related to the control structure. Once these well-defined steps to (re)design the PS and CS are completed, a problem arises when moving on to organizing an organization's innovation structure, since modern

sociotechnic has no mention of how this should be worked out. However, MST does teach us that the link between sociotechnic and the innovation structure is important.

Therefore, to provide guidance on how innovation can then be structured, this study will build on Lekkerkerk (2012) and the Model Innovation and Organizational Structure (MIOS) he developed. The MIOS addresses twelve functions and their relationships. These are divided into three groups having to do with the primary process, innovation and the central functions, connecting the first two groups.

The first group is regarding the production and these functions are known as the Supply (Voortbrengen in Dutch) functions and thus know as the V-functions. Supply product service-V1 ensures the realization of products and services to meet customer demand. Regulate supply-V2 takes care of the operational control of this primary process. Propose improvement-V3 creates project plans for the most promising opportunities. The found opportunities arise from Search improvements-V4. This function focuses on better exploitation of current products, services, processes and markets (Lekkerkerk, 2012).

The second group of functions are the Innovation or I-functions. Innovate-I1 has the goal to implement innovation projects. The second function is Regulate innovation-I2 and takes care of the operational control of the innovation process. Propose innovation-I3 creates innovation projects for the most promising opportunities. These may require a change in strategy. New possibilities that might lead to promising opportunities are found based on research done in Search future new options-I4 (Lekkerkerk, 2012).

The last group includes the Central functions, or C-functions. This group forms the connection between the first two groups with V- and I-functions. Remember-C1 can be described as the organizational memory. The next is Tune-C2 which aligns the contributions of all other functions on schedule. Balance-C3 ensures balance between exploration and exploitation, thus balance between incremental and radical innovation. For this balance, strategic criteria are used to decide which project plans from Propose improvement-V3 and Propose innovation-I3 are worth implementing. Balance-C3 also makes the decision whether projects already underway may continue or are discontinued. The last central function, Define mission-C4 has the function of establishing the mission, vision, goals and strategy of the organization (Lekkerkerk, 2012). In 2015, continuous improvement was added to the MIOS as well and is described as follows: Continuous improvement is mainly carried out within and by any department alongside the daily work, and the changes are implemented without prior higher management approval and

without much involvement of other departments (Lekkerkerk, 2015). All of the above functions are briefly summarized and explained in appendix 1, table 3.

If these total of twelve functions and continuous improvement are assigned in an organization and arrangements are made how they relate to each other, this guarantees the continuity of an organization. However, it should be noted that employees should perform the functions well for this continuity to be true (Lekkerkerk, 2012).

2.3: De Sitter's parameters

De Sitter was not a fan of the functional structure, but preferred to change the organizational production and control structure into a more flow-like structure with integrated activities across different organizational levels (Achterbergh & Vriens, 2009). The goal of changing an organizational structure is to have as minimal internal disturbances as possible and to create as much autonomy of workers as possible (Achterbergh & Vriens, 2009). Therefore, redesigning the structure affects the quality of work, quality of working relations and quality of organization. For this reasoning the concept of controllability is important in modern sociotechnic (MST). Controllability meaning: the ratio between control demands and control options. If you get rid of the functional structure and adopt a more flow-like structure you can increase control options of workers (thus increasing their regulatory capacity) and decrease control demands. Although MST lacks comprehensive guidance on how to design the innovation structure, the parameters used as starting points for the (re)design of the production structure and control structure can be used to assess functions of the MIOS. De Sitter discussed seven parameters as described by Achterbergh and Vriens (2009). The four most important ones, parameter 1, 2, 4 & 5 will be explained below. The lower the parameter value, the better it is for controllability, quality of work, quality of working relations and quality of organization.

1. Level of functional concentration. To assess the functional concentration, check to what degree are specialized activities grouped in specialized tasks and to what degree do all orders pass through all sub-systems. In a structure with maximum functional concentration, workers perform tasks related to all possible order-types. If the level of functional concentration is minimal, all tasks, necessary for the production of some order-type, are only coupled to this specific order-type, and grouped together into a production-flow. Within an organization with a low parameter value for functional concentration, 'parallel flows' coupled to types of orders

may appear, so workers only perform a task related to one order type (Achterbergh & Vriens, 2009).

2. Level of differentiation of operational transformations. De Sitter split the operational transformation process up into making, preparing and supporting. Making is the direct process of realizing output. Preparing provides the necessary conditions for the making process, such as purchase, planning and sales departments. Supporting consists of all operational activities indirectly tied to realizing the output such as maintenance, HR and technical service (Achterbergh & Vriens, 2009). This parameter is high if the operational transformation process is separated into making, preparing and supporting, and low if the operational tasks have all three activities combined.

4. Level of separation between performance and regulatory activities. To assess the value of this parameter, it must be checked whether or not performance and regulatory activities are all assigned to specialist tasks (Achterbergh & Vriens, 2009). If this parameter is high there is a big split between thinking and doing in an organization. The parameter is low if an employee performing a task in the operational transformation process also has a lot of regulatory potential to regulate the performance of his duties.

5. Level of differentiation of regulatory activities into aspects. This parameter shows how operational regulation, design regulation and strategic regulation are divided. Operational regulation is about the possibility for employees to decide on fixing everyday tasks in the here and now. Design regulation describes if employees can say something about the organizational infrastructure in which they operate, thus technology, structure itself and HR. Strategic regulation is about employees influence on determining company goals (Achterbergh & Vriens, 2009). The parameter value is high if the types of regulation are separated into different tasks and low if the three types are merged into one task.

2.4: Summary of the theoretical background

In this study, in the context of structuring an innovating organization, Lekkerkerk's definition of innovation is guiding. The definition is as follows: innovation is the (intended) outcome of an innovation project in the form of new knowledge, a new product, a new service, a new process or an organizational innovation and almost always a combination of those (Lekkerkerk, 2012). To map the structure of an organization, both Mintzberg (1980) and De Sitter (1986)

suggest configurations and tools that can be used in the context of Organizational Design and Development. Both however, lack a clear description of how the innovation structure should be built. The literature provides a solution here in the form of the MIOS (Lekkerkerk, 2012). This model describes 12 functions and continuous improvement as a way to research the organizational structure. Using the MIOS, systematic descriptions of structures can be created that result in an overview of the innovation structure (Lekkerkerk, 2012, 2015). In modern sociotechnic, De Sitter describes parameters that act as starting points for the (re)design of the production structure and control structure (Achterbergh & Vriens, 2009; De Sitter, 1994). These parameters can be used to assess functions of the MIOS as well. The general rule is: the lower the parameter, the better. The key parameters in this regard are: level of functional concentration, level of differentiation of operational transformations, level of separation between performance and regulatory activities, and level of differentiation of regulatory activities into aspects.

Chapter 3: Methodology

3.1: Research methods

The type of research conducted is a single case study. A diagnosis of the innovation and organizational structure was done followed by a gap analysis. The practical objective of this research was to gain a more in-depth understanding of the innovation structure of Hyster-Yale Nijmegen and to develop opportunities for the improvement of organizing innovation within Hyster-Yale. The Model for the Innovation and Organizational Structure (MIOS) created by Lekkerkerk served as the basis for these steps (Lekkerkerk, 2012, 2015). In this research the MIOS was used as a specific tool to research organizational structures in order to create systematic descriptions of structures and be able to compare them. Based on this comparison, characteristics of effective and efficient structures emerged with a specific focus on the underlying innovation structures (Lekkerkerk, 2012). In combination with the MIOS, De Sitter's parameters were used to help make an assessment of the descriptions of how functions of the MIOS are fulfilled within Hyster-Yale and to provide information about the quality of work, quality of working relations and quality of organization for Hyster-Yale, compared to the literature. From this gap analysis followed opportunities for the improvement of organizing innovation within Hyster-Yale.

The company on which this research focused was Hyster-Yale in Nijmegen. To obtain data from this organization, the researcher obviously needed to gain access to the company. The researcher himself has been working for Hyster-Yale for two and a half years (half year fulltime, two years part-time). With the first contact made a long time ago, gaining access to the organization was a mere formality. The organization knows what kind of person the researcher is and there is a trusted bond between both. As a result, the researcher also has extensive prior knowledge of the organization. Together with the team leader manufacturing & process engineering and the manufacturing engineering manager, possible research topics suggested by the thesis supervisor were discussed as well as the way in which the researcher wanted to conduct the research. From this conversation, the innovation and structure side emerged as suitable perspectives.

In order to define this research, the intervention cycle was used to determine which phase this research connected to. The intervention cycle has four phases: diagnosis, design the change, implement the change and evaluation (Vennix, 2019). In this study, the focus was diagnostic. The research aligns with the diagnosis phase the best because it diagnosed what Hyster-Yale's innovation and organizational structure currently looks like. At the same time, there was a focus

that provided insight into opportunities for the improvement of organizing innovation within Hyster-Yale by making an assessment of the functions of the MIOS and using De Sitter's parameters. Therefor this research connected with the design the change phase of the intervention cycle as well. According to the intervention cycle, a logical next step for Hyster-Yale could be to get started with these outcomes in the design phase and redesign the way the organizational structure is arranged whereupon in the intervention phase a restructuring of the innovation structure could be implemented, for example.

3.2: Data collection

To take a first step, the researcher started searching within Hyster-Yale's intranet and the generally accessible process engineering network drives for the presence of documents that could contribute to a better understanding of the company. Documents regarding how the company's structure is arranged, related to the current innovation structure and in what ways Hyster-Yale is currently engaged in innovation were the aim. In consultation with the thesis supervisor and company supervisor, the final interview questions were drafted using the MIOS as a guideline.

