A framework to transfer information from sales to operations in new-build yachting

A case study in an Engineer-to-Order environment

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TU Delft

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Abstract

A framework to transfer information from sales to operations in new-build yachting

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Unstable information transfers at the beginning of a project lead to risks and uncertainties in the project's development. In the yachting industry, it's known that the project's duration is long-term, and the costs are high. The impact of uncertainties regarding the maturity of information at the beginning of the project can bear enormous costs and delays at the end of the project. Information transfer lacks a consistent and uniform process from sales & design to operations. The success of the yacht-building process is increased by avoiding delays in delivering the yacht and reducing excessive extra costs. Using an information system between the different disciplines and/or departments can increase the success of the yacht-building process. The focus of this problem is at the beginning of a project on the information flow between the 'commercial team' and the 'project team'. This raises the question of how an information transfer framework can improve the exchange of information to avoid uncertainties in new-build yachts. The method for this research is a case study within a Dutch yacht-building company. Knowledge about the currently available Sales and Operations Planning process (S&OP), luxury and complex Engineer-to-Order (ETO) environments, and Information Management will be gathered through literature research. The company's needs and requirements regarding an information framework are defined by a structured analysis of interviews both manually and in Atlas.ti. Combining these knowledge sources provides input for the design of the information transfer framework and recommendations for improving information transfer within the company. Finally, the Information Transfer Framework (ITF) is based on knowledge activities, which are activities of transferring knowledge and the drivers of why to share the knowledge. Recommendations for the company operating in the unique, luxurious, and complex engineer-to-order environment include improving collaboration between departments and processes, training in data management, balancing flexible and structured information, and increasing proactive problem-solving. The research contributes by integrating a useful Information Transfer Framework within the S&OP process in luxury and complex ETO environments.

Keywords: Information Management, Sales & Operations Planning (S&OP) process, commercial, operational, information transfer framework, Engineer-to-order, Structured information sharing, luxury goods, and case study.

Preface

Before you lies the master thesis 'A framework to transfer information from sales to operations in new-build yachting.' This thesis represents the final requirement of the Master's program in Management of Technology at the Delft University of Technology. Writing the thesis took place from March to August 2024.

The thesis reflects my interest in combining marine technology and project management, which led to a project management thesis written at a yacht-building company. This allowed me to combine previous knowledge from my BSc in Marine Technology and recent knowledge from the master's into a subject that interests me. I studied interesting and complex processes during the research, providing insight into the company's processes. During the interviews, I spoke to inspiring and supportive people, providing me with as much information as possible to execute my research. I've also discovered that obstacles are a necessary part of the process. I have, therefore, learned a lot from my thesis, personally and professionally.

The company provided me with a perfect opportunity and created an environment where I could be part of the team while conducting my research. Stephan van der Ruit and Noël Versteeg offered valuable assistance during this period. They gave me weekly feedback and advice throughout the entire project. Stephan was instrumental in helping me understand the processes and provided fascinating insights into relationships between departments. Noël supplied all the necessary technical details. Their cooperation and expertise were crucial in enhancing the project's discoveries. Thank you both for your tremendous help!

This research was conducted with the support of professors from TU Delft. In particular, Laurens Rook guided me through the process, providing valuable tips and creating time and space for questions and additional feedback. His expertise helped shape the research and thesis, aligning theoretical, practical, and analytical knowledge into a cohesive result. Similarly, I want to thank Victor Scholten for his critical analysis and support throughout my project.

Lastly, I am grateful for the support of my friends, family, and colleagues at the company. To all who stood by me during this time, your encouragement helped me stay critical of my work and strive to improve at what I do. Thank you!

J.J.M. van den Heuvel
Delft, August 2024

Summary

0.1. Research question

The main question of this research is: How can an information transfer framework improve the exchange of information within the Sales and Operations Planning process to reduce uncertainties in new-build yachts? This case study aims to recommend improvements in information transfer within Engineer-to-Order environments. An analysis of the information flow within the Sales and Operations Planning (S&OP) process helps to identify the crucial steps in the process. The recommendations provide valuable insights into the key steps to focus on when sharing information.

0.2. Problem and research objective

Existing knowledge gaps reveal a deficiency in the integration of information systems within the S&OP process of Engineer-to-Order companies. In today's environment, decisions are increasingly data-driven, influencing the Sales and Operations Planning process. This evolution makes transparency and information sharing essential. Therefore, new insight in information sharing integrates different processes towards new insights. The case company highlighted a challenge in maintaining consistent quality and maturity when sharing information. While the literature provides insights into the Sales and Operations Planning process, it falls short in addressing the integration of information systems. Therefore, the research objective is to explore the role of Information Systems within the S&OP process of an ETO company in the shipbuilding industry, addressing real-world challenges.

0.3. Methodology

The methodology of this research is a single-case study addressing a unique, real-world problem. The study has two sides starting with a theoretical side into the characteristics of the Sales and Operations Planning process and additional the Engineer-to-Order related problems within this process, completing the theoretical side with a study into information systems. This theoretical side leads to a theoretical framework with the independent variable, the Information systems, the moderator variables, the Engineer-to-Order environment, and the Sales and Operations planning process, impacting the dependent variable, which are the uncertainties in the yacht-building process. The other side of the study is the practical side, collecting information on the current process, thoughts on information sharing and the strengths, weaknesses, opportunities and threats in the process. The analysis method used is the coding in the software Atlas.ti, starting with detailed codes later summarized in code groups.

0.4. Findings

A novel Information Transfer Framework is designed to include five main categories: sources, information, knowledge activities, drivers, and outcomes. It offers an overview of the connections and relations when transferring information. The Framework is used as a basis to make recommendations on improving data transfer, with a focus on the maturity and quality of the data, with the goal of reducing uncertainties. Four recommendations are being made. First regarding the integration and collaboration of departments. Secondly, define a structured data management plan and get employees familiar with the structure and process steps of this data management. Thirdly, creating clarity between hard and soft data to find a balance between on one hand flexibility and, on the other hand, structure. Finally, motivate the department to act proactively in problem-solving. The designed framework involves all stakeholders, including clients and design teams, and aims to achieve improved understanding, accurate interpretation, core identity retention, increased collaboration, and a stronger team mindset. Overall, this approach supports more effective information exchange and reduces uncertainties in the yacht-building process.

0.5. Contributions

The results of the case study lay the foundation for designing measures to improve information exchange within the Sales and Operations Planning (S&OP) process, thereby reducing uncertainties in new-build yachts. Equipping the Sales and Operations Planning process for complex Engineer-To-Order with an Information Transfer Framework to improve business operations. Giving the company valuable insight and handles in collaboration, data management, balancing information and creating a proactive environment to tackle weaknesses and turn these into strengths.

Contents

List of Figures

List of Tables

Nomenclature

ATO	Assemble-to-Order
BAP	Business Assumptions Package
CVF	Competing Values Framework
CSR	Corporate Sustainability Reporting
CODP	Customer Order Decoupling Point
PDMS	Data Management System
EPC	Engineer, Procurement, Construction
ETO	Engineer-to-Order
ERP	Enterprise Resource planning
HRM	Human Resource Management
IS	Information Systems
ITF	Information Transfer Framework
LOI	Letter of Intent
MQ	Main Research Question
MTO	Make-to-Order
MTS	Make-to-Stock
MPC	Manufacturing Planning and Control systems
MDL	Master Document List
MSc	Master of Science
MPS	Master Production Schedule
OSBIT	On Specification, Budget and In Time
PD	Project Director
PMD	Project Manager Design
PME	Project Manager Engineering
PMP	Project Manager Production
PM	Project Manager
PP	Project Planner
PPM	Project Procurement Manager
PT	Project Team
S&OP	Sales and Operations Planning process
Qx	Sub Research Question, number
UDSO	understand, document, simplify and optimise
VSM	Value Stream Mapping
YBA	Yacht Builder Agreement

1

Introduction

1.1. Topic and Motivation

Imagine standing at the Monaco Yacht Show about to sell a yacht. Next to you are multiple other yachts with a total value of 3.6 billion euros (Dazert, Webster, and Dowling, 2021). In the harbor, over a hundred yachts are showing off their beauty. Thirty-seven of these yachts are new-builds; the others are second-hand or refitted. 44 of these yachts are for sale, and the salesman hopes to create and sell even more prototype yachts. The superyacht construction industry is characterised by significant financial investment. According to Forbes (Adamczyk, 2015), on average, a 100-meter superyacht costs around 275 million dollars (250 million euros). The duration of building such a project is three to five years. An expensive, long-lasting project comes with big risks. Therefore, this duration and risks must be accounted for while selling a yacht.

1.1.1. Luxury good

A yacht is a special, luxury good. A way to explain a yacht is in the following quotes. According to the Oxford English Dictionary, luxury is defined as ”a thing desirable but not necessary” (Oxford English Dictionary, 2024). To give context to the quotes, a yacht is an expensive purse, up to 140 meters. This ’purse’ is not only luxurious and expensive but unique and one-of-a-kind as well.

In contrast to a purse, a yacht requires more details to be defined by the client. These details arise during the design process; defining all details can take over a year. A yacht is specifically made for one client according to their wishes; only then is the owner’s perfect yacht. The yacht doesn’t have a business model, it is purely meant for the pleasure of the owner and his guests. Therefore, the technical focus of a yacht is on quality, comfort, luxurious details, and noise and vibration damping.

> ”A yacht is actually a really expensive purse.”[1]

> ”THE PERFECT YACHT can only be the perfect yacht when it is THE OWNER’S perfect yacht.”[2]

1.2. Background, Focus and scope

A yacht builder is a special and unique company in the Engineer-to-Order (ETO) environment due to its luxurious projects. Outstanding quality, detail, and constant design iteration make a yacht builder stand out from a shipbuilder in the Engineer-to-Order environment, leading to a difference in the requirements for completed ships. Ships from a shipbuilder should be functional, reliable, and have a long lifecycle. In contrast, yachts need to be high-quality, comfortable, detailed, and aesthetically appealing. Providing an exceptional and luxurious experience for their owners and, most importantly, producing as soon as possible so the owner can enjoy their yacht. Moreover, the scope of the case company is special in their niche market. The company is a yacht-building facilitator. The

[1] Anonymous interviewee, personal interview, [28-05-2024].

[2] Source: https://www.workingatoceanco.com/working-at-oceanco/about-oceanco, accessed [03-08-2024].

competencies are focused on coordinating the build process with over 80% outsourced scopes. The company manages the build process that contractors in our facility realize. However, the company is the main one responsible for the building process and, therefore, absorbs the risk of the process.

The success of the yacht-building process is increased by avoiding delays in delivering the yacht and reducing excessive extra costs. To achieve this success in the project, uncertainties in the planning and financial aspects should be reduced. Variables affecting these uncertainties are the quality of data and the communication. An Information Transfer Framework should create more rigidity in these variables. Therefore, the sales and operational strategies of this unique process of the super yacht builder should be aligned. For this alignment, there must be a constant and uniform flow of information from the Sales team to the Operations team. An Information Transfer Framework (ITF) is needed to obtain a stable information flow. The Sales and Operation Planning (S&OP) process captures the alignment of the sales and operational strategies. The current state of the company's Sales and Operations Planning (S&OP) process appears to be lacking clarity and definition. Moreover, there seems to be a gap in establishing a structured information transfer framework for effectively sharing relevant data.

Custom-built luxury goods are categorised in the Engineer-to-Order (ETO) environment. This environment has low standardisation, so applying the standard S&OP process is impossible. Adding an Information Transfer Framework in this ETO environment and S&OP process comes with additional challenges. Therefore, the standard processes should be adapted to the engineer-to-order environment. This directs the research into a literature study on the S&OP process, the ETO environment, custom-built luxury products, and the existing Information Systems (IS). Companies can be ranked into a S&OP maturity model in which the current state of the S&OP process is described (Lapide, 2005, 1). The ETO environment characteristics lead to adjustments in the standard S&OP process. An extra complex dimension is the custom-built luxury goods. Next, the current information system can be ranked (Grimson and Pyke, 2007, 3), ranging from Excel to automated software tools. These ranks implicate the current state and help to develop an Information Transfer Framework within the S&OP process for custom-built luxury products in the ETO environment, which will help increase the effectiveness of the information flow. This leads to increased information transfer variables and reduced uncertainties.

1.3. (Practical) Relevance

The yacht-building company is not a stand-alone company; instead, it works with multiple subcontractors and suppliers. Therefore, a sub-optimal flow of information creates financial and time-wise uncertainties that are not only a problem for the company but also for the entire co-makers and sub-contractors (yacht-builder business) ecosystem. A business ecosystem is a system with multiple designers, suppliers, and other important stakeholders. An information transfer framework helps to reduce the aforementioned uncertainties for both the company and the stakeholders. Good prediction, for example, helps the company and others in their business ecosystem because it delivers reliable, mature information.

The research adds both academic and practical value to the existing knowledge. Firstly, there is a unique academic knowledge gap in information transfer in the organisational process of custom-built luxury goods. This gap can be found in niche industries. The gap will be approached and closed within the S&OP process in Engineer-to-Order environments. This integrated ITF can be used as a performance measure to measure the effectiveness of the S&OP process (Ávila, Lima, Moreira, Pires, and Bastos, 2019). Secondly, the practical knowledge gap of a company operating in this custom-built luxury goods market is caused by the lack of a uniform process for transferring information from sales to the operations department. Value is added by introducing a useful Information Transfer framework and recommendations on how to use it.

This research applies the scientific knowledge of the S&OP process in information system technology. It uses knowledge from the MSc study Management of Technology as a resource to improve the project effectively, customer satisfaction, financial gain, and overall business strategy. The MSc study provided the structure for a case study approach; the scientific models are tested in a real-world challenge while

exploring the role of IS in the S&OP planning process.

1.4. Research objectives

To explore the role of an Information Transfer Framework in the Sales and Operations Planning (S&OP) process of an Engineer-to-Order (ETO) company, focusing specifically on a company that builds unique custom-built yachts.

The study aims to assess the current S&OP process and evaluate the effectiveness of the current information transfer within the yacht's sales and operations process. Therefore, the custom-built luxury products and Engineer-to-Order characteristics are taken into account. The requirements of the Information Transfer Framework are investigated and analysed on how this ITF can be implemented in the S&OP process. The study's goal is to increase the understanding of the motivations for sharing information between departments within an ETO company that builds custom luxury goods and, with that, reduce the uncertainties.

The methodology involves reviewing the existing literature on the S&OP process in an ETO environment for luxury products, combined with an analysis of the existing Information Systems applied in this process. The insights and requirements of the Information Transfer Framework within the ETO environment for custom-built yachts will collected through interviews conducted with the management layers of the yacht-building company. The collected data is systematically analysed to identify areas for improvement. Based on the findings and best practices from the literature review, an Information Transfer Framework will be developed. Finally, an Information Transfer Framework will be proposed and recommended within the company's S&OP process.

1.5. Research questions

The main question is: How should an information transfer framework improve the exchange of information within the Sales and Operations Planning process to reduce uncertainties in custom-built luxury yachts?

1. Q1. What are the different characteristics and levels of the Sales and Operations Planning process?
   This question analyses the problem of the S&OP process, looking into the standardised and non-standardised processes and how they can be used and implemented.
2. Q2. What are the Engineer-To-Order related uncertainties that are having an effect on the Sales and Operations Planning process, specifically for custom-built luxury products?
   Insight is gained in the challenges that emerge while implementing the S&OP process in an Engineer-To-Order environment. Custom-built luxury products add an extra complex dimension to these challenges. The challenges are the variables that influence the uncertainties.
3. Q3. Which requirements should an information transfer framework for custom-built luxury yachts in an Engineer-To-Order environment meet?
   This question analyses the custom yacht-building company requirements for luxury products within the Engineer-To-Order environment. The requirements for an Information Transfer Framework should aim to reduce uncertainties in the Sales and Operations Planning (S&OP) process by enhancing the variables of information transfer and communication within the organisation.
4. Q4. How can the Sales and Operations Planning process influence an Information Transfer Framework for Engineer-to-Order environments in luxury products?
   Finally, the Information Transfer System must be designed while considering the insights from literature and data collection.

1.6. Research framework

This research framework illustrates the connection of the various research elements, including the research questions. It begins with a literature study on the left, followed by case analysis and data collection. As the research questions are addressed, the answers collectively lead to the main findings

of the study. This research framework functions as a funnel, guiding the process from broad data collection to the specific insights and main takeaways of the research, as depicted in figure 1.1.

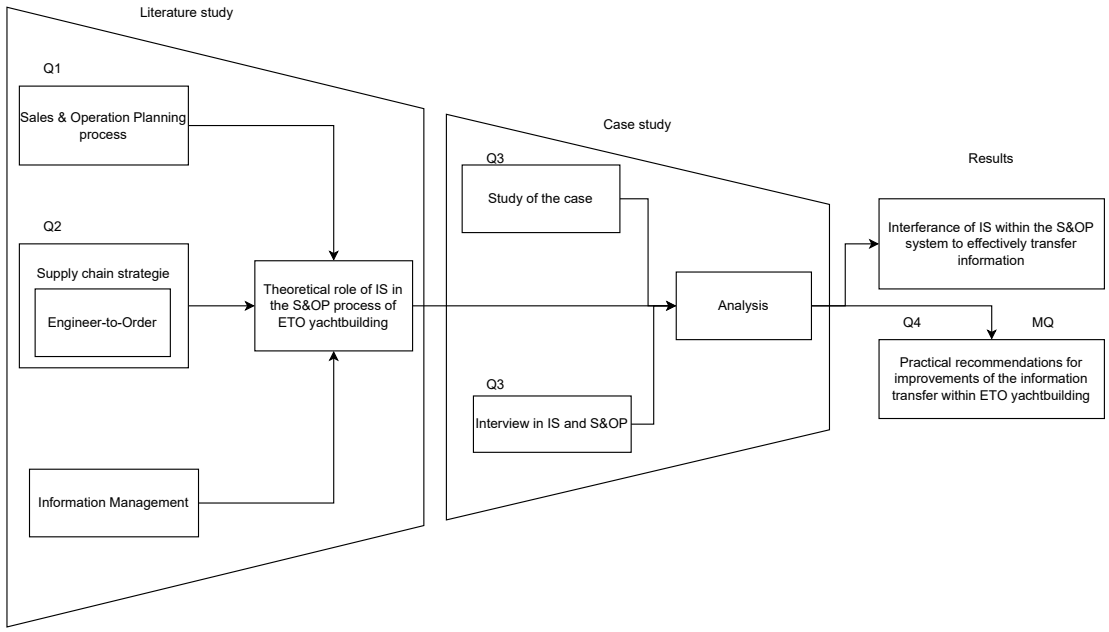

Figure 1.1: Research framework

1.7. Overview of the structure

The thesis begins with an introduction (chapter 1) outlining the study's relevance, key research questions, objectives, research framework, and overall structure. The study contains three parts. Part one defines and explains the context. The theoretical background (chapter 2) explains concepts relevant to an Information Transfer System, addressing Q1 on S&OP characteristics and Q2 on ETO-related problems. Part two is the method and data collection. The method section (chapter 3) details the case's uniqueness, research methods, variables, and data analysis techniques.

The case (chapter 4) provides the company's history and information-sharing processes, answering Q3 on framework requirements. The last part, part three, the results chapter (chapter 5), uses Atlas.ti, and addresses Q3 and Q4 on improving S&OP processes. The Information Transfer Framework (chapter 6) links theory, methodology, results, and practical recommendations, addressing the main question (MQ). The conclusion discusses the research's theoretical and practical relevance, limitations, follow-up studies, and application conditions.

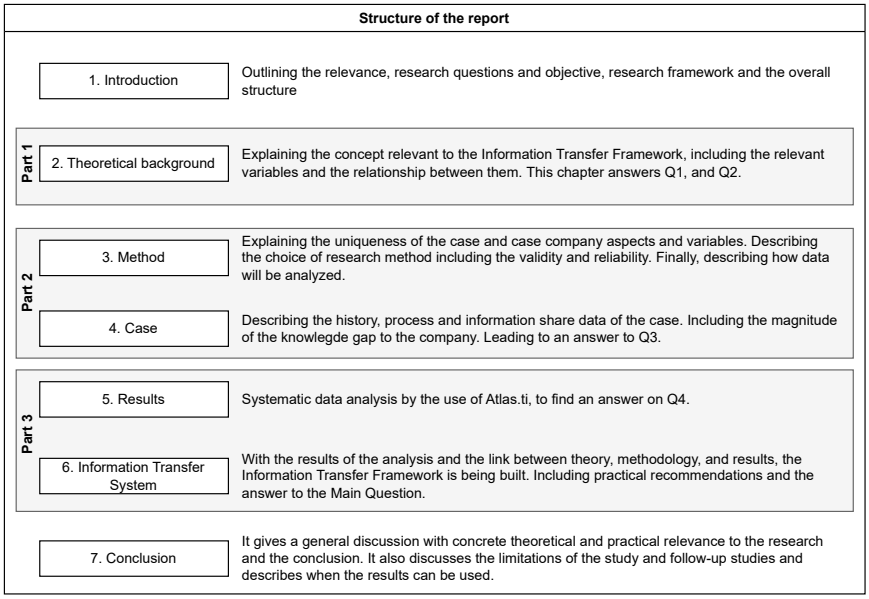

Figure 1.2: Structure of the report

2

Theoretical Background S&OP and IS

To start the research, there are three parts. The first part is to determine and understand the concepts and the link between the concepts by presenting them in a framework. The basis for this research is a literature review. The concepts are analysed in section 2.1. The literature review starts with Sales and Operations Planning (S&OP) in section 2.2. It defines the tactical and strategic planning process that aligns business objectives and includes the Maturity model to categorise the S&OP process. Supply chain strategies follow this in section 2.3 describing how orders are handled. This will narrow down into the Engineer-to-Order environment (section 2.4). Additionally, the explanation of yachts as custom-built luxury yachts. From the literature review, the independent, dependent and moderator variables are defined and linked in a theoretical framework.

This literature study answers research questions one and two, respectively. Finally, this leads to the Research Objective: Explore the Role of S&OP in the ETO environment to address real-world challenges.