The exact individuals and departments with whom an interview was conducted were determined in consultation with the company supervisor and on the basis of conversations with employees. There was fairly quick and unanimous clarity on the first five individuals who would qualify as interesting respondents. These respondents held jobs that had a lot to do with innovation. The second criteria was that the person to be interviewed must be working for Hyster-Yale for more than two years. By working with respondents with more than two years of service, the assumption could be made that the individuals in this sample had enough knowledge of Hyster-Yale and its structures. Researcher was given the tip to ask for equally interesting respondents during these interviews and thus to make use of snowball sampling. By doing so, the name of the innovation leader emerged in several interviews as an interesting respondent. However, an interview with the person in this position was planned from the beginning. Furthermore, the big truck program manager recommended talking to a project leader. This tip was gratefully taken advantage of and an interview with this position was therefore planned. By speaking with the manufacturing engineering manager several times prior to the study, it quickly became clear to the researcher that this person was also a very suitable candidate as a respondent for this study. An interview was therefore held with the person in this position as well. Quotes from

respondents are used in chapter 4: findings. The quotes are described as personal communication, with corresponding job title and the date of the interview. How all the respondents relate to each other can be found in the organizational chart in appendix 2 The following table lists the respondents:

Name of respondent	Job title	Date of interview
Marcel van Eeden	Value Stream Manager	30-05-2023
Willem Nieuwland	Big Truck Program Manager	01-06-2023
Saskia Jacobs	Logistics Manager Manufacturing	01-06-2023
Niels Bongers	Manufacturing Engineering Manager	01-06-2023
Neha Roy	Innovation Leader	02-06-2023
Peter van Sommeren	Senior Director Manufacturing and European Parts Operations	02-06-2023
Nico Berns	Project Leader (new introductions)	07-06-2023

Table 1 List of respondents

The next step was collecting data in the form of interviews until saturation occurs. Prior to the interviews, the selected individuals were sent an accompanying email containing the following items (Bleijenbergh, 2015):

- The question if they want to participate in the study.
- Explanation what the study entails.
- Why the respondent's input is needed.
- What topics will be covered.
- Approximate length of the interview.
- That the data will be treated confidentially.
- That the interviewer prefers the interview to be held online via Microsoft Teams, since this makes it easier to record the interview.
- Brief explanation about the researcher himself and how he can be contacted.

The interviews with employees of Hyster-Yale took place at Hyster-Yale's own location via teams. Firstly, this provided a very low threshold for participation in the interviews (Bleijenbergh, 2015). Secondly, given the fact that this is the environment in which the interviewees are working, the researcher felt that this would ensure that the respondents could clearly envision the innovation structure. Most of the employees working in Nijmegen are Dutch. In order not to create an unnecessary language barrier between interviewer and

interviewee, the interviews were conducted in Dutch. Conducting the interviews in one's mother tongue gives the interviewees more freedom of choice of words, making it easier to answer and thus improving the quality of the answers. The Dutch data was then coded in English for the purpose of the writing language of this thesis. For one interview, with the Innovation Leader, the situation however necessitated an interview in English.

The interview as a method of data collection has several advantages. It allowed the researcher to go more into depth and make respondents feel more taken seriously because they could really share their stories, thoughts and experiences with respect to the innovation structure within Hyster-Yale (Bleijenbergh, 2015). The interviews were semi-structured. The choice for this type of interviews allowed the researcher to direct which topics were covered since the focus is on innovation and structure, but allowed respondents to bring in new relevant topics and perspectives during the interview as well. An additional benefit of the semi-structured interview was that the researcher could make changes in the order of the interview questions during the conversation and that new questions sometimes emerged during the interview (Bleijenbergh, 2015; Myers, 2013). This allowed for specific focus on the issues that are perceived as important regarding the innovation structure (Bleijenbergh, 2015). Finally, semi-structured interviews increased the reliability of the data collection because all interviewees are asked the same basic questions (Myers, 2013).

While interviewing, Microsoft teams functioned as a recording device for the interview and pen and paper was used to make some quick notes. Beforehand, respondents were told what these materials would be used for. In addition, before the start of the interview, the respondent was given the choice whether or not the interview could be recorded. To ensure that the interviewee's words had been interpreted correctly, the respondents were asked of they would like to receive a typed transcript of the interview. In this way, the respondent could indicate whether his or her answers had been accurately represented and could make changes to them if deemed necessary. However, none of the respondents required access to the transcripts because they were confident that their words had been put on paper correctly. In a single case where some confusion arose amongst the researcher about an answer given, clarification was sought verbally. Upon completion of the overall study, the respondents were sent the results as a service and proof of thanks for participating in the study and a presentation of the results is scheduled for September.

During the months of this study, the researcher was present at Hyster-Yale in the research role on a regular basis to collect data for this thesis. At the same time, he also had the freedom to conduct interviews during his regular weekly work days when he was not primarily in the role

of researcher. This ensured that the researcher was very flexible in terms of when interviews were conducted, allowing him to accommodate himself almost entirely to the schedule of those to be interviewed. Because of this high frequency of attendance, no problems arose regarding inability to obtain data due to busy schedules, holidays of persons to be interviewed, or illness.

3.3: Data analysis

In order to extract suitable data from the interviews, they were transcribed. This was done verbatim, meaning everything was written down except for hesitations and stop words, which were omitted. In this process, a small amount of information was lost, but this was no problem for this study. Due to the confidential nature of the information from both the documents and interview transcripts, they appear anonymously, named by job-title. In order to assess the completeness of the research, the original information was however shared with the thesis supervisor.

To avoid errors and simplify the transcription process, available automated technologies to transcribe were used. This was done via Microsoft Teams. The software provided transcripts that were found to be very useful by the researcher, although the researcher eventually carefully had to check the generated transcripts with the voice recordings made to remove inaccuracies.

The next step was to begin the content analysis using the literature, specifically the MIOS and De Sitters parameters. The analysis in this step was entirely theory-driven (Bleijenbergh, 2015). The MIOS specifies twelve functions plus continuous improvement. Divided into three groups having to do with "the production" (primary process), innovation or with the central functions, connecting the first two groups (Lekkerkerk, 2012, 2015). On the basis of these twelve functions plus continuous improvement, the researcher established a coding scheme in advance that served as a guideline during the coding of the collected documents and interview transcripts. The selected codes were then arranged in the form of a tree structure. In this chosen approach, distinctive concepts such as the central concept, dimensions and indicators recur (Bleijenbergh, 2015). The central concept was split up in dimensions which in turn were broken down into indicators. These indicators formed the connection between the central concept and the collected empirical material.

This approach was chosen because the MIOS and De Sitter’s parameters provide a solid theoretical basis that builds on various concepts and perspectives that were discussed during

the researcher's Organizational Design & Development master specialization. In addition, the MIOS has already been tested in practice at five innovative Dutch companies (and proved useful) during the completion of Lekkerkerk's PhD thesis in 2012, which made it suitable for application to this case study of Hyster-Yale. Furthermore, the researcher himself is a supporter of the deductive science view in order to build on established names and already proven theories. Because of these reasons, the choice for the MIOS and the parameters of De Sitter was a very self-explanatory one.

3.4: Validity and reliability

This single case study used a combination of data collection methods, namely document analysis and interviews. This allowed for triangulation of methods which increased the depth of the study and allowed for comparison of different observations to increase quality. Peer debriefing was also used to increase quality. The researcher sat together with two fellow researchers active in similar research fields. During these meetings, the researcher presented draft versions of his assigned interpretation of fragments to the attendees. The fellow researchers were asked for a reaction and on the basis of this the already assigned interpretation was in some cases adjusted, nuanced or further elaborated (Bleijenbergh, 2015). In addition, the researcher consulted the thesis supervisor, who is the developer of the MIOS as well, several times to increase the validity and reliability of the thesis.

3.5: Limitations and research ethics

The neutrality of the researcher could have been an issue due to the fact that the researcher was already employed by the company where the case study was conducted and thus was studying and interviewing colleagues. By having a clear understanding in advance of what questions the researcher wanted answered, the interviews were as objective as possible. Furthermore, the aforementioned peer debriefings helped ensure that the researcher's opinion was absent as much as possible during the study. For the past two years, the researcher has worked under two supervisors and worked directly in his department with about 20 colleagues. Approximately 750 employees are employed within Hyster-Yale Nijmegen, many of whom have also seen the researcher. In relation to the direct supervisors, one can indeed speak of a power imbalance given the hierarchical relationship. However, the culture in this regard is very open within Hyster-Yale. Therefor this did not cause any problems. In relation to the other colleagues, there

was no direct difference in power. The diagnostic research that took place focused on structure and innovation and thus progress of Hyster-Yale. In doing so, it contributed to the future survival of the company. With this comes employment and salary, which can be seen as a very positive driver for this research. By making this clear, the researcher indicated that he took a research approach focusing on what is best for the company as well as employees and that both benefit. For this reason, the researcher was not seen merely as part of "management" and sought to obtain answers and data from employees as openly and honestly as possible. At the same time, being a colleague also provided opportunities as it was easier to talk in jargon and further elaborate on certain topics because of the researcher's prior knowledge of the company.

Generalizability for the literature should also be mentioned. Qualitative research in organizations can be very suitable for developing theory (Bleijenbergh, 2015). However, because this was a single case study, the results cannot simply be generalized for other companies.