- Q1. What are the different characteristics and levels of the S&OP process?
- Q2. What are the Engineer-To-Order related problems in the Sales and Operations Planning process, specifically for custom-built luxury products?

2.1. Study guidance

The literature search plan analyses relevant S&OP and IS concepts with Google and ChatGTP. This gives a basic understanding of the concepts and relevant keywords that are used in the databases. Databases used to gain academic knowledge in the field of Sales and Operations Planning processes are Google Scholar, Science Direct, Emerald Insight, and Elsevier. Important papers are collected and stored in Mendeley. The S&OP process started in the 1980s as a stable production plan; in 1993, the Five Step Process was introduced, which started to change the S&OP process into an 'integrated business management' process ((Coldrick, Ling, & Turner, 2003)). Therefore the timeline of the literature is set from 1993 onwards to narrow down the results and keep the knowledge relevant. Keywords used in the search are 'bridge between sales and operations', Sales and Operations Planning (S&OP) process, Five Step Process, S&OP stages or levels, S&OP performance measures, Engineer-to-order, ETO AND S&OP, luxury goods, yachts, information systems, information technology, and case study. Search operators (AND, OR, NEAR, and *) are employed to enhance the relevance of the search results and find more accurate and targeted information. Two search methods were used to increase the number of relevant sources. The first is the snowball method, where the sources of key publications are used to find additional information and useful papers. Literature syntheses, e.g. (Tuomikangas & Kaipia, 2014), are often referenced and can be used to find specific literature. Secondly, 'author-based-search' is used to find relevant authors with multiple papers in the field. The author, Thomé, is a specialist in the field of S&OP, and the author, Bhalla, connects the S&OP process to the Engineer-to-Order environment.

2.2. S&OP

In this S&OP chapter, first, the historical development of the Sales and Operations Planning process and its growth from a tactical to a strategic plan are elaborated. The plan is an integrated business plan between the Sales silo and Operations silo, and for integration, the silo characteristics should be taken into account. The standard S&OP process is described, and the coordination process leads to the needs of the S&OP process. Implementation of the S&OP process is shortly explained, and then moving on to the S&OP Maturity Model, including the performance measures.

2.2.1. Tactical S&OP

The traditional S&OP process was introduced around the 1980s as a tactical process to align the supply and demand functions of a company. The S&OP process arose with the need to align the supply and demand functions of a business and increase efficiency. Companies needed to change the organisation by improving the communication between the sales and operations silos. The sales and operations were organised as independent groups, organised by themselves, and reached their own goals. This led to a misalignment in the supply and demand and inefficient use of the assets. The early S&OP process changed this by balancing supply and demand. This was done by process steps focusing on the availability of resources, manufacturing capacity, and demand analysis. The planning horizon of the tactical S&OP process was medium-term, which is typically 12 to 18 months. The process of controlling it happens monthly, and updates are communicated between the sales and operations groups. The first case where S&OP was implemented was a business with a single manufacturing plant (Coldrick et al., 2003).

2.2.2. Strategic S&OP

After introducing the tactical S&OP planning process, the focus was shifted to a strategic S&OP process. The scope of the process got broader and included a longer-term horizon and more silos. The added silos are finance, marketing, procurement, and other key areas such as development. The main goal is still to balance the demand and supply, but in this strategic S&OP, the finances and operational planning are included in the integrated organisational planning (Ávila et al., 2019; Tuomikangas & Kaipia, 2014). The more strategic and thus integrated the process gets, by including all silos of the company and taking into account each silo's specific needs and goals, the better the collaboration. Better collaboration between the groups leads to better decision-making and improved overall performance (Coldrick et al., 2003). Models often used within the strategic S&OP process are the 'stage gate model' in which, for each gate in the process, specific goals are defined, and before moving on, there is a go/no go moment. Or the 'innovation funnel management', which is a method of streamlining the iterations of idea development from a broad to a summary of the most promising ideas (Katz, 2011). Another important step according to Coldrick et al. (2003) is the integrated reconciliation. Integrated reconciliation involves the earlier-mentioned reconciling of supply, demand, and financial plans to create an executable business plan. It also includes ensuring that all silos of the business work towards the same goal and that problems between silos are addressed proactively. Most important is the feedback loop to improve the process.

2.2.3. Capacity S&OP

Capacity planning ranges from short-term control and execution to long-term capacity planning. The capacity is controlled by the management, and the management has different tools to coordinate and plan the capacity. The S&OP process is used as a long-term planning tool. A complex element in capacity planning is that capacity comes in large, discrete steps instead of small increments. Therefore it is important to plan the capacity changes, whether you lead, lag or track the capacity. From a S&OP standpoint, the capacity of production in relation to sales is the main focus of capacity management (Olhager, Rudberg, & Wikner, 2001).

2.2.4. S&OP process description

The manufacturing planning and control (MPC) system's longest-term planning level is provided by the S&OP process. The planning horizon is typically one to five years, and the planning period can be a month or a quarter. The input for the S&OP tool is the sales plan based on a demand forecast and a production plan based on the supply capacity. Both affect the inventory or backlog plan. The S&OP

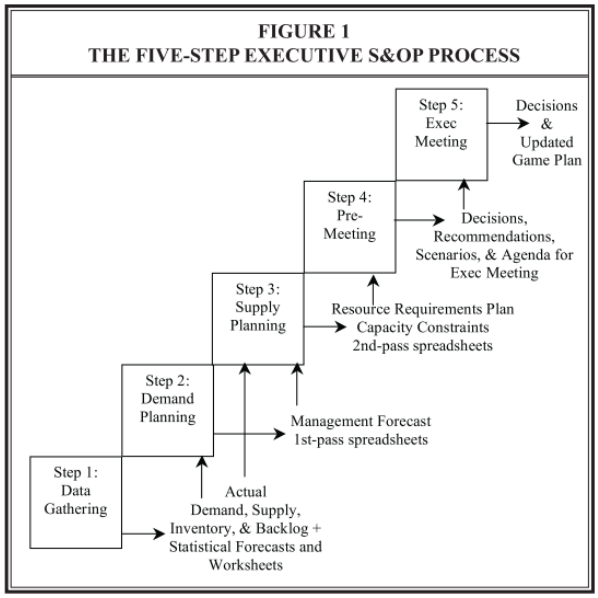

Figure 2.1: Five step executive S&OP process (Lapide, 2005, 1)

plan is constantly reviewed by feedback from the execution of the sales and production plan. The S&OP plan offers two options: first, modifying the demand to match the production constraint, and second, modifying the supply to match the sales plan. In early S&OP reports, the past and current performance and the future plans are described Olhager et al., 2001. Later a standard S&OP model is defined and often referred to (Grimson & Pyke, 2007, 3; Hulthén, Näslund, & Norrman, 2016, 9; Wagner, Ullrich, & Transchel, 2014, 2; Wallace & Stahl, 2008, 3) as the 'five-step process' or 'five-step executive S&OP process' figure 2.1. The five steps describes by Wallace and Stahl (2008, 3) are as follows:

1. **Data Gathering**
   The first step in making a forecast is to gather data and analyse the causes of significant forecast variance. This is analysed for a specific time horizon from one to three months.
2. **Demand planning**
   Forecast Analysts check the forecasts for biases. The detailed forecasts are also transformed into resource forecasts. [1] The Demand Planning is the most crucial step; if the work here is done correctly, the chances of doing the job well increase.
3. **Supply planning**
   Market analysis should be done to find the best moment to launch, and documenting assumptions is essential in the forecasting process. The finance department should check the finances.
4. **Pre-meeting**
   Validate and authorise the forecast by the operations team before it goes to the Supply Planning Process. This also helps to avoid surprises at the executive meeting. In this pre-meeting, a consensus on the demand is reached.
5. **Executive meeting**
   In this short meeting, the forecast will be presented to the board.

Another model on the S&OP process from Oliva and Watson (2011, 5) describes the process differently, using a flowchart with feedback loops (figure 2.2). This model is used into Make-to-Stock environments and is produced for a consumer electronics company that sells through resales. The first step is the cross-functional preparation and collection of planning-related information packages. This information leads to a business assumptions package (BAP). The BAP is the output of the information sharing and the starting point of the validation. The second step is validation by product planning and strategy, sales

[1] For new products, in the demand planning, the people from supply are already included in the demand step. They can provide historical knowledge in addition to new product forecasts. Therefore, including supply people can help blend the new product efficiently and prepare for sales. (Wallace & Stahl, 2008, 3)

directors, and demand management organisations. This step includes a feedback loop and iteration until there is a consensus forecast, which is evaluated each month. The final consensus forecast is sent to the finance department and is converted into a revenue equivalent. Revisions are made if there are still gaps in the financial performance. Finally, the approved forecast is released, and a Master Production Schedule (MPS) is created.

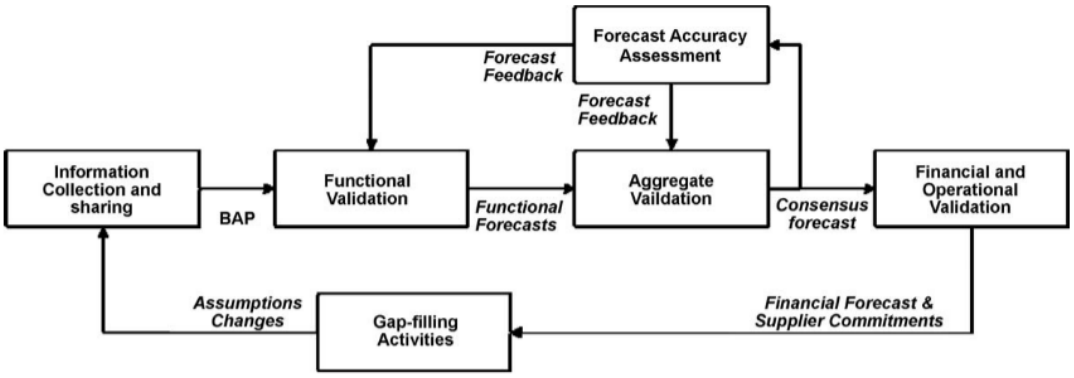

Figure 2.2: Sales and Operations Planning process (Oliva & Watson, 2011, 5)

All processes are integrated into one overarching process that maximises opportunity, minimises risk, and makes deliberate trade-offs based on profitability (Ávila et al., 2019). Thomé, Scavarda, Fernandez, and Scavarda (2012, 1) described the S&OP process in five main features to reach the goals of the process.

- A cross-functional and integrated tactical planning process within the firm.
- It integrates the business plan into a unified plan.
- It comprehends a planning horizon from less than three months to over 18 months.
- It bridges strategy and operations.
- It creates S&OP process value and is related to the firms' performance.