Confidentiality of data is a key issue. The lift truck business is a highly competitive one. Therefore, it is important to Hyster-Yale that the data collected is handled in a responsible manner. Accordingly, the researcher coordinated at all times with the direct manager and the manufacturing engineering manager on what information could be published in his report.

Chapter 4: Findings

In this chapter, a breakdown will be made for the functions of the MIOS for Hyster-Yale to answer the sub-question *"How does Hyster-Yale Nijmegen fulfill the functions of the MIOS?"*. First of all, the Supply-functions (V-functions) will be described, since they focus on the primary process (V1), to which all other functions are directly or indirectly related. Next, the Innovation functions (I-functions) will be described. Thirdly, the Central functions (C-functions) will be explained. Among the Central functions, Continuous Improvement will be analyzed as well, as this is an priority item within Hyster-Yale. To answer the sub-question *"How does the innovation and organizational structure at Hyster-Yale compare to how it should be according to the literature?",* table 2 summarizes the MIOS functions and their judgement and the values of De Sitter's parameters are discussed.

4.1: Supply functions

4.1.1: Supply product service-V1

To simplify V1, a division was made into making, preparing and supporting. This is equal to the subdivisions of the operational transformation process conceptualized by De Sitter. Thereafter, Supply product service-V1 is summarized in figure 2 with an image.

V1-making: To Supply product service-V1-making belong the 325 employees of the production lines. Two parallel streams can be identified, the Big Truck Line (BTL) and the Jumbo Truck Line (JTL). On the big-truck line, contrary to what the name suggests, the "smaller" trucks are assembled within the Nijmegen site. These are trucks with a lifting capacity of 6 to 18 tons. On the jumbo truck line, the very largest trucks, with a lifting capacity of 18-52 tons, are assembled. There is additionally a separate sub assembly production line for operator cabs, the Cab Line. All lines assemble according to the mixed model flow line principle. This means that different models of trucks or cabs are assembled in a streamlined manner across the production lines. It allows Hyster-Yale Nijmegen to efficiently produce different series of trucks with different specifications without having to recalibrate the production environment each time. As a result, lead times are reduced and productivity and efficiency increase.

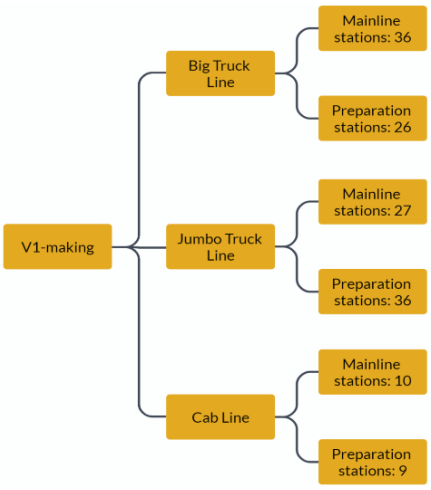

Figure 1 Overview V1-making

One day before the main frame arrives at the first station of the main line, preparations are started at some prep stations to ensure that sub-components can be delivered to the main line

on time. The employees generally have a fixed station on the line at which they perform their work, but if necessary they can be flexible and perform the work of the station before or after their standard workplace. In addition, after working at a station for a somewhat longer period of time, the operators indicate that they would like to change for variety in their work. This happens regularly and by doing so, they gain additional knowledge of the production process. With an average years of service of 15, there are many very experienced operators within the plant. However, it is currently difficult for Hyster-Yale Nijmegen to fill new vacancies.

At the end of the lines, there are Out-Of-Flow areas where trucks or cabs are temporarily stored if problems are encountered and therefore need to be taken off the production line. This way they do not disrupt the production process for other trucks or cabs. At this place the trucks or cabs can be checked by the quality department and repaired by special operating teams if needed. At the end of the jumbo truck line, another building houses the mast hall. Here, masts and customer-specific attachments are assembled separately on the trucks because these parts have a height of up to 15.5 meters, making assembly impossible at the regular production line. Located next to the mast hall, new models of trucks are tested both inside and outside in the test and validation center. Furthermore, in a separate building across the street is the shipping hall where the truck is partially dismantled and prepared for shipment. For the interested reader, an overview of how Hyster-Yale buildings are arranged and located is attached in appendix 3.

At the heart of all production lines is the Demand Flow Technology (DFT) principle. Demand implies production based on customer demand, also known as pull. Flow indicates that each production operation is matched to takt time, the time that can be spent on a truck per station. Technology includes the working together of engineering, production, process engineering and associated applications and processes.

V1-preparing: The marketing department helps customers choose between a truck that can be built modularized or a truck with modifications. In the first case, an order goes into the standard process; in the second case, it becomes a Special Products Engineering Department (SPED) order. This involves looking at the customer's specific requirements and an engineer will check the possibilities and make calculations. This can vary from a small blue light that a customer would like to have built into the cabin, to extra power in terms of engine capacity, to special attachments that can be used to specifically pick up truck trailers, instead of the standard forks. For this year and 2024 the order book is already completely full. As soon as an order comes from the marketing department, purchasing makes sure that all the necessary parts come to Nijmegen. Problems in the supply chain result in the fact that not all parts are delivered in

Nijmegen on time at the moment. In addition, one of the major tank suppliers has indicated that it is struggling financially, causing delays in production of Hyster-Yale.

Production planning determines the start of construction of a truck in Nijmegen. Logistics takes care of all the transportation movement within the production facility. The engineering department develops possible models of trucks by drawing them using CAD software. These models are then passed on to the process engineering department, where about 19 employees ensure that the trucks are built at the right production stations, in the correct order, and improvements are made. They also create work instructions for how the trucks should be assembled.

"The process engineering department can therefore be seen as the work preparation department of the production lines" (Manufacturing Engineering Manager, personal communication, June 01 2023).

V1-supporting: Technical service is provided by the Manufacturing Support Center (MSC). After a request for technical assistance has been created, MSC comes to the relevant station in the production line as soon as possible to perform the necessary work. This usually involves maintenance of machinery, robots and tools but occasionally is it metalworking that cannot be performed by the operators of the line themselves, such as welding and cutting. Maintenance of buildings is performed by the two employees of the facilities department.

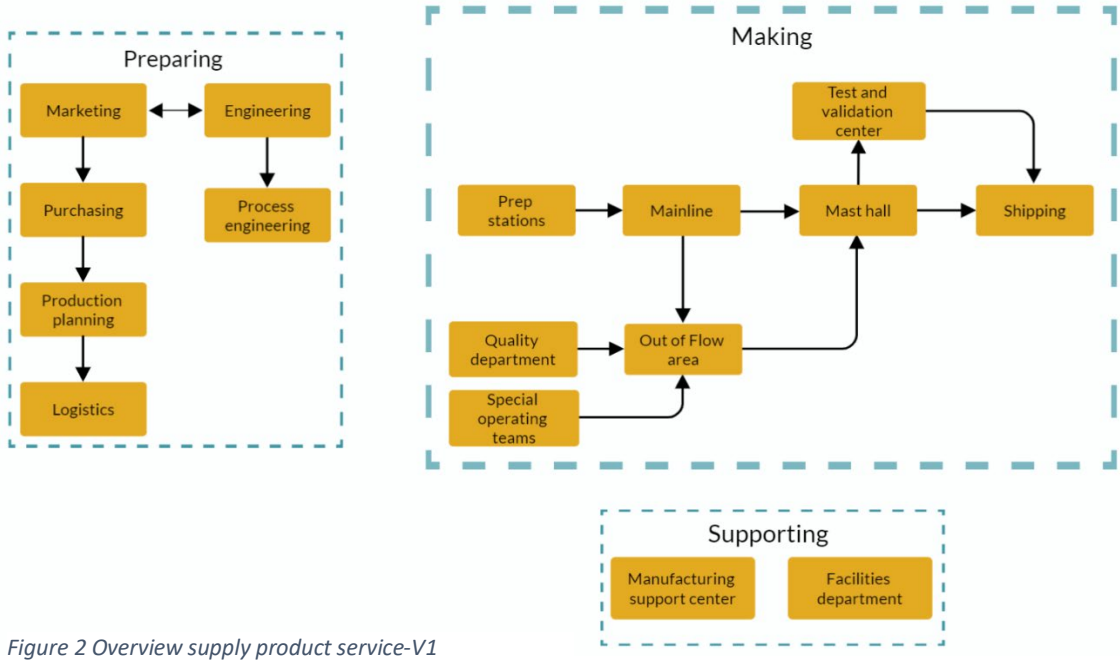

Figure 2 Overview supply product service-V1

4.1.2: Regulate supply-V2

The daily operational control of the primary process is in the hands of the value stream managers (VSM). These manage the four areas into which the lines are divided by means of one areacoach (AC) per area with corresponding operators. In total, the VSM is responsible for over 100 people. In terms of hierarchy, above the VSM is still the management team along with the plant manager. The operators on the line initially have the ability to solve problems themselves. Because of their own knowledge, they already come a long way with this. If they cannot solve this themselves or need other departments, the issue is escalated and the AC is informed. The areacoaches of each production line sit together in an office, so they are aware of the ongoing issues and problems in each other's areas. As a result, the communication lines are short and support can be provided quickly to each truck during the day. The day starts in the morning at 7:45 am with the tier 1 meeting in each of the four areas. Here everyone from the area is present and problems or news from the previous day can be discussed. One hour later there is a tier 2 meeting in which the areacoaches sit together with employees from preparing and supporting departments. This progresses to tier 3 with all managers and team leaders together. And finally comes tier 4 where the management team consults with the plant manager. If necessary, interventions and contributions to solutions for production can be made from each tier level.