2.2.5. S&OP silo's

A silo is when a group or department focuses on their own goals instead of common goals. The S&OP process deals with a lot of silos like Sales, Operations, Finance, Marketing, and others. These groups are functional silos, specialised in different company operations and, therefore, different parts of the planning. This naturally leads them to their own goal and also their own perspectives of time and planning (Oliva & Watson, 2011, 5). Integrators in coordinating positions can act as mediators to integrate the goals of each silo into one integrated plan. According to Pedroso, da Silva, and Tate (2016) the barrier with the most influence on the integration of the S&OP process is the silo culture. Silo culture is the mindset regarding the planning, coordination, and socialisation between silos in a company (Tuomikangas & Kaipia, 2014). The organisational theory deals with the macro-level analysis of intergroup relationships, organisational strategies, and structure. To analyse and gain a deeper understanding of the S&OP process in a company, it is important to take the silos and silo culture into account (Abugharbia & Glavas, 2021). Looking into the horizontal organisation of a company gives insight into departments working together, Abugharbia and Glavas (2021) described for types of cultural values: Clan (Collaboration), Adhocracy (Create), Market(Compete), and Hierarchy(Control), which are used to explain the culture of an organisation. The types are placed in a 2x2 matrix in figure 2.3. A well-coordinated silo culture can enhance reaching a better S&OP process by providing a clear job description and delegating these roles. Also, by incorporating common business goals into silo goals and metrics to strive for (Abugharbia & Glavas, 2021).

2.2.6. S&OP process coordination and needs

As the silos, the S&OP process also needs to be coordinated.Tuomikangas and Kaipia (2014) provided multiple coordination mechanisms for the S&OP process, which help to ensure effective

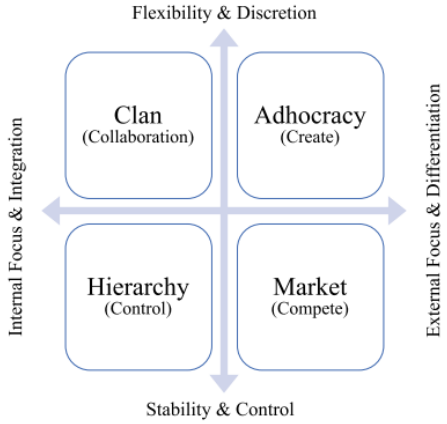

Figure 2.3: Competing Values Framework (CVF) (Abugharbia & Glavas, 2021)

communication, collaboration, and alignment between different silos. Examples of coordination mechanisms are S&OP organization, process, tools and data, performance management, strategic alignment, and culture and leadership (Tuomikangas & Kaipia, 2014). According to Coldrick et al. (2003), effective coordination is crucial for achieving goals and business objectives and improving the overall organisational performance. Poor coordination of activities in the S&OP process leads to poor decisions, even leading to a mismatch in demand and supply (Grimson & Pyke, 2007, 3). Therefore the S&OP needs regular cross-functional meetings to review performance and updates on the business objectives (Tuomikangas & Kaipia, 2014). There is always some uncertainty in a forecast, but with monthly measures between groups, uncertainty can be reduced (Coldrick et al., 2003).

2.2.7. S&OP Maturity model

Lapide (2005, 1) explained the S&OP maturity model. This model is used to describe the advancement of the S&OP process of the company. The maturity model has four stages, starting from a disjointed plan and moving to the ideal process. Measures for the mature model are the meetings held, the alignment of plans, and the technologies that are used. The more integrated and aligned the S&OP process is, the higher the stage of the maturity model and the more integrated the process. Analysing the stage of the S&OP process helps in deciding on a strategy for the company. Over the years, multiple S&OP maturity models have been introduced. For example, Grimson and Pyke (2007, 3) has a Maturity Model of Five stages, Lapide (2005, 1) has a Maturity Model of Four stages, Wagner et al. (2014, 2) has a model from level 0 to level 5 and finally Thomé et al. (2012, 1) compares all existing models up to 2012. The most commonly used model is the one from (Lapide, 2005, 1) with the following stages. The S&OP model can be analysed with three categories: Meetings, Processes and Technology figure 2.4.

1. **Marginal** – Informal meetings, disconnected schedules, multiple repositories
2. **Rudimentary** – Formal meetings, fully integrated planning process, incomplete participation
3. **Classical** – Formal meetings, fully integrated planning process, full participation
4. **Ideal** – Event-driven meetings, fully integrated planning process, supervising process improvements

According to Abugharbia and Glavas (2021), until today, there is a wide understanding of the Maturity Model, but the implementation is challenging. The 'one-size-fits-all' design doesn't fit all contexts; having a custom-built luxury product is one of the most complex situations in which to implement this maturity model. Therefore, this should be studied in more detail.

2.2.8. S&OP Performance Measures

The performance measure's set rules and regulations. Before performance can be measured, there should be an established baseline with a clear process. This process should be the baseline for performance measures. The company's objectives must be used to determine the performance criteria. Furthermore, it is imperative that performance criteria enable the comparison of entities operating in the

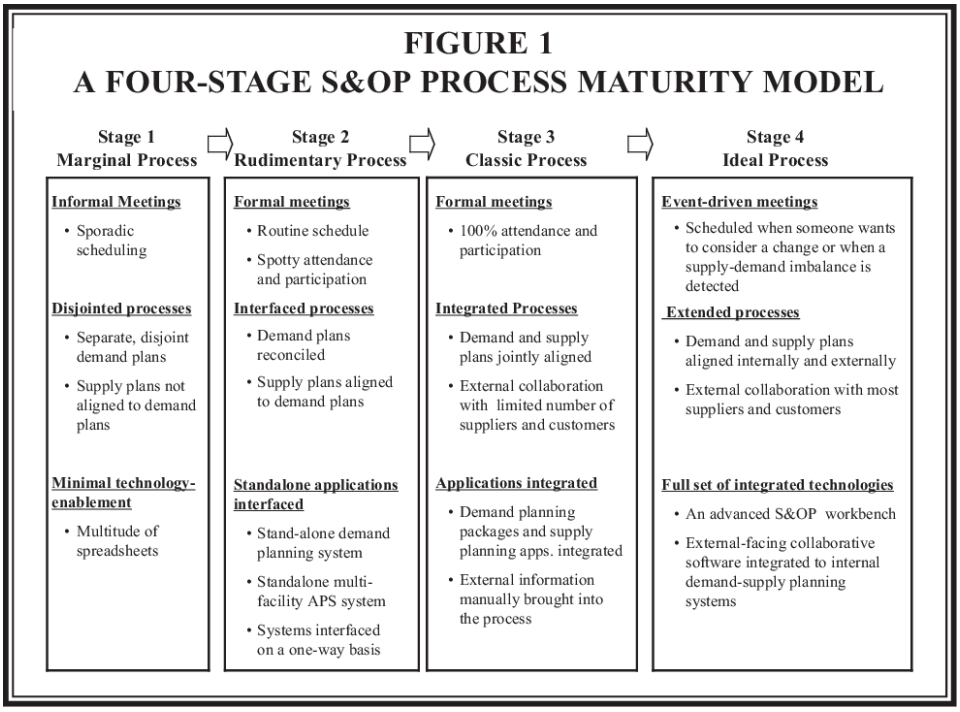

Figure 2.4: Four stage Maturity model (Wallace & Stahl, 2008, 3)

same industry, and that the objectives behind each criterion be distinctly stated (Neely et al., 2000, 10). The performance of the S&OP process can be measured. A performance measurement framework is defined by Hulthén, Naslund, and Norrman (2017, 1), Hulthén et al. (2016, 9). The measures are based on efficiency and effectiveness and give concrete steps to improve the S&OP process. Efficiency measures are based on three clusters; the process, the organisation, and the people within the organisation. This will lead to increased customer satisfaction. Effectiveness measures are based on established routines, participation in meetings, and information sharing. This will lead to cost reduction. Challenges in effectiveness measures are to define the cross-functional trade-off measures, which mainly occur in the lower stages of S&OP process maturity (Hulthén et al., 2017, 1).

2.2.9. S&OP optimization

The early process steps are well understood, but optimisations remain a mystery to many people. The main challenge is connecting the different silos; Sales, Operations, Production, Finance, and Marketing. Each group has different needs, if the silos communicate and try to align they find out they all want something else. So to finding an integrated process is a balance between the silos. The final process influences the performance measures. Performance can be measured based on forecast and planning. Problems that arise during the integration process are bringing together the functional views, different inputs at different moments in time, having another path to the same goal, and involving stakeholders while keeping a transparent process. The S&OP process is driven bottom-up, this implies first designing the process, thereafter optimising the process.

2.2.10. Summary S&OP

To summarise, the S&OP process is a useful tool for integrated business planning. This helps a company reach its goals and objectives. A drawback of the standardised tool is that it's not applicable one-to-one in all different business practices. Therefore, for each company, the Maturity Model stage of the S&OP process should be defined. The performance measures and needs follow from the stage of the maturity model. Correctly coordinating the silos is very important to improve the business practices.

2.3. Supply chain strategies

There are three production planning strategies, which are lead, level, lag, and chase for the supply capacity (Staeblein, 2023). A lead strategy is to increase production capacity in anticipation of future demand increases. The level is the constant production rate established over the planning horizon, and the 'level' is described as effectively decoupling supply from demand. The aim is to reach effective and uniform utilisation of resources and minimise costs related to changes in production. Matching the production rate to the demand is 'chase', and in 'lag', the production rate changes after a few periods with demand changes. The difference between sales plans and production plans leads to an inventory plan. When discussing planning strategies, the market environment is important. Underneath are the four market environments. Each environment needs a different approach when the supply is modified (Olhager et al., 2001). Supply chain strategies are to compete successfully, and operations must be strategically aligned with the market requirements of any type of firm. According to Olhager (2003, 3), there are even four different types of supply chain structures. These are Make-to-Stock (MTS), Assemble-to-Order (ATO), Make-to-Order (MTO) and Engineer-to-Order (ETO). The most important difference is the decoupling point. These and further details about the different strategies are explained in the following paragraphs.

2.3.1. Decoupling point

The decoupling point is the point where the supply chain is matched to the marketplace (Gosling & Naim, 2009). The point in the material flow where the product is connected to a particular customer is known as the Customer Order Decoupling Point, or CODP for short. The supply chain segment that uses forecast planning and the segment that reacts directly to the customer is divided by the decoupling point. The decoupling point can serve as both a tactical hedge against demand volatility and a useful method for scheduling standardised parts in response to erratic orders (Olhager, 2012). From a company's point of view, the CODP can be positioned inside their manufacturing operations, or it can be positioned at the suppliers (upstream in the value chain). It can also be at the interface of the supplier (raw material inventory), at the border towards the customer (at some finished good inventory) or even further downstream in the supply chain. Connecting the CODP to the value chain, a standardized process has the CODP further downstream, whereas in a customized process, the decoupling point is further upstream in the value chain.