Minor improvements also take place through this same tier structure. Hyster-Yale Nijmegen has recently started working with so-called t-cards. With these cards, operators can post their ideas on a board, which then need to be acted upon. A maximum of three ideas per area are allowed on the board. These are small things, so they can be solved within days or weeks through the tier meetings. Teams decide for themself which t-cards they plan to do and which ones not to do. Although the bureaucracy of the organization does slow down this process, it generally works quite well because the employees can and do quite a lot themselves.

"Because of this, I don't even always hear about everything right away, but that is okay because if it is resolved and improved, it is fine by me" (Value Stream Manager, personal communication, May 30 2023).

Introducing smaller improvements is really seen as continuous improvement within Hyster-Yale.

"This can be through very simple things and so I don't immediately see it as innovation" (Manufacturing Engineering Manager, personal communication, June 01 2023).

At the same time, it also often involves collaborations between departments and making agreements.

"It is often little effort to address things anyway and do things differently, which ultimately makes it easier to work together and get better results" (Project Leader, personal communication, June 07 2023).

Within the Regulate supply-V2-function, the staff scheduling is aligned with production planning. Due to shortages of parts from suppliers, a shortened work schedule has been used regularly over the past 1.5 years, with operators and support departments working 37.5 hours a week instead of the usual 40. In consultation with the works council, it was agreed that these hours would be compensated for at a later time when all parts were back in stock. At those times a workweek is 42.5 hours. This resulted in some complaints from the employees, but by maintaining this division of work weeks during parts shortages, there was no need for layoffs. This is beneficial for both the employees and Hyster-Yale Nijmegen itself, as the company is now not losing technically trained personnel. This allows the company to continue to respond to the increasing demand for trucks that is already visible for the coming years.

4.1.3: Search improvements-V4

In general, within Hyster-Yale Nijmegen not that much distinction is made between the functions Search improvements-V4 and Search future new options-I4. In China however, there is an active search for opportunities to better exploit existing big- and jumbo truck products and knowledge. Hyster-Yale sees China as a major player in the market because of the size of their ports and the growing market. Seven of the ten largest ports in the world are in China.

"You actually have a global market and you have the Chinese market and that Chinese market is almost as big as that whole global market for us and sometimes we don't realize that" (Manufacturing Engineering Manager, personal communication, June 01 2023).

For this reason, Hyster-Yale Nijmegen has invested in a factory in China that in the coming years will be further expanded with knowledge and products from Nijmegen. China buys as little as possible outside its own borders, but the country does have enormous market potential for Hyster-Yale Nijmegen. For this reason, it was decided to set up a joint venture with a Chinese manufacturer under the brand name Maximal. The main focus at the moment is to be present in China and gradually expand.

Processes are continuously reviewed to see where contributions can be made to generate more revenue. During these reviews a reflection is done as well to keep searching for improvement. This creates many ideas and opportunities, but it is perceived as difficult and disadvantageous to be working on this a lot because it comes on top of the daily work.

"In the end, you have a lot of work on your desk that keeps you busy for 40 plus hours. If you also have to do a project and focus on it, it is very difficult and you often get bogged down. This is actually the case everywhere within Hyster-Yale Nijmegen" (Value Stream Manager, personal communication, May 30 2023).

Already built SPED (Special Products Engineering Department) orders are used to better exploit existing products. A lot of time goes into engineering such a SPED truck. Once delivered to a customer and proven to work well in practice, such a design can be offered to other customers without further modifications.

"I personally find SPED a very, very innovative approach to not do game changing product development, but still keep adapting yourself to the market needs, and be flexible towards your customer" (Innovation Leader, personal communication, June 02 2023).

Noteworthy is the position Hyster-Yale Nijmegen finds itself in the coming years. Because of the very rapid changes associated with the energy transition, the company will have to spend the next few years trying to protect its current market position, even though it will soon be completely changed due to the strong expansion of innovative technologies such as electric and hydrogen fuel cell powertrains.

Search improvements-V4 is not formally assigned to Hyster-Yale Nijmegen employees. During and after projects, the search for improvement does take place, but because the members of project teams differ each time, this takes place informally. Furthermore, this formal allocation is absent because large parts of this function are included in Search future new options-I4.

4.1.4: Propose improvement-V3

A clear distinction between Propose improvement-V3 and Propose innovation-I3 is not indicated within Hyster-Yale Nijmegen. Managers of departments do sit down with their employees to make proposals for improvement. But as soon as this starts to take shape, such a proposal is passed on to Propose innovation-I3. In this function, the proposal is turned into an actual business case and further follows the steps described in Propose innovation-I3.

4.2: Innovation functions

4.2.1: Innovate-I1

For New Product Introduction (NPI), Hyster-Yale Nijmegen uses the so-called 6-gate review process in which new models are implemented step by step. When this is started, proof of concepts and system innovation projects have already proven that the innovation is feasible. Each gate should be completely passed before starting the next gate to avoid risks.

"There is an increasing tendency to do implementation incrementally and not all at once, because then you don't have the risk of something not working" (Project Leader, personal communication, June 07 2023).

After passing each gate, it is also reviewed to include lessons learned. The DMAIC methodology is widely used within Hyster-Yale to carry out innovation projects, and success is measured against predetermined KPIs. It is noticeable that for the larger projects, all steps are followed much more seriously, than for smaller innovative projects. A possible explanation for this is that the management of the Nijmegen site is often directly involved in these large projects. The smaller projects rely more on intuition and informal consultations with colleagues. Some examples of innovation projects implemented in recent years include: more modular construction of trucks (IRIS project), new cabs, using 3D printers and merging the inbound locations at stores. Innovation projects currently being worked on include the use of augmented and virtual reality, collaborating with engineers in India to ease the process in Nijmegen and working with CAD drawings with a smooth outline so that even the smallest details of parts can be better seen. The phased implementation of innovation projects actively involves employees. This ensures greater dedication and also allows them to learn to work with new products and processes right away. Consequently, most innovation projects find their way through the organization via the tier structure.

Innovation-I1 is formally assigned to specially appointed project teams. These involve employees from the operational level to the management team working together in varying teams. How many employees are responsible for fulfilling this I1-function therefore depends on the number of ongoing projects and the size of these projects. A positive aspect here is that many employees throughout the company are involved in innovation and a lot can be learned from each other's expertise. On the downside, Hyster-Yale is a fairly large organization, which slows down the speed of innovation. This is because day-to-day work must take priority over innovation projects and, at the same time, bureaucracy is of influence because the

implementation of innovation projects takes place across many organizational layers with all the procedures and rules that this involves.

4.2.2: Regulate innovation-I2

A project leader is always appointed for the final responsibility of an individual innovation project. Overall, management also plays an important role in this. They often function as the sponsor of a project, with whom the project leader is constantly sparring to give the project as much focus as possible.

"I was constantly sparring with my sponsor at the time: this is what I want to do, or what do you think? Can I do more with this? What problems are we going to solve first?" (Value Stream Manager, personal communication, May 30 2023).

Based on the priority given to a project, it is then decided how many people will work on it. Every year there is the annual budget round in which an estimate is made of how much capital is needed and that is then made available for the following year. Meanwhile, in addition to management, a special position has been vacated for the Nijmegen site; the innovation leader. This is an overall coordinating and question point for all innovation projects.

The project leader, as the clear leader of an innovation project, controls the operational regulation of the project. Since most projects have a hard deadline for completion, it gives a lot of direction to determine what step to take when. In doing so, however, the project leader must be in compliance with certain priorities that are given at times by the management members to whom he reports. Although much use is made of informal paths, project leaders of key projects have a monthly obligation to provide a 5-10 minute update to each other and management on how things are going, what problems they are running into and where they need help. By doing so, project leaders keep themselves mutually engaged with each other's projects and many issues can be taken care of.

"Often all those projects run into the same issues, then it's kind of easy for management to be able to coordinate everything all at once" (Project Leader, personal communication, June 07 2023).

4.2.3: Search future new options-I4

Since two years there has been a specific role in this I4 function, assigned to the innovation leader.

"She really needs to capture innovation, that's specifically her job" (Project Leader, personal communication, June 07 2023).

The innovation leader maintains a technology roadmap. Basically this map is a database maintained together with the system group and engineering team that keeps track of which new technology or innovation is at what phase of maturity and how it seems to develop. Based on this Hyster-Yale Nijmegen decides whether to do projects to experiment with these innovations right now or, say, in ten years. Customers also come up with requests to do some additional research on certain technologies or innovations. This makes Hyster-Yale Nijmegen look into technologies that were not originally in their thought process. The roadmap could therefore be innovation driven as well as business driven.

Within the Nijmegen site, the influence of the entire Hyster-Yale Materials Handling Inc. company on innovation is clearly visible. Naturally, ideas come over from the other production sites around the world, but the headquarters also co-determines the innovation direction of Nijmegen. The current CEO is someone who once started as an engineer and has fully progressed to the strategic top and therefore has a clear vision of where product innovation should go. Furthermore, Hyster-Yale Nijmegen is also partly guided into future innovation directions by funding provided by governments. Such subsidies are currently used to design more sustainable trucks, with electrification and the hydrogen fuel cell as flagships.

A clear difference between how product innovation and process innovation are viewed is apparent. With regard to process, it is noticeable within Hyster-Yale Nijmegen that each department is independently responsible to innovate and there is no direct overarching supervisor for this. A lot happens because people simply talk to each other and brainstorming sessions are held. Innovative ideas regarding processes are passed back and forth between different levels through the tier structure, and employees are actively encouraged to keep coming up with ideas. With innovation challenges and innovation time on Fridays, the Big Truck Development Center tries to actively encourage its engineers to work on something they want to innovate on. Time is specifically set aside for this. In order to maintain this involvement for all employees however, Hyster-Yale Nijmegen can still improve.

"People have lots of ideas but you can't solve everything or take it to the next stage. But no matter the decision, it's essential to get back to the employees on the outcome no matter what. This unfortunately by no means always happen" (Logistics Manager Manufacturing, personal communication, June 01 2023).

Hyster-Yale employees subsequently regularly visit trade fairs to keep themselves informed about emerging technologies and trends relevant to the industry. The internet is also widely consulted to contribute to this. In addition, benchmark visits are made to companies with similar products such as DAF, Scania and John Deere. A characteristic feature of Hyster-Yale Nijmegen is the high level of cooperation with universities of applied sciences and universities. There is regular participation in workshops and dozens of interns and graduate students join the company each year to bring in many new ideas and explore the future.

4.2.4: Propose innovation-I3

Employees are free to suggest ideas for exploitation and exploration. Through discussion in the tier structure, these ideas take more shape. Then it is time to start making the promising ideas more tangible by preparing a Project Approval Request (PAR). In a PAR, the main outlines of an idea are drafted according to a standard format. The PAR is then submitted to top-management. After all the ideas are collected, management decides which ideas they want to focus on and what priority each project will be given during a strategy day (please see Balance-C3).

"We can obviously do 20 things at once next year, but we have to put focus on what is important" (Value Stream Manager, personal communication, May 30 2023).

First, of course, an idea must be realistic. This starts with a Proof Of Concept (POC). In this step, something is tried in a small area and the result is measured against pre-established KPIs.

"The POC is very simple: just prove that it can do what you want and then we'll talk after that" (Manufacturing Engineering Manager, personal communication, June 01 2023).

Depending on the progress made against the KPIs, the department makes a decision to expand something or not. The next step is then the Most Valuable Product (MVP). This involves looking at where can you most easily implement with the most impact. During both phases, again, the help of an intern is regularly enlisted to give them a great opportunity to be involved with an

innovative project. Once both of those steps are successfully completed, the PAR moves on to Balance-C3 for management to make a decision about the feasibility of the project.

The process of handling project approval requests and investment proposals is well structured and clear choices are made in this. Because it takes place informally, every employee can contribute by coming up with innovative ideas. Yet employees are often still somewhat reluctant to express their ideas and actually write them down. With a strategy day every trimester, a moment when innovation ideas are discussed by management occurs regularly enough. There is something to be said for the fact that management ultimately decides nearly alone on these ideas, but this does make balancing resources and time a lot easier within a company of this size. The ultimate goal within Propose innovation-I3 is to responsibly come up with as many useful ideas as possible and thereby improve and innovate as much as possible.

4.3: Central functions

4.3.1: Remember-C1

Opinions differ quite a bit about the documenting of all knowledge within Hyster-Yale Nijmegen. The Remember-C1 function is informally expected to be performed by employees. Some individuals work very accurately and document much of their progress in, for example, presentations on their network drives that are accessible to everyone. Although these are available to everyone, employees often prefer to come up with their own ideas for their project, rather than spend a long time searching the network drives for old projects that could have served as a good basis that would have allowed the project to be implemented more quickly. The management indicates that a lot is indeed documented, but that this is not done in a structured way and that there is certainly room for improvement. Both within the Nijmegen site and worldwide, therefore, too little knowledge is used cross-functionally. For this reason, Hyster-Yale would like to purchase a database to provide structure, but no decision has yet been made on when it should be implemented. Within engineering and manufacturing, the DEVLOG system is being used. Problem analysis is done with this and the root cause and solution are documented, but this can be done better and more conveniently. Finally, there are also the employees who actually document little or nothing. Knowledge is therefore really in the minds of the employees involved. While this is not a sustainable way of saving knowledge, it occurs a lot within Hyster-Yale.

"If the team leader stores & receiving leaves tomorrow, then we will have another problem, because we have no information documented" (Logistics Manager Manufacturing, personal communication, June 01 2023).

"The way in which we document knowledge, I think, could be a lot better" (Big Truck Program Manager, personal communication, June 01 2023).

It is not much better for the knowledge of projects that may or may not be temporarily discontinued. On some network drives, some information can indeed be found, but it is often not easy to find it quickly. Some systems still document the requirements used in these paused or discontinued projects, but this is often done too infrequently because the project no longer has priority. A little evaluation is still done in the form of Even Better If's and Lessons Learned, but it usually stops there (Manufacturing Engineering Manager, personal communication, June 01 2023).

4.3.2: Tune-C2

Coordination between Innovate-I1 and Supply product service-V1-making takes place between the responsible project leader and the Assembly Manager in collaboration with the Value Stream Manager. These two, in turn, will be bringing in other needed colleagues in a timely manner. Regularly, the work resulting from innovation projects is the construction of prototypes, so-called pilot-builds. These builds are assembled on the production line between normal orders and therefore require more coordination because continuous support from the process engineering and engineering departments is necessary. The coordination of the introduction of innovation projects within V1-preparing and V1-supporting departments is organized jointly between the project leader and the manager of the department affected by the project. The other functions, the policy cycle, are aligned by top-management. This is done during the strategy day, which is held every three months.

4.3.3: Balance-C3

In order for every individual function to perform well and coordinate all the Supply, Innovation and Central functions, the Project Management Organization (PMO) was recently set up. The PMO simply consists of the management team and plant manager that meet 4 times a year at the so-called strategy day. The PMO reviews the progress of the projects that are already being carried out (I1) using the 6-gate review process. The projects that are planned for the upcoming periods are addressed after that. The main objective of the PMO is to ensure that projects should not hinder each other's execution due to a lack of use of space, money or personnel capacity. To establish a balanced project portfolio from the new proposals of V3 and I3, the management team decides on the strategy day which submitted projects will be carried out in the near future and which will not. The larger the project, the more likely it is that a new proposal will be included in the policy plan. The Nijmegen production facility has its own budget for this, called Capital, but to the finance department at headquarters it must be well justified why these projects are necessary in Nijmegen.

"Every year Capital is determined and we have to substantiate that very well. We would prefer to do everything, but of course that doesn't work" (Logistics Manager Manufacturing, personal communication, June 01 2023).

Included under this C3-function is addressing risks and managing challenges. The biggest challenge right now remains the availability of time and money. A number of factors are tested

in advance in the PMO. One of these is the risk factor. This factor is discussed a lot in order to cover risks. This aims to align all functions as smoothly as possible. During ongoing projects, everyone is also encouraged to actively engage in risk management to minimize the impact of unexpected problems. In the process, the data collected in this manner also directs the mutual alignment of all functions.

"We collect an awful lot of data. From that data you actually have to start prioritizing what you want to start doing and what you want to start changing and align things in this way" (Senior Director Manufacturing and European Parts Operations, personal communication, June 02 2023).

For a while during the covid period, there was no money at all and Capital projects were even put on-hold altogether. As a result, innovation was given a lowered priority at the time. This still affects today the new projects that people are eager to do, as the lost time has not yet been made up. Smaller projects are not addressed in the balancing function. No specific plans are made for these by Nijmegen's top-management because there are so many local initiatives. These smaller projects therefore belong to the scope of continuous improvement.

4.3.4: Define mission-C4

Although Hyster-Yale is an American company in origin, the Nijmegen site really does have its own mission and vision where they want to go. For the short term, that is where the company wants to be next year and for the longer term, it is really a five-year plan. These plans are made by the management team combined with the plant manager. They are currently discussing the future a lot because of the energy transition that is going on. These long-term plans mainly have to do with electrification and hydrogen fuel cells. Additionally, the roadmap of technologies that the Innovation Leader keeps track of gives further direction to the long-term plans. The long-term plans are already leading to much interest from existing and new customers.

"Electrification and hydrogen fuel cells, that is actually the direction we need to go and there are a lot of things that need to happen for us to eventually be ready for that" (Value Stream Manager, personal communication, May 30 2023).

Management would also like to see Hyster-Yale continue to assemble in the Netherlands in a responsible way. That is both in terms of new products, but also in a responsible way for the future generation of people. On top of that, employee development is considered very

important. Therefore, the mission is not specifically attributable to innovation or improvement, but is being pursued company-wide.

“Our mission is as follows: cost effective and resilient global manufacturing footprint” (Manufacturing Engineering Manager, personal communication, June 01 2023).

4.3.5: Continuous improvement

It is widely stated within Hyster-Yale Nijmegen that it is important for all personnel to think about opportunities to keep improving while performing their job. In the daily operational process, there is always the intention to make steps and improvements. Employees such as process engineers and operators themselves regularly propose ideas for improvement. Through Continuous Improvement Files (CIF) and t-cards, they can express their ideas. New employees are explained LEAN and Demand Flow Technology (DFT) practices on course days by experienced employees to familiarize them with relevant ways to engage in continuous improvement. And for experienced employees in, for example, the process engineer position, an annual course to keep their knowledge up to date is organized.

"You have to think every day about what's wrong today to do better tomorrow. I will stop working when there are no more opportunities to improve, but I don't see that happening any time soon" (Senior Director Manufacturing and European Parts Operations, personal communication, June 02 2023).