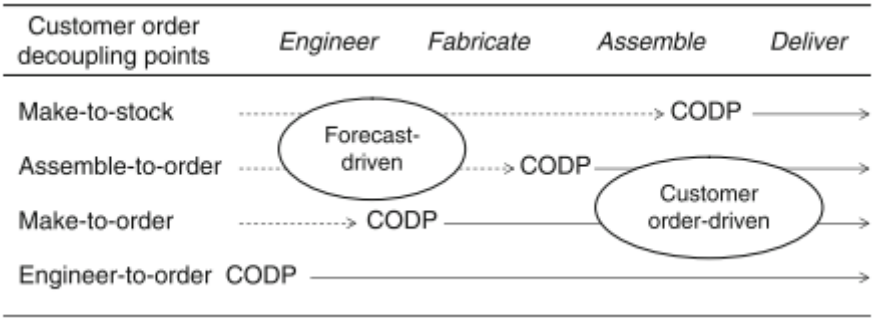

Figure 2.5: Different customer order decoupling points (Gosling & Naim, 2009)

Gosling and Naim (2009) specified scenarios defined using the decoupling point concept 2.5. 'This can be defined as a buffer between fluctuating customer orders and smooth production output' (Gosling & Naim, 2009). It provides a useful classification system for supply chains and helps to distinguish between stock-driven and order-driven systems.' (Gosling & Naim, 2009). Using this concept, a range of structures can be defined, ranging from repetitive MTS to customised ETO industries.

2.3.2. Make-to-stock (MTS)

Make-to-stock is a production strategy where goods are manufactured based on forecasted demand and kept in inventory until sold. This approach aims to ensure product availability for immediate delivery, minimising customer wait times. MTS is effective for standardised products with predictable demand and is commonly used in industries like consumer goods and retail. This environment asks for a

steady production output throughout the planning horizon. The lag production strategy requires some anticipation of inventory build-up during less busy periods. But also the level production rate is quite good in this environment. High-volume standard commodity items are manufactured in continuous processes. In this environment, the key factor to success is price. Focus on price and resource utilisation leads to a lag strategy (capacity demand surplus) and a level production rate to enhance cost-efficiency (Olhager et al., 2001). In the MTS environment, the planning is fully dependent on market demand. There is no customer participation within the supply chain, and the business can quickly respond to the demand. Customisation and, therefore, the production costs are low (Qin & Geng, 2012, 3).

2.3.3. Assemble-to-order (ATO)

Assemble-to-order is a production strategy where products are assembled only after an order is received, using pre-manufactured components. This approach balances customisation and efficiency, allowing companies to quickly fulfil specific customer needs while minimising inventory costs and production lead times. ATO is common in industries like electronics and automotive manufacturing. A level production strategy suits for components and sub-assemblies, for the final assembly a chase production strategy fits because its is triggered by customers. This hybrid approach allows for quick response to customer needs while maintaining efficiency and control over inventory levels. The customer order decoupling point is located at the sub-assemblies within the assembly process. Businesses produce large-scale standardised products, and the customers have little impact on the supply chain. This environment makes the rate of specialisation a bit higher and the lead time shorter by working in components. For businesses, the stock can be regulated, and they can meet the demand quickly (Qin & Geng, 2012, 3).

2.3.4. Make-to-order (MTO)

Make-to-order is a production strategy where goods are manufactured only after a customer order is received. This approach allows for high customisation and reduces inventory costs but often results in longer lead times. MTO is suitable for specialised or bespoke products commonly used in industries like aerospace, custom furniture, and industrial equipment. The decoupling point is positioned in the manufacturing. The production needs are organised after the customer orders them. A chase production strategy is used to adapt the production to the customer's requests. The output is directly aligned with the demand. The chase strategy results in longer lead times, but on the other hand, there is no need to hold stock. The customer order decoupling point is positioned in the manufacturing activity. In this environment, there are fewer economies of scale, the production time is longer, and there is no stock (Qin & Geng, 2012, 3). For this environment, the fluctuations are managed by changes in the order backlog (increasing/decreasing the backlog). The backlog can be seen as a negative inventory (product is sold, inventory drops, production/backlog needs to start). Fluctuations can be managed by in- and outsourcing, subcontracting without changing the internal production rate (Aveskamp, 2023).

With very short lead times, MTS = MTO, and without any backlog inventory, it's the ideal case. Even in MTO situations, new capacity investments can be delayed if production can be levelled rather than chasing demand (Olhager et al., 2001).

2.3.5. Engineer-to-order (ETO)

Engineer-to-order (ETO) is a production strategy where products are designed and engineered only after receiving a customer order. This approach involves significant customisation, often requiring unique specifications and engineering work. ETO is typically used for complex, large-scale projects like industrial machinery, custom-built equipment, and construction projects, accommodating highly specific customer requirements but with longer lead times and higher costs. In this research, it is for a custom-built luxury yacht. In the ETO environment the chase production strategy is used, products need to be designed and fully customised. Maintaining stock is impractical, and production aligns closely with customer demand. The lead times are high. The customer order decoupling point is positioned after the design activity. A typical order winner in the ETO category is flexibility. A lead strategy (capacity supply surplus) is preferable to allow for volume flexibility. Also, due to the inherent nature of ETO not manufacturing to a forecast, a chase strategy is preferable (Olhager et al., 2001). 'ETO is characterised by a strong influence of customer specification and continuous changes during the project from design

to delivery time' (Nujen, Alfnes, Mwesiumo, Gran, & Tomasgard, 2022).

2.4. Engineer-to-Order for yachts

In this section, Engineer-to-Order is further explained. It starts with the uniqueness of yachts in an Engineer-to-Order environment and the building strategy of a yacht. It is followed by the definition of and types of ETO. The bridge between ETO and S&OP is shown additionally with Lean and Agile for ETO. Productivity and performance measures are explained, and the sources of uncertainty are given. Finally, ETO improvements are introduced.

2.4.1. Unique luxury yacht ETO

Custom-built luxury yachts are a unique type of Engineer-to-Order (ETO) product due to their high level of customization and complexity. Each yacht is tailored to the owner's specific preferences, involving advanced engineering and integration complex, never built before systems. The process requires close collaboration with clients and continuous iterations for each detail of the project. Therefore, there are multiple customer decoupling points during the process. The decoupling points in a yacht are per zone or area, per system or per contractor. Building these yachts involves long lead times and cutting-edge technology, reflecting the owner's lifestyle. The project management challenges are substantial, requiring coordination of specialized trades and rigorous quality control, making these yachts a distinctive example of ETO products. While keeping this in mind, the ETO characteristics are described.

Specific challenges for this research include managing the nearly limitless design options and iterations, maintaining the yacht's unique high quality, and ensuring the Sales and Operations team can adapt to fluctuating decoupling points. For yacht building, the design team should always be one step ahead of the client, accounting for the problems that may arise when implementing newly designed elements. Additionally, understanding how to streamline the design process and improve coordination between teams to handle the high level of customization and complexity in ETO projects will be crucial. The most important teams on the sales side are the sales and project development teams, and on the operational side are the Engineer, Procurement and Construction (EPC) teams.

To give an example of a problem where prediction is necessary: an air-conditioning unit for the outside dinner table should be close enough to the table to have an effect, but it creates a cold airflow. This cold airflow can be annoying for the guests dining at the table, and this problem should be solved before the design is implemented. The question the designers have to ask themselves is: How can we create cold air at the dining table without feeling like sitting underneath an air-conditioner? Answers will be found in the early design phase within the Engineer-to-Order environment.

The Customer Order Decoupling Point (CODP) of an ETO company is at the end of the engineering phase, where the product is connected to the customer. For yachts, the decoupling point is a special point that occurs multiple times during the project. The cause is grounded in the scope of the project. The building schedule has a planning horizon of three years and a specific order on how it is built. Starting from the bottom and tanks (the underwater part of the yacht) and building higher and wider until the yacht has its full length and height (the mast of the yacht), see figure 2.6. Therefore, the bottom parts have to be designed, 'decoupled', and built before the detailed design of the mast is started.

2.4.2. ETO definition

Within the literature, there is no universally accepted definition of Engineer-to-Order (ETO) (Willner, Powell, Gerschberger, & Schönsleben, 2016). Grimson and Pyke (2007, 3) highlight several key variations in ETO definitions, noting its association with complex project environments in industries like custom-built yachts. Engineer-to-Order (ETO) refers to a production strategy where each customer order initiates a unique design and engineering process, often linked to complex, large-scale projects. It is associated with industries like custom-built yachts. It features a Customer Order Decoupling Point (CODP) at the end of the design phase, marking the shift from forecast-driven to customer-driven production. Variations in terminology across literature include terms like project, craft, one-of-a-kind, design-to-order, and engineer-to-order, which all describe similar customized, project-specific supply chain operations (Gosling & Naim, 2009). Some view it as modifying existing designs, and others as creating entirely new designs, requiring high flexibility in project management to handle diverse

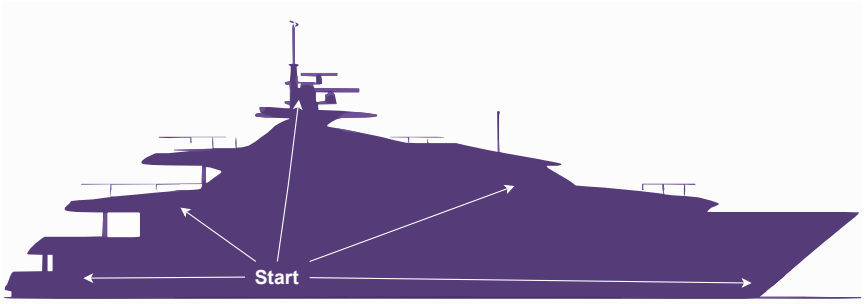

Figure 2.6: Building strategy of a yacht

requirements and maintain quality.

ETO environments have characteristics such as low volume, high customization, product complexity, and process variation. Customisation is seen as a form of competitive advantage (Olhager, 2003, 3; Thomassen, Alfnes, & Gran, 2015). The design, delivery speed, and flexibility are typical order winners. ETO environments demand extensive customization for each order, leading to variability in definitions. This approach necessitates a high level of adaptability in managing projects to address diverse requirements while ensuring high-quality outcomes.

2.4.3. ETO types

There are four types of ETO environments: complex, basic, repeatable, and non-competitive. The differences are in standardisation and automation strategies. A matrix defined by Willner et al. (2016),figure 2.7 can support practitioners to make strategic choices regarding their ETO process. The *complex ETO* is the most traditional one where 'one-of-a-kind' products are ordered in low volumes with complex engineering (ships and oil platforms. The *basic ETO* are low-volume products with low complex engineering (construction plants). The *Repeatable ETO* are products with high volume and low complex engineering (busses or high rise elevators), and finally *Non-competitive ETO* with high volumes and high complex engineering; this is the least common type of ETO. Non-competitive ETO can happen when a company tries to gain a big market share and produce high volumes. Other previous research categorised ETO as innovate-to-order (ITO) and redesign-to-order (RTO) (Alfnes, Gosling, Naim, & Dreyer, 2023). ETO systems are designed to individually meet the needs of a particular client or customer's unique product that is under project management and control.