Smaller projects initiated locally by departments belong to continuous improvement. These projects do not require top management approval because they can be solved within the department's budget. Using preparatory and decision-making rounds and PDCA methods, these projects are implemented. When evaluations of projects or products take place, the employees involved reflect and specifically indicate where there is room for continuous improvement. Through frequent contact and teamwork between departments, employees also actively learn from each other. Furthermore, Hyster-Yale employs several LEAN greenbelts and one blackbelt specifically appointed to provide additional support and guidance where needed to stimulate continuous improvement.

4.4: Summary and diagnosis of the structure of Hyster-Yale

MIOS function:	Function fulfilled:	Judgement of MIOS function:
Supply product service-V1	Formal	Sufficient
Regulate supply-V2	Formal	Good
Propose improvement-V3	Informal	Insufficient
Search improvements-V4	Informal	Insufficient
Innovate-I1	Formal	Sufficient
Regulate innovation-I2	Formal	Good
Propose innovation-I3	Informal	Sufficient
Search future new options-I4	Formal	Good
Remember-C1	Informal	Insufficient
Tune-C2	Formal	Sufficient
Balance-C3	Formal	Sufficient
Define mission-C4	Formal	Good
Continuous improvement	Informal	Good

Table 2 Structure Hyster-Yale

4.5: De Sitter's parameters

Looking at De Sitter's parameters, it can be said for Hyster-Yale that there is an intermediate level of functional concentration. Basically, operators work at a particular station for an extended period of time, performing repetitive work on a regular basis. However, this is quite justifiable because it gives operators a high degree of knowledge of a specific part of the production process of a complex technical product. Consequently, this benefits the quality of the trucks that Hyster-Yale Nijmegen builds. The operators can arrange the work relatively freely within their task, as long as the truck is built within the takt time per station. In addition, it is a favorable development that the operators change stations regularly to become a real all-round mechanic and get to know a large part of the production process. It is a good thing to notice that preparatory and supporting departments do as much as possible to ensure that the primary process runs smoothly, problems are solved quickly and there is close cooperation. Thus the ultimate goal is to get a truck complete and working off the line, and department-specific issues are secondary to this. This separation does result in a high parameter value for

the level of differentiation of operational transformations. However, employees would have an overly large and complex set of work activities if they had to simultaneously perform making, preparing and supporting tasks for Hyster-Yale, which does make this three-way division quite inevitable.

By returning more and more power to the operating teams, Hyster-Yale is trying to reduce the hierarchy and the level of bureaucracy, which can be viewed as a good development. But currently there is still a fairly moderate level of separation between performance and regulatory activities because the areacoaches and VSM still handle a decent amount of regulatory activities. Each areacoach oversees quite a bit of the production line which ensures a low degree of specialization of regulatory activities, which in turn can be seen as positive. In addition, the VSM has a lot of decision-making power and is positioned close to the primary process. This allows Hyster-Yale to keep the number of relationships within the tasks manageable which reduces the chance of disturbances.

If we dare to look a little further, we could also roughly apply De Sitter's parameters to Innovate-I1 and Regulate innovation-I2. The project teams in I1 contribute to a lower level of differentiation of regulatory activities into aspects. Employees from all levels of the organization can participate and contribute to the implementation of innovation projects. As a result, they partly have the possibility to decide on fixing everyday tasks in the here and now. At the same time, this also allows for more variety in their work, improving the quality of work. Since a project leader regulates the entire project in I2, there is a low degree of separation between performance and regulatory activities per project. This is because the project teams can decide very independently about how they want to run the project, then proceed with it and adjust the result whenever necessary.

Chapter 5: Conclusion and opportunities

Based on the business request from Hyster-Yale Nijmegen to focus more on innovation to stay ahead of the competition and to meet customer demand, the idea for this research was born. The master specialization and thesis supervisor offered the MIOS as a framework to review the innovation and organizational structure. The conclusion is divided by category of functions of the MIOS. Next, the opportunities for organizing innovation will be addressed.

5.1: Conclusion Supply functions

For Supply product service-V1 holds that Hyster-Yale Nijmegen can be seen as an organization with parallel streams: the Big Truck Line and the Jumbo Truck Line, that assemble according to the mixed model flow line principle. Working with a mixed model flowline creates diverse work and calmness within production while reducing lead times. The five layers into which the 325 employees of the production structure are subdivided may seem like a lot at first, but due to good coordination between them, the layers are not very noticeable. Therefore, the production structure is sufficiently formally assigned. However, it is difficult for Hyster-Yale Nijmegen to fill new vacancies. Furthermore, shortages at suppliers created at the time of the corona crisis are still evident in the supply chain. Add to this the fact that one of the largest suppliers for essential hydraulic and fuel tanks is in tough financial conditions and therefore delivering much less, and it becomes clear that Hyster-Yale Nijmegen is currently having quite a bit of trouble getting production to the desired output level. Because operators work at a particular station for an extended period of time, performing repetitive work on a regular basis, the level of functional concentration is intermediate. At the same time, the level of differentiation of operational transformations has a high parameter value because of the clear split between making, preparing and supporting tasks. Both values are somewhat justifiable because operators are doing complex work, but it is not the ideal situation.

Regulate supply-V2 fits nicely to Supply product service-V1 and is fulfilled correctly. Operators have quite some regulatory potential to make their own improvements in their daily work. This results in a moderate value of level of separation between performance and regulatory activities. The operators are supported in their daily work by Area Coaches and eventually the Value Stream Manager, which to a certain extent creates a hierarchy of regulators. Because of the complexity and size of the production process, this regulation hierarchy is definitely needed. In the hierarchy, it is quite clear who can and may do what. This provides a good fulfillment of the V2 function. To deal with operational problems, Regulate supply-V2 is

trying to better apply technologies, automate, set up work processes more efficiently and, where necessary, collaborate with engineers in India to make an effort to maintain production levels. But the problems in the supply chain, as much as they would like to, unfortunately cannot be solved by the employees fulfilling this V2-function. The Propose improvement-V3 and Search improvements-V4 functions are not formally assigned, because no one really has a clear understanding of how the functions should be fulfilled. The respective functions are therefore simply merged with Propose innovation-I3 and Search future new options-I4.

5.2: Conclusion Innovation functions

Project teams with a each time varying mix of employees handle the implementation of innovation projects-I1. To conduct product innovation projects, Hyster-Yale works with a 6-gate review process. Each gate must first be fully passed before the steps of the next gate may be taken. Hyster-Yale is a fairly large organization with many procedures and rules that slow down the speed of innovation. Moreover, innovation projects do not always proceed as quickly as they should because day-to-day work must take priority over innovation projects. The large projects more often follow all the steps of the somewhat bureaucratic paths within the organization compared to the smaller projects, but in general, the implementation of innovation projects is going reasonably well. It is worth mentioning that Innovate-I1 is positively characterized by the active involvement of many employees. For each project, there is a clear project leader who has full support from management, leaving Regulate innovation-I2 basically with nothing to worry about.

The appointment of an innovation leader, input from headquarters, ideas from staff and students, government subsidies and requests from customers ensure a good focus on innovation in Search future new options-I4. Because all employees are free to suggest ideas, the Propose innovation-I3 function is somewhat more informal, but that is precisely where the strength lies. Once an idea has finally taken more shape by brainstorming a lot about it with colleagues, a standard format to build on this is then available: It starts with a small-scale test of the idea by preparing a Proof Of Concept with appropriate KPIs. Then the process moves on to Most Valuable Product to complete the Project Approval Request. Yet employees are often still somewhat reluctant to express their ideas and actually write them down.

5.3: Conclusion Central functions

The Remember-C1 function is informally fulfilled and, for that reason, regularly causes inconvenience and problems because knowledge is far from being properly documented. Remember-C1 could thus certainly use an upgrade. Although there is a lot of information in the company, it is usually not stored in a generically structured way. Knowledge of projects is mostly in the heads of employees, which has often caused problems when employees leave Hyster-Yale Nijmegen. The systems in which knowledge and information are stored and project evaluation to learn from mistakes and points for improvement could be improved as well. Tune-C2 is adequately addressed and to align all functions in Balance-C3 the Project Management Organization has the upper hand. The Project Management Organization consists of the management team and plant manager that meet 4 times a year at the so-called strategy day to decide which submitted projects (originating from Propose innovation-I3) will be carried out in the near future and which will not.

Strategic choices from Define mission-C4 to free up resources and capacity for electrification and hydrogen fuel cells as the powertrains of the future are already leading to much interest from existing and new customers. Based on this, it can be concluded that management acted correctly regarding fulfilling this function. Informally assigning continuous improvement to all employees provides a good basis to make steps and improvements. Employees are actively encouraged to look for improvement, the tools and systems provided for this are good, and regular training keeps the staff up to date on the techniques and methods used within Nijmegen. If required, extra support is available in the form of LEAN experts.

5.4: Opportunities for organizing innovation

In addition to analyzing the functions of the MIOS and the parameters of De Sitter, the opportunities found are included in this study to provide additional future prospects for Hyster-Yale Nijmegen. Therefore, this chapter will provide answers to the sub-question *"Where do opportunities arise to improve organizing innovation within Hyster-Yale Nijmegen?"*.

Perhaps the most important opportunity relates to better documentation of knowledge in Remember-C1. Currently, this happens informally and insufficiently. It would be beneficial to record more of the knowledge that is now in the minds of employees. Employees often work in Nijmegen for a long time, so knowledge does not just disappear, but a way of documenting this knowledge provides more certainty. By doing this in a centralized and well-organized database,

different departments can easily access each other's work and processes in innovation, allowing for new ideas on current or upcoming projects. The evaluation and lessons learned from past projects should also be included in this database to avoid repeatedly proposing identical ideas.

Since Propose improvement-V3 and Search improvements-V4 are not currently distinguished from Propose innovation-I3 and Search future new options-I4, it is recommended to formally assign these two V-functions to specific employees. This clearly separates the exploitation and exploration activities that Hyster-Yale performs. The better focus on innovation that the company would like to achieve can be established this way. To fulfill these V-functions, the recommendation for Hyster-Yale is to seek and intensify cooperation with external companies. These companies often face similar problems, so it would be useful to learn from each other to find out how something is addressed or solved and to discuss how incremental improvements are made.

Opportunities within Innovate-I1 also exist. Although the function is formally assigned to project teams with a varying mix of employees for each project, the implementation of the innovation project is often secondary to the performance of daily work. Consequently, projects do not always run smoothly. Once a final implementation deadline approaches, it suddenly becomes necessary to work all-out to deliver a satisfactory result. In exceptional cases, this also causes the deadline to be postponed, which in turn creates internal scheduling problems, upset customers and delays for other innovation projects. Therefor, to implement innovation projects, fixed hours should be made available for an employee when participating in a project team so that it does not add to the regular workload.

Propose innovation-I3 is fulfilled in a more informal way so everyone is free to suggest ideas. However, what is often seen in this is that it is the same employees who come up with ideas and that the other employees are often still somewhat reluctant to express their ideas and actually don’t write them down. Establishing a set moment to think about innovation that recurs on a regular basis can also give these employees more incentive to come up with ideas. At such a time, cooperation with Hyster-Yale's own factories can boost innovation. Although Nijmegen makes a unique product within Hyster-Yale Materials Handling Inc. it is of course not the only production location of the company. Basically, at the end of the day, every factory more or less makes a forklift. By cooperating, more knowledge is spread, and you will eventually get more input in return. With this, factories can build on their own ideas or even adopt complete ideas from other parts of the world. This prevents factories from potentially reinventing the wheel on their own.

In terms of De Sitter's parameters, Hyster-Yale appears to have a good chance of improving as well. The intermediate level of functional concentration, fairly moderate level of separation between performance and regulatory activities and high parameter value for the level of differentiation of operational transformations could use a decrease in parameter value if we consider De Sitter's literature. The problem, however, is that it is a complex environment that requires specialized knowledge to ensure the quality of trucks and guarantee safety. This means that redesigning the structure of Hyster-Yale to lower certain parameter values may be better for quality of work, but not necessarily better for the organization. Because of the company's size, the layered regulatory structure is also reasonably justifiable.

The parallel production lines and the intention to return more regulatory activities to the operational level show that the will to improve in this respect is certainly present for Hyster-Yale. The advice, therefore, is to continue in this direction.

Chapter 6: Discussion

In this chapter, the research process will be reviewed through discussion. The discussion is divided into the theoretical part, practical part and methodological part.

6.1: Discussion on the theoretical part

This research is practice oriented, therefore the theoretical part is of secondary importance. The research is a follow-up study to Lekkerkerk (2012, 2015) and uses De Sitter's (Achterbergh & Vriens, 2009; De Sitter, 1994) parameters to study how innovation is organized in practice and applying the guidelines for the design of an organizational structure for development or innovation within an integral structure design, while adding a case of a Dutch-based innovative manufacturing company to the literature.

The current study thus complements the literature by testing the usefulness of the MIOS a good decade after it was developed. The thirteen functions (continuous improvement included) offered by the MIOS proved to be good guidelines to give proper direction to the research. They were used during the drafting of the interview questions, and then for writing out the findings, the functions served as a codebook. The results of this study were briefly compared to the companies studied by Lekkerkerk (2012) Hyster-Yale does have similarities in all functions with one or more of the case companies investigated at the time, but a comprehensive analysis is something that was not the focus of this study. Opportunities certainly exist here by looking at best practices and learning from the specific ways each company is fulfilling the functions of the MIOS. At the same time, the values of De Sitter's parameters give a good impression of the production and control structure. However, concrete opportunities did not emerge from most of the values because Hyster-Yale has good reasons for the current structure.

Respondents found it quite difficult to answer the questions intended to draw an outline of the functions V3 and V4 during the interviews. This was frequently noticed in the fact that people answered, "what exactly do you mean by this?". In hindsight, it would have been useful to use the definition of innovation projects described by Lekkerkerk (2012) to provide more clarity to the respondents. From the literature, the case study companies showed more often that no clear distinction was made between the functions V3, V4, I3 and I4 (Lekkerkerk, 2012). This could explain why the questions regarding the relevant functions also led to ambiguity within Hyster-Yale Nijmegen. Therefore, during the research at Hyster-Yale Nijmegen it was decided to provide additional information prior to and around the interview questions that were intended to give a description of V3 and V4 in order to try to get a better idea of how these functions

were fulfilled. The interviews furthermore reveal a strong tendency for employees to focus on product and process innovation, but options such as marketing, business model innovation or cost-reductions are little talked about. All in all, it does appear that the MIOS continues to be a good way to look at how innovation is organized within a company in 2023, in order to then be able to give advice on areas of opportunity based on a comprehensive description of the functions.

6.2: Discussion on the practical part

This master thesis is not specifically focused on theory creation. The main goal was to analyze the company Hyster-Yale Nijmegen using existing theory and the use of the MIOS as a framework in order to make a practical contribution to the company's goals. At the same time, this research provided practical advice in the area of organizing innovation for the Nijmegen site. By putting these recommendations to work, Hyster-Yale Nijmegen will soon be able to reap the benefits of this research, and with it, the goal has been achieved. What was also frequently heard back from respondents was that the questions made them think again about specific processes and the innovation structure. In this way, the research helps to ensure that innovation remains an important topic on the agenda. For managers that work for manufacturing organizations, this research provides insight into how to study their innovation and organizational structure in order to then make any necessary structural adjustments to embed innovation more efficiently and effectively into their company. At the same time, it may be considered whether the recommendations can be incorporated without too much adaptation because the situation described within Hyster-Yale is very similar to theirs.

6.3: Discussion on the methodological part

It should be taken into account that the researcher has been working for Hyster-Yale Nijmegen for a number of years. Based on his own experience and knowledge of the company, assumptions may have been made more quickly about certain information. Data collection took place within the boundaries of the single case study. The interviews and documents used met the requirements for empirical material. With semi-structured interview questions, operationalization went well and sufficient data was collected to properly answer the sub- and research questions. Conducting interviews was a research method that was time-consuming, especially with transcribing afterwards. Despite the help provided by transcription software,

this took up a considerable amount of time. Because the researcher was able to be present at very flexible times within Hyster-Yale, it was easy to schedule an interview with six of the seven respondents. Due to the busy agenda of the Senior Director Manufacturing and European Parts Operations, scheduling the interview with him was a bit more difficult. Despite advance notice that about 45-60 minutes would be needed for the interview, the available interview time ended up being only 30 minutes. As a result, not all the interview questions were covered in equal detail. In hindsight, it would have been useful to use the definition of innovation projects described by Lekkerkerk (2012) to provide more clarity to the respondents. In addition, the MIOS could have been better explained prior to the interviews.

My personal role as researcher was perceived as pleasant by the respondents. People indicated that they found the questions interesting, the clarity in advance through the accompanying email was appreciated, and the fact that it was easy to speak in jargon was considered positive. One respondent said afterwards that he would have preferred to do the interview face-to-face, but the online interview via teams was not that big of a problem because he got familiar with working from home. During the past few months, respondents have also asked about the progress of the study on several occasions when I bumped into one of them, which made me feel that my research was truly appreciated. Furthermore, the support and feedback I received from my company supervisor and the Manufacturing Engineering Manager always helped me get started when I had questions about certain topics.

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Appendix 1: Model Innovation and Organizational Structure

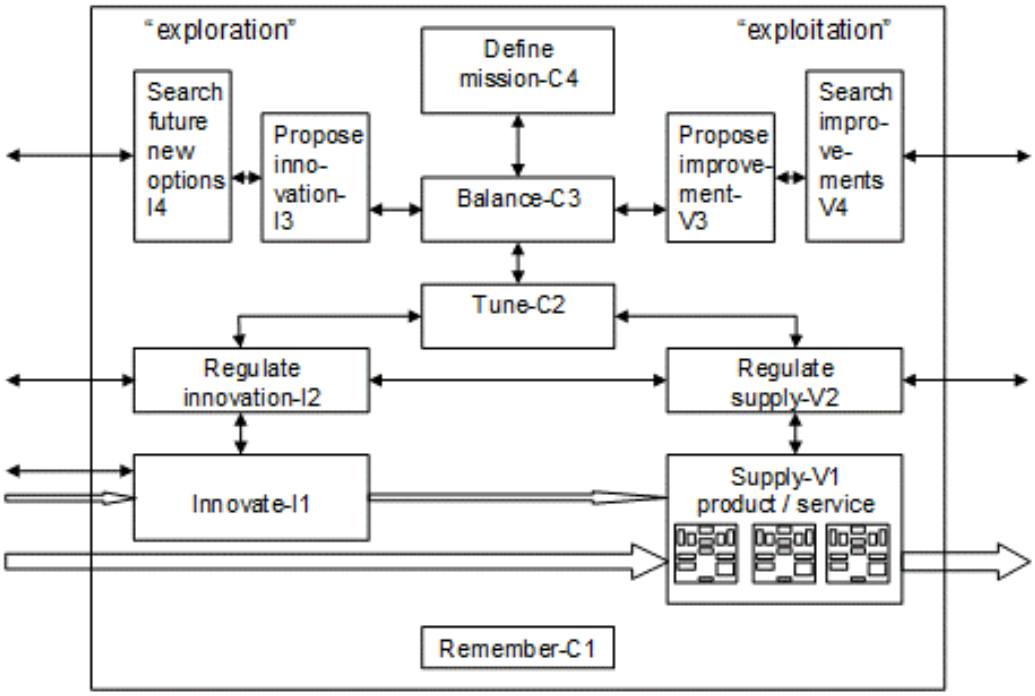

Figure 3 Model for the Innovation and Organizational Structure (MIOS) (Lekkerkerk, 2012, p. 296)