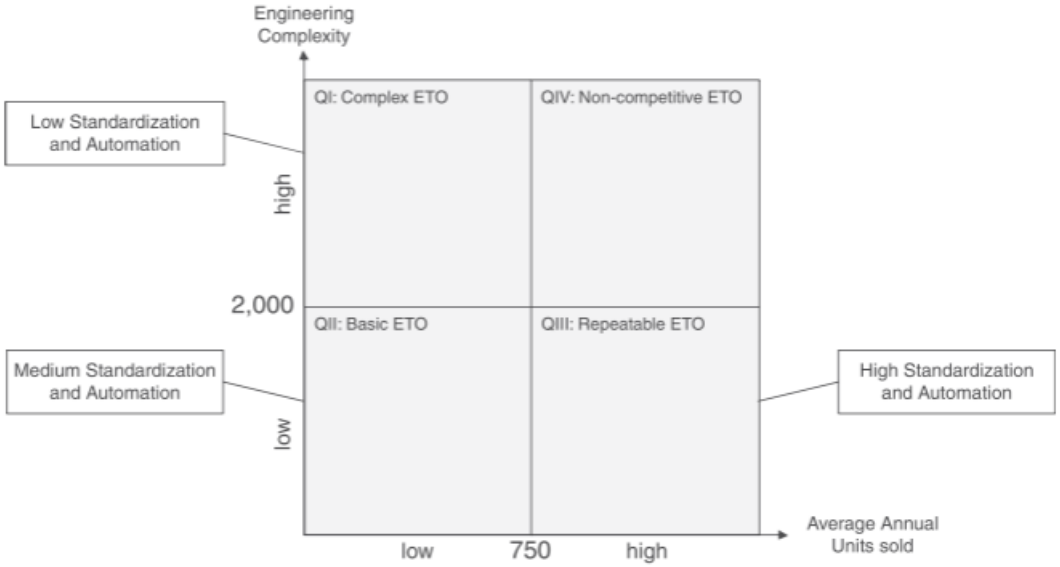

Figure 2.7: Types of ETO environments (Willner, Powell, Gerschberger, & Schönsleben, 2016)

2.4.4. ETO and S&OP

S&OP is a process that predicts production and resource availability. In an Engineer-to-Order environment, balancing demand and supply is challenging. Additionally, highly customized and step-wise decoupling points of the ETO for yachts make this process extremely challenging. Variables in the S&OP process, like communication and data management, cause uncertainties on the demand side. Therefore, the ETO environment's characteristics influence the design of the S&OP process.

The main research areas of S&OP and ETO are customer enquiry management (the systematic process of handling, tracking, and responding to inquiries made by customers), multi-project management, and spare parts management (Bhalla, Alfnes, Hvolby, & Oluyisola, 2021). Shorter lead times are generally regarded as a competitive advantage in the ETO sector (Olhager, 2003, 3; Willner et al., 2016). Engineer-to-order products must be fully developed and adapted to customer specifications within order fulfilment (Gosling & Naim, 2009). This takes engineering time and manufacturing time, which leads to a substantial delivery and lead time.

High levels of uncertainty occur in demand, for example, contracts that allow customers to change the design during the process. As well as from internal processes, such as new technologies or challenging designs. Uncertainties also arise from supply-side sources, for example, last-minute engineering changes due to problems with delivery and their own control systems like overlapping project activities (Alfnes et al., 2023). Often the supply chains are temporary or highly adaptable.

2.4.5. LEAN thinking and Agile manufacturing ETO

Lean and Agile are both managerial methods to improve efficiency and flexibility.

- Lean thinking. This is about reducing waste, and there are 'five principles to lean: value, the value stream, flow, pull, and perfection' (Gosling & Naim, 2009).
- Agile manufacturing Flexible manufacturing focuses on the ability to produce goods and services to compete effectively in the face of continuous change (Gosling & Naim, 2009).

It is often recognised that Engineer-to-Order organisations that produce many non-standard goods and non-repetitive processes find it extremely challenging to use lean principles (Thomassen et al., 2015). Supply chain structures can help implement a lean, agile or leagile strategy. Research suggests agility is more suited to the ETO supply chain (Gosling & Naim, 2009). Value stream mapping (VSM) is a simple and effective way to achieve lean flow. Thomassen et al. (2015) produces a method for 'discontinuous flow line manufacturing environments and is most suited for linear product routing and

standard products'. Therefore, this model is less useful in shipbuilding for 'one-of-a-kind' yachts. But the agile methodology is an important take-away in making the information transfer more effective.

2.4.6. Productivity, ETO production and performance measures

Productivity is dependent on the production process and production management. An important tool is production planning. It should merely focus on procurement, quality control, engineering and production, production facilities, and plant involvement (Nujen et al., 2022). 'The business objectives can be reached more effectively by reducing design iterations and rework, recognising customers' requirements up-front, and building quality into design and manufacturing' stated by Gosling and Naim (2009). Performance includes the degree of customisation, project delivery schedule, and budget adherence. ETO systems have, due to their nature, a high degree of uncertainty and risk.

2.4.7. ETO sources of uncertainties

Gosling, Naim, and Towill (2013, 1) defined a list of uncertainties in the ETO construction environment by literature analysis of five projects. Four groups of uncertainties are identified, which are itemized below. The ETO construction environment has the same uncertainties as the luxury goods environment. Due to the extreme customization, there can be additional or more extreme risks in the uncertainty of timely information from the client and late changes in specifications.

- Control
  This group contains uncertainties in reaching milestones, decision making, timely and correct information, competence in the project, sharing, and timely and correct information from clients.
- Process
  Availability of equipment, quality problems, site management, and safety hazards are elements of uncertainty found in the process group.
- Supply
  Uncertainties in supply rely on the performance of suppliers, capacity of subcontractors, delivery timing, liquidity of subcontractors and timely and correct information from suppliers.
- Demand
  Uncertainties find demand are caused by late changes in specification, drawing approvals, new technology or technique, the design being to rigid, and non-payment of the client.

According to Gosling, Towill, Naim, and Dainty (2015, 3) all ETO construction reports have the same persistent weakness around structural fragmentation and an apparent inability to innovate. Interaction is maximised around productivity concerns at the price of creativity and possibilities for training. Given the lack of "regularity" in the project context, several authors question how much supply chain integration through partnering can be achieved in such supply chains. 'Numerous issues raised in the paper are typical "structural" issues that ETO construction supply chains deal with' (Gosling et al., 2015, 3).

2.4.8. ETO improvements

Gosling and Naim (2009) described for performance improvement techniques, 'A possible strategy to manage the diverse product variety in the ETO sector is to forward shift through supply chain structures via modularity'. Modular configurations and standard items can reduce costs and lead times, but then you move from an ETO environment to an ATO structure. Another improvement is supply chain management for ETO systems. For example: (Gosling & Naim, 2009) 'Improving the interface between site activities and the supply chain, improving the supply chain, transferring activities from the site to the supply chain, and integrating of site and the supply chain'. Also, just-in-time and supplier development can help reduce suppliers (less fragmentation) and create deeper and longer-lasting relationships, and suppliers can be controlled as part of in-house manufacturing. The summary of supply chain strategies for ETO mentioned by Gosling and Naim (2009) is:

- Change the structure of the supply chain to fit the market, standardise it, and simplify it.
- Supply chain integration
- Information management

- Business systems engineering/ business process re-engineering
- Flexibility

Business Systems Engineering, which focuses on designing and integrating complex business to improve productivity and efficiency. Business Process Re-engineering (BPR), involving fundamental re-thinking and re-designing business processes to achieve significant improvement in critical performance measures. Both have also been proposed as routes to improve the ETO sector. (Gosling & Naim, 2009). 'A tool that can be applied is the UDSO (understand, document, simplify and optimise) business systems engineering routine to a case study to demonstrate a successful application of the systems approach' (Gosling & Naim, 2009). Flexibility is as important as a strategy (Gosling & Naim, 2009). There are three types of flexibility which are process, product, and volume flexibility.

2.5. Information Management

First of all the difference between data and information has to be cleared. Data something you collect, to make information from data the data need to be analysed to find relevant data.
Gosling and Naim (2009) mentioned information management in an ETO environment. Manufacturers in a project supply chain can benefit from advanced demand information, even if it is imprecise and incomplete since it lowers demand uncertainty. 'Benefits can be gained form using an identity based system for tracing, tracking, and control of project deliveries' according to Gosling and Naim (2009). Furthermore, managing an ETO system with only a material resource planning (MRP) production control is ineffective. The high degree of uncertainty and customer-specific product specifications should be taken into consideration by using alternative production control systems. The supply chain professional Bharadwaj (2018) analysed in 2018 the future trends in demand management and S&OP practices. Data comes in structured and unstructured forms and will be rich in information. Firms shall often have unstructured data in complex Enterprise Resource planning (ERP). The push-pull approach is also described by Bharadwaj (2018), especially in an Engineer-to-Order industry, pushing and pulling information will increase. The application of current methods to organise this information transfer needs to gain traction on when and where to exchange data. A need arises to manage these flows of information within the S&OP process correctly.

Decisions are more and more data-driven, which influences the S&OP process, causing information sharing and transparency to become crucial. In an Engineer-to-order environment, where the decoupling point is placed after all engineering is done, and with constant changes in the design, constant and up-to-date information supply is crucial. Although the basis of the S&OP process with its five steps doesn't change, the detailed data combined with the ETO environment will increase the complexity (Bharadwaj, 2018). To cover this complexity, new skills should be added to the participants in the S&OP process. These new skills include data management and analysis, demand performance management, cross-functional leadership, and change management. The focus of new skills should be adapted to the context in which it is used.

An important part of information management is planning. Decentralised production planning can improve responsiveness, flexibility, and transparency, all of which can increase production planning's influence on project completion (Nujen et al., 2022). Due to its top-down, sequential interdependence and rigidity, centralised production planning is likely to stifle the impact on production planning. Production is viewed in this centralised manner as linear, predictable, and precisely implementable.

2.6. Research objective

To fill the gap of information management within the S&OP process in Engineer-to-order industries, a case study in this area done. This leads to the research objective: Explore the role of Information System within the S&OP process of an ETO company in the shipbuilding industry, to address real-world challenges.

2.7. Theoretical background summary

This paragraph summarises the theoretical background and answers the research questions. Answering the questions is the first step in analysing the research objective.

2.7.1. Q1. What are the different characteristics and levels of the Sales and Operations Planning process?

The S&OP is a strategic and tactical planning tool to make a forecast and how to coordinate this between the Sales and Operations silos. The S&OP process is described in five steps presented above in section 2.2.4. To judge the S&OP model, a maturity model exists, which has four levels, explained in section 2.2.7. The S&OP process is a standard process which can be adjusted to any type of industry and context.

The level of customisation and the lead time of a product are challenging to forecast in the S&OP process and, therefore, need a lot of customisation to the process. Another challenging factor in the S&OP process is the coordination between silos. Different silos are known to have different cultures and ways of communication. Managing the process from one maturity level to the next takes commitment from all participants and integrated business planning. Aligning the company objectives and coordinating the S&OP process takes effort and time from all stakeholders.

The effects of an efficient S&OP process are measured in the process, the organisation, and the people, and the result can be found in customer satisfaction. The effects of the effectiveness of the S&OP process are measured in routines, participation and information sharing, and the results lead to cost reduction.

2.7.2. Q2. What are the Engineer-To-Order related uncertainties that are having an effect on the Sales and Operations Planning process, specifically for custom-built luxury products?