Name-code	Contribution of function to organization:
Supply product service-V1	represents the primary process supplying products and/or services by transforming inputs in output. Includes order-related activities: logistics, process planning, sales, finance, procurement, etc. Includes supporting activities: maintenance, HR, facilities management etc.
Regulate supply-V2	operational regulation of the various aspects of the primary process including continuous improvement
Propose impro-vement-V3	make project proposals for the best opportunities for improvement received from V4
Search impro-vements-V4	search for and find ways to improve exploitation of current products, markets, facilities, etc.
Innovate-I1	carry out all approved innovation projects and improvement projects

Regulate innovation-I2	operational regulation of individual innovation projects and operationally manage the portfolio of projects in progress
Propose innovation-I3	make project proposals for the best future options for innovation received from I4
Search future new options-I4	exploration of environment and search for future options for innovation, aimed at new and existing markets
Remember-C1	organizational memory storing codified knowledge relevant for the organization
Tune-C2	tuning V1 and I1 enabling smooth implementation of innovations and tuning the upper six functions contributing to the strategic planning process
Balance-C3	balancing the project portfolio by strategically choosing which new proposals (from V3 & I3) should be funded and at the same time which of the projects in progress should be continued, paused or aborted
Define mission-C4	define the mission, vision and strategy for the company and deriving lower level strategies for supply and innovation including performance indicators and budgets
Continuous improvement	small scale improvement or 'kaizen' activities within each functions operational regulation

Table 3 Brief description of the functions in the MIOS (Lekkerkerk, 2012, 2015)

Appendix 2: Organizational chart Hyster-Yale Nijmegen

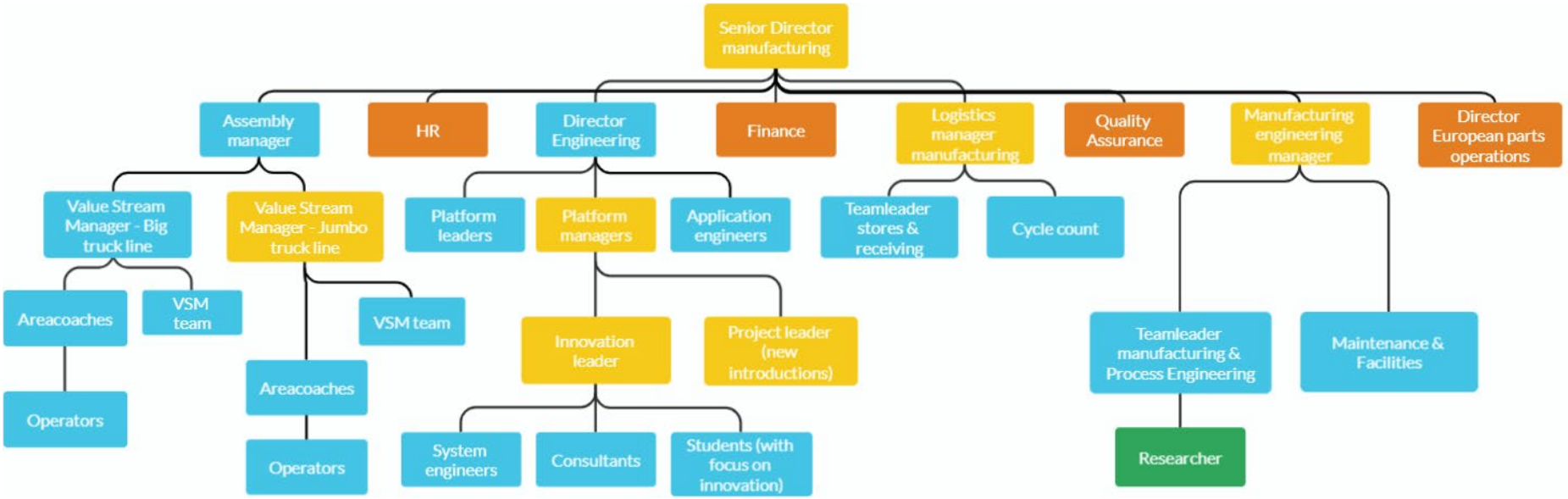

Figure 4 Organizational chart

The organizational chart shows a simplified version of how the employees interviewed during this thesis relate to each other. The yellow-labeled boxes are the functions that were interviewed. The orange-labeled boxes are supporting departments. The green box shows the position of the researcher within Hyster-Yale Nijmegen.

Appendix 3: Overview of how Hyster-Yale Nijmegen buildings are arranged and located

Figure 5 Map of Hyster-Yale Nijmegen

Appendix 4: Interview questions in Dutch

Kunt u mij een korte omschrijving geven van de functie die u hier doet?

Wat verstaat u onder innovatie en waarom is het belangrijk voor Hyster-Yale Nijmegen?

Welke drijfveren achter innovatie zijn er voor Hyster-Yale Nijmegen? Zowel intern als extern. *(Concurrentie voorblijven, wetten, klantvraag, interne verbeterdrang, etc.)*

Kunt u enkele voorbeelden geven van innovatieve projecten of initiatieven die Hyster-Yale Nijmegen heeft ondernomen op het gebied van product, proces, marketing, business model, supply-chain, en organisatie?

Welke strategie hanteert Hyster-Yale Nijmegen om innovatie te stimuleren en te ondersteunen? (*Zijn er speciale programma's, incentives of beloningen om innovatieve ideeën en inspanningen te stimuleren?).*

Hoe wordt er gezocht naar manieren om de bestaande producten en reeds aanwezige kennis en processen van Hyster-Yale Nijmegen beter te exploiteren? *(Te denken valt aan omzet verhoging, andere geografische markten benaderen etc.)*

Op welke manier worden de eerder gevonden manieren om de huidige situatie beter te exploiteren geïdentificeerd en geselecteerd voor verdere ontwikkeling?

Hoe vindt de operationele dagelijkse besturing plaats en hoe worden kleine verbeteringen doorgevoerd in het dagelijkse operationele proces?

Hoe worden ideeën voor innovatie gegenereerd en verzameld binnen Hyster-Yale Nijmegen?

Op welke manier worden de eerder gevonden innovatieve projecten geïdentificeerd en geselecteerd voor verdere ontwikkeling?

Hoe worden succesvolle innovaties geïmplementeerd en opgeschaald binnen Hyster-Yale Nijmegen?

Hoe zorgt Hyster-Yale Nijmegen ervoor dat er voldoende middelen en ondersteuning beschikbaar zijn voor innovatieprojecten?

Welke rol speelt het management in het bevorderen van innovatie en het ondersteunen van innovatieve projecten?

Zijn er speciale teams of afdelingen binnen Hyster-Yale Nijmegen die verantwoordelijk zijn voor innovatie? *Zo ja, wat zijn hun taken en verantwoordelijkheden? Welke afdelingen zijn allemaal betrokken bij innovatie?*

Hoe wordt de voortgang en het succes van innovatieve projecten gemeten en geëvalueerd? *(Welke criteria hanteert u?)*

Hoe wordt de opgedane kennis van projecten vastgelegd? Hoe gebeurd dit voor projecten die (al dan niet tijdelijk) stop zijn gezet?

Op welke manier worden risico's en uitdagingen rond innovatie aangepakt, beheerd en vastgelegd binnen Hyster-Yale Nijmegen? *(Hoe wordt er geleerd van fouten?)*

Hoe vindt onderlinge afstemming plaats tussen de afdelingen die betrokken zijn bij verbetering en innovatie? *Is hier een overkoepelende functie voor?*

Wordt er periodiek een plan vastgesteld waarin bepaald wordt welke nieuwe projecten uitgevoerd gaan worden? *(Die betrekking hebben op zowel de huidige producten, processen en werkwijzen, als op voorstellen voor compleet nieuwe producten, processen en werkwijzen)*

Hoe worden voor de langere termijn missie, visie en doelstellingen bepaald met betrekking tot innovatie?

Op welke manier blijft Hyster-Yale Nijmegen op de hoogte van opkomende technologieën en trends die relevant kunnen zijn voor de sector?

Hoe zorgt Hyster-Yale ervoor dat innovatie een voortdurend belangrijk punt op de agenda blijft?

Werkt Hyster-Yale Nijmegen samen met externe partijen, zoals universiteiten, startups of andere bedrijven, om innovatie te stimuleren? *(Zo ja, hoe worden deze partnerships georganiseerd en beheerd?)*

Ziet u kansen of verbeteringen in de manier waarop er binnen Hyster-Yale met innovatie en verbeterprojecten om wordt gegaan?