There are several supply chain strategies, each with unique traits and, thus, distinct points of decoupling. The portion of the supply chain that uses forecast planning and the portion that responds directly to customers are divided by a decoupling point. In the Engineer-to-Order environment, the decoupling point is just after the engineering is done. The engineer-to-order environment in custom-built luxury goods asks for even more flexibility and multiple decoupling points due to the one-off products, process variety, and high customisation, quality, complexity, and building strategy of the yacht. Typical order winners, and therefore forms of competitive advantage, are the design, cost, delivery speed, flexibility and, of course, level of customisation. There are four types of ETO, the yacht industry operates in the complex ETO (low standardisation and automation).

Engineer-to-order uncertainties can be caused by four main groups. The first group is 'Control', with dependency on the client as a main uncertainty found in luxury goods. The second group is 'Process', with quality management as an important factor. The third and fourth are uncertainties in demand and supply. Balancing the demand and supply in the S&OP process within this ETO environment is extremely challenging. Uncertainties on the demand side cause are the high level of customisation, late changes in design change, and customer enquiry management are the sources of these uncertainties. On the supply side, the scope of the project and the last-minute changes also make the project dependent on the suppliers' resources. Another challenge is making the ETO company lean thinking and reducing waste because of the degree of non-standard products.

2.7.3. Theoretical framework

From the literature, a theoretical framework can be derived with an independent variable. This independent variable originates from the request for an information management system in the section Information Management. The variable consists of an Information Transfer Framework

(ITF), which will be adjusted to fit the request. By changing the ITF, changes can be observed in the dependent variables, which are the quality of data and communication. These changes result in a decrease in uncertainty. Lastly, moderator variables influence the relationship between the dependent and independent variables. This relationship is influenced by the S&OP process and ETO environment, influencing the flexibility and variations. The relations are also influenced by technical and organizational support. The framework is found in figure 2.8.

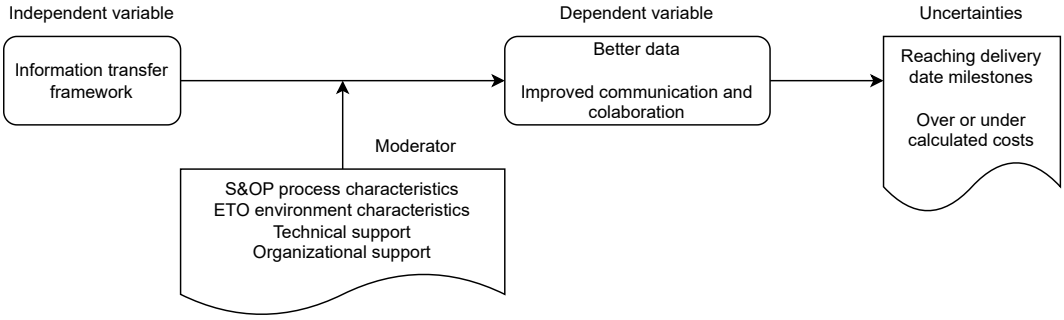

Figure 2.8: Theoretical framework derived from literature study

3

Methodology

This chapter explains the methods used for the design and conducting of the research. The research is a single-case study. First, the conditions for the case are explained, including the conditions for luxury Engineer-to-Order, and the conditions and variables for the studied case (3.1). The case is further explained in chapter 4. Followed by the choice for a single case study and the research questions the study aims to answer in section 3.2. Validity and reliability need to be accounted for (3.4). Theories are derived, therefor the role of theory is explained (3.5). Thereafter, the strategy supporting this case study is explained in section 3.6. This includes preparation, data collection and analysis. For the analysis, a special sub-chapter is added to explain the use of the software package Atlas.ti. Finally, the research ethics are explained.

3.1. Case conditions

For the case, there are some practical conditions regarding the complex, luxury ETO environment and the studied case.

3.1.1. Conditions of complex, luxury Engineer-to-Order

The studied case is a special case in the Engineer-to-Order environment. It operates in a complex ETO and a niche market, which indicates low automatization and low standardization. Luxury yachts are always one-off projects. All details, from the shape of the hull to the colour of the doorknob, must be defined. Therefore, automation and standardization are almost impossible. The characteristics of luxury yachts create a very specific market, which is bound by the price of the product. Only the richest can afford a yacht, and they need to have an affinity with water. The product to attract a customer is a one-off prototype, which, therefore, doesn't yet exist, but it must be possible to build the prototype. Not to forget the uniqueness, the product must have superior design and craftsmanship and the highest quality. Because of the scope of the project and the variety of the building strategy figure 2.6, there are multiple Customer Order Decoupling Points (CODP). For luxury yachts in an Engineer-to-Order environment, there is a constant balance between flexibility and structure. Due to the nature of the flexible design process, structuring processes can cause a hazard. On the other hand, some elements in the yacht are always there, such as an engine, which can be captured in the structure. The goal is to sell a luxury yacht as structured as possible. To keep a flexible basis, communication between silos should be quick and streamlined. The information being shared should have a known maturity; this helps analyse the value and tasks additional to the information.

3.1.2. Conditions of the studied case

The case company has a project organization, up to four projects at the same time. A project consists of the sales, design, and operational aspects of a custom-built luxury yacht. The company has a daily board with a CEO, CFO, and CTO, as well as horizontal clusters. The horizontal clusters are Commercial (Sales & Design), Finance & Control, ICT, HRM, Business Innovation, QHSSE (safety), Discipline Chairman, and Technical Chairman.

The commercial cluster organized the sales and design of a project; for one project, this is a team of five people. This phase of the project can take between a few months up to a year. The duration is dependent on the client. If the client wants to sign the contract instantly or wishes to develop the yacht in a longer period (8 to 12 months). The longer this phase takes, the more mature the information is. The Project Team (PT) coordinates the operational side of the project and is led by the Project Director (PD), who is supported by the 'core team'. Ideally, the core team consists of six people the Project Controller, Project Manager (PM), Project Manager Production (PMP), Project Planner (PP), Project Procurement Manager (PPM), and the Project Manager Engineering (PME). The complete project team consists of 30 people. The design, operational and building process of a project takes three to four years and happens simultaneously.

The variables mentioned in the theoretical framework (figure 2.8) can be found in the case as well. Therefore, the constraints of the case are listed below.

- Independent variable
  The Information Transfer Framework is designed for the case company, so variations in information must be handled quickly and stored in the correct location.
- Moderator variable
  The S&OP process indicates the case company must have established silos which are the commercial cluster and the project team. A complex ETO environment within the case company. The company is organized as an outsourcing or management company that coordinates the connections between all parties, and uses software to transfer information.
- Dependent variable
  Communicating between the silos and parties and sharing data with a data management system.
- Uncertainties
  The uncertainties are in the delay in delivery time or excessive costs caused by surprises in a project.

Moreover, documenting S&OP processes is essential for providing a baseline to analyze current information transfer practices and their effectiveness. These documented processes help identify where communication breakdowns occur and how these can be mitigated. It is also critical for the company to include the effect of co-makers and suppliers in the study. These external partners are vital because, without their capacity and cooperation, initiating and managing such large projects would not be feasible. Including suppliers and co-makers ensures that the study captures the full scope of information transfer and coordination required in the yacht-building process.

Finally, the organization demonstrated a commitment to improving its S&OP processes and being open to analysing the options of new frameworks and recommendations derived from the case study. This commitment should, in a later stadium, be transformed into implementing and testing the recommendations. This is needed to ensure that the findings lead to actionable improvements rather than remaining theoretical. By meeting these practical conditions, the case study can provide comprehensive and relevant insights into enhancing information transfer within the S&OP process, ultimately reducing uncertainties in the new-build yacht industry and contributing to more effective and efficient project management.

3.2. Single-case study justification

The research tries to explain the causal link between the existing knowledge in literature and a real-world problem at an existing company. The situation does not have a single output, and the environment is evolutionary changing. This study has indeed two sides, a theoretical side, a practical side, and a complex environment. Therefore, problems like this are commonly researched using a case study (Yin, 2003).

Existing knowledge gaps defined in chapter 1 show a gap in the integration of information systems within the S&OP process of ETO companies. This will be achieved by finding an ETO company with a challenge in sharing information between the sales and operations silos. To analyze the problem and achieve reasonable results, multiple workers from different departments in the same company should

be interviewed. To make the results clear, people in charge of the processes will be interviewed. Their knowledge is most likely to be accurate about the current and ideal activities.

The research objective explains why the research is executed: *To explore the role of an Information Transfer Framework in the Sales and Operations Planning (S&OP) process of an Engineer-to-Order (ETO) company, focusing specifically on a company that builds unique custom-built yachts.*

A case study allows for an in-depth analysis (Yin, 2003) which is needed to find the specific context of the yacht building industry, providing rich, detailed data on the complexities of the Sales and Operations Planning (S&OP) process in an ETO environment. This method facilitates an understanding of the interactions between different departments and stakeholders, revealing specific points where information transfer can be enhanced to mitigate uncertainties. The understanding and rich data gathered through a case study make it possible to generate practical, actionable insights directly applicable to real-world settings (Gerring, 2017).

Moreover, a case study's exploratory nature is well-suited to investigating the complex systems involved in yacht building (Sekaran & Bougie, 2016). By focusing on a real-world company, this approach can identify current practices and lessons that are relevant not only to the studied organization but also to other ETO companies in similar sectors. Detailed process mapping and stakeholder perspectives obtained through a case study highlight where communication lacks and how these can be addressed, leading to the development of customized solutions to the specific needs of the organization. These solutions can then be adapted and tested in other contexts, enhancing the robustness and applicability of the research findings.

In addition, a case study provides concrete examples and narratives that illustrate the real-world impact of improved information transfer frameworks on reducing uncertainties. These illustrative examples make the findings more relatable and easier to understand, facilitating the assessment of the benefits of the proposed framework. By offering insights and practical recommendations, a case study ensures that the research not only contributes to academic knowledge but also delivers tangible benefits to practitioners in the yacht building industry, ultimately leading to more effective and efficient S&OP processes (Yin, 2003).

Definitions are important to get a clear overview of the problem, according to Yin (2003). Therefore, the research question defines the unit of analysis as the 'Information transfer system'.

3.3. Research questions

A research design is a logical plan for executing the study and starts with the study's questions. The research questions give an overview of what is studied. This component has already been described in chapter 1. The first word of a question indicates what kind of question it is. The 'what' questions are explanatory and are likely to be answered by an analysis of the literature. The question starting with 'which' indicates a design-oriented question and aims to design an artefact for a framework. The last sub-question and main question start with 'how' indicating an evaluative question, doing an analysis and offering a new model (Ubacht, 2024). The combination of these intentional questions help to find supported recommendations by analysing literature and extracting data, four sub-questions are presented below. Each sub-question relates to a part of the research to answer the main question. The focus is on phenomena within the real-life context.

Main Question: How should an information transfer framework improve the exchange of information within the Sales and Operations Planning process to reduce uncertainties in custom-built luxury yachts?

Q1. What are the different characteristics and levels of the Sales and Operations Planning process?
The first sub-question brings to attention the main process of the case, which is the Sales and Operations planning process. The question aims to analyze the various aspects of the S&OP process, focusing on both standardized and non-standardized procedures and their implementation. Understanding these characteristics is crucial for identifying the existing problems within the S&OP process. The literature review will cover tactical, strategic, and capacity S&OP, along with detailed descriptions of the S&OP process, including silos, coordination needs, maturity models, performance measures, and optimization strategies. These topics will provide a comprehensive foundation for understanding how S&OP processes operate and where they might fail.

Q2. What are the Engineer-To-Order related uncertainties that are having an effect on the Sales and Operations Planning process, specifically for custom-built luxury products?
This question seeks to gain insights into the challenges specific to the ETO environment, focusing on the luxury ETO environment. The concept of decoupling points, supply chain strategies relevant to ETO, and several production models like make-to-stock (MTS), assemble-to-order (ATO), make-to-order (MTO), and engineer-to-order (ETO) will all be covered in the literature review. Detailed coverage of the features of ETO, how it works with S&OP, various types of ETO, Agile and LEAN manufacturing methods, production scheduling, and performance indicators will also be addressed. Additionally, the review will address sources of uncertainties in ETO and strategies to mitigate them, providing a clear picture of the complexities involved in managing ETO projects.

Q3. Which requirements should an information transfer framework for custom-built luxury yachts in an Engineer-To-Order environment meet?
To address this sub-question, a case study within a luxury good ETO company will be conducted to identify the specific requirements that the information transfer system must meet. This involves gathering data through interviews with the sales and operations departments, analyzing internal documents, and observing the current implementation and interactions within the S&OP process. The goal is to understand the practical needs and challenges faced by the company in its environment and in improving information transfer and coordination.

Q4. How can the Sales and Operations Planning process influence an Information Transfer Framework for Engineer-to-Order environments in luxury products?
The final sub-question focuses on the link between the first three sub-questions. The Information Transfer Framework is the independent variable influenced by the Sales and Operations planning projects. The influence is increased by the unique and luxurious Engineer-to-Order environment. This question will give insight into the relationship between these variables.

3.4. Validity and reliability

Important conditions for conducting a case study are its validity and reliability. For validity, there is construct validity, external validity, and reliability. These validities are known as design parameters.

3.4.1. Construct validity

Construct validity means having a correct operational measure for concepts. To maintain consistency, the method for the case study includes specific procedures for data collection and analysis. For the data collection, the interview uses an interview protocol. The participants, who are aware of the company processes, will review the current information transfer process. The case study problem has existed for a few years in the company; there are processes on how information should be transferred (the gate management procedure) and how it currently goes. This indicates that tacit knowledge of the process exists and that the participants are aware of the information transfer process, but there are still problems in the process. This indicates it is hard to translate the tacit knowledge into a clear procedure. Using the interview protocol and including the drawing helps to approach construct validity in the process. The translation from tacit to concrete written knowledge can create bias (Yin, 2003).

3.4.2. External validity

External validity is to establish a domain for generalization, therefore, to which extent the data can be used as a theory for other cases. To establish this validity, the study can be checked with multiple cases in similar ETO industries, for example, the construction industry. This approach allows the findings to be applicable to a wider range of ETO environments beyond the initial study context. Documenting the context and outcomes is part of external validity as well to help other researchers and practitioners assess the applicability of the findings to their specific situations (Sekaran & Bougie, 2016).

3.4.3. Reliability

Reliability refers to the consistency and repeatability of the research findings. For this study it will be ensured through the development and adherence to a detailed case study protocol. This protocol will outline the procedures and general rules to be followed during data collection and analysis, ensuring that the study can be replicated by other researchers under similar conditions. Additionally, a case

study database will be created to organize and document all data collected, including interview transcripts, internal documents, and observational notes. This database will provide a clear and organized repository of evidence, making it easier for other researchers to inspect and verify the data. By maintaining a meticulous chain of evidence and ensuring consistent application of the research procedures, the study will achieve high reliability, allowing the findings to be trusted and replicated in future research (Yin, 2003).

3.5. Role of theory and information

Theories are useful to get a grasp of the issues being studied. It is an instrument, model or framework that helps to understand phenomena and to make predictions to expand existing theories. Analysis of the domain and usage of the theory can help to support the findings of research. In this research, theory helps to understand the details of S&OP and ETO phenomena and the theory can be used to integrate Information Management in the new situation (Sekaran & Bougie, 2016).

The theory in this study is developed from rich, qualitative interview data and the case analysis combined with existing theory from literature. For a case study it is important to focus on the details of the theory instead of the generalized theory. Creating the theory involves looking at the data differently and shape the S&OP and ETO theories towards the research objective. The theory develops through an inductive process towards a theoretical framework which is shaped as the study matures. Finally, the theoretical framework can be transformed to an conceptual framework which evolves with each new insight (Sekaran & Bougie, 2016).

3.6. Research strategy

The problem exists at a company, and therefore, the business research is a case study. The problem is described as a challenge in the information transfer between the Sales and operations silos. The silos, current processes, culture, and the people are some factors that are involved. The process can be measured using the S&OP maturity model and the validity during the interviews. To reach this point, a series of thoughts is necessary and a sequence of activities is needed to the business problems can be minimalized, this involves investigation and examination. The research should be an organized, systematic, data-based, critical, and objective investigation of the problem. With the goal to find answers or solutions. Finally, the research gives managers the necessary information to make informed decisions.

The intention of the applied research is to find results to solve a specific problem currently being experienced in an organization. Basic research from literature contributes to what is currently known and generates more knowledge about a subject. Both forms of research are used for the case study. First, the basic research is applied to literature to gain knowledge on the S&OP, ETO, and information systems and create a link between this unit of analysis. Then, applied research is done in the case of a company to find solutions for an existing problem.

The final goal is to identify and effectively solve issues experienced in the unique environment of luxury goods. To determine good from bad, one must constantly be aware of the multiple influences and effects of factors on a situation, take calculated risks in decision-making knowing the probabilities, prevent possible variables from influencing a situation, relate to hired researchers more effectively, and combine experience with knowledge while making a decision.

In business research, rigour and scientific research are hard to reach because of the people, emotions, attitudes, and perceptions. Therefore, getting a representative sample of participants is difficult. Another option is pragmatism, where the focus is on the applied part of the research. This approach is based on the generalization of previous experience of observable and objective phenomena. Different viewpoints help the researcher to understand the situation, while the truth is changing over time. Theory is derived from practice and then returned to practice.

3.6.1. Part 1. Preparation

The preparation of the research begins with defining the broad problem and translating this to the research topic and important concepts. This research topic needs to be specific and well-defined with clear boundaries. The perspective on the research topic can give definitions, earlier findings, and strategies. It starts with preliminary information gathering, contextual background information, and literature. It is beneficial to collect secondary data from existing sources like literature and current processes simultaneously with the new, primary data, which are the interviews. The findings can help each other.

There are multiple sources to collect the data. These are the literature, the company, and the interviews. The literature gives the current theories on the matter, it is the body of the knowledge available. This knowledge helps to define the problem clearly. The company data gives the origin and history, the size and location, growth strategy, processes, resources, the relationships, and, of course, the structure of the company. This knowledge is helpful when talking with employees and relating factors within the research. The interviews give insight into the cultures, the actual process, the strengths and points of improvement, and the ideal improvement for a person in a specific role. The information gives relevant insight into the relationships between factors in the research.

The variables taken into account there are a few different variables expected in the research. Dependent variables (criterion variables) are the primary interest in this research. The goal is to describe and understand the dependent variable to explain or predict the variability. In this case, it is the uncertainty, customer satisfaction, cost reduction, and timely delivery. Improving these variables will increase the successful delivery of a yacht. The variable is quantifiable and measurable, other variables can have influence on these variables. Independent variables (Predictor variable) influence the dependent variable. So, this research uses the information transfer framework. These variables precede the dependent variables and have an effect on them. The effect should not be caused by something else, and there must be a logical explanation of why the dependent variable is affected by the independent variable. Moderating variables have a strong effect on the independent-dependent relationship. The ETO characteristics and S&OP process characteristics and organizational support are moderating variables which have a strong influence on the information sharing. The S&Op process characteristics have influence on the coordination between silo's. The ETO characteristics have influence on the customization, flexibility requirements and complexity and can therefore moderate the effectiveness of the information transfer framework. The organizational support has effect on the involvement of stakeholders in the information transfer system. Mediating variables intervenes over time in the process, for example an improvement program, because the scope of the research is not about change over time. Mediating variables are left out.

From the literature, a theoretical framework can be derived. This shows how the variables are related in a model and is supported by an explanation of the theories used. The theoretical framework starts with introducing definitions of concepts and variables in the model. The definitions are the process which is the S&OP process and is a contextualized S&OP process for Engineer-to-Order environments. The concept of Engineer-To-Order is seen in the moderating variables, where flexibility is an important variable that affects the routine in the process. With the variables, the theoretical framework can be built. This is shown in figure 2.8. The theoretical expectations can be tested against the real-world expectations of the company. From these expectations, recommendations can be derived.

This is the point where the basic research goes into applied research. The applied research for the case study, this involves collecting data round a specific case. The case is illuminated from both the observational angle and interviews are executed. Analysis gives the researcher an interpretation of the case in its real-life context. The goal is to find applied knowledge which includes the case description and the interviews. In the next section is described how information is collected and measured.

There are two important parts to preparing for the data collection. First, the skills required and then the training required. The skills the researchers should obtain are asking good questions and being a good listener. Be flexible and adaptive, but not at the cost of rigour. Also, the researcher needs to have a firm grasp of the issues being studied and be unbiased by preconceived notions (open to the contrary). The training parts are about why the study is being done, what evidence is sought, what variations can be anticipated, what constitutes supporting or contrary evidence can arise, and also more practical matters like planning.

3.6.2. Part 2. Collecting knowledge & insights

While collecting data, it is important to keep the information as free as possible from bias. Biases are caused by the participant or by the researcher. To reduce biases, it is important to have a proper interview protocol, make sure questions are understood correctly, look at facial expressions and listen well to the answer. On the other hand, it helps to make the participants feel comfortable and help them to gain trust in the research. The amount of participants is pre-defined and controlled by the amount of new information gathered. When no new information is gathered, enough interviews have been done. The knowledge sources are defined in table 3.1.

Table 3.1: Knowledge sources

Data source	Method	Details	Used in
Documentation	Content analysis	Process documentation, Corporate Presentation, Sales documents	Case analysis
Website	Content analysis	Company website, magazine articles, LinkedIn	Case analysis
Individuals	Interviews & Observations	Face-to-face interviews, knowledge sharing	Data collection

The first part of collecting knowledge is getting knowledge from the case. First, the case is connected to the ETO characteristics from the literature review. To find the information in the chapter, the characteristics applicable to the case are mentioned. The case company itself is analyzed according to historical data and horizontal goals available from the website, corporate presentation and the sales department. The case company is unique in it's kind which is carried in each employee throughout the company, talking to people helps to find the uniqueness. The sales department and onboarding presentation provided me with the company structure and the recent changes in this structure, the risk are collected this way as well. Finally, the design and build process is collected from the website, documented processes and the interviews.

The second part of the data collection on the S&OP process and information systems is collected by interviews with participants from the field. The interviewed group consists of five people from sales and five from operations, covering all elements of the Sales & Operations Planning process; the overview can be found in figure 3.1. Data from interviews is primary data collected from individuals. The interviews are executed according to a pre-written, semi-structured interview protocol. The interview protocol is added in appendix A.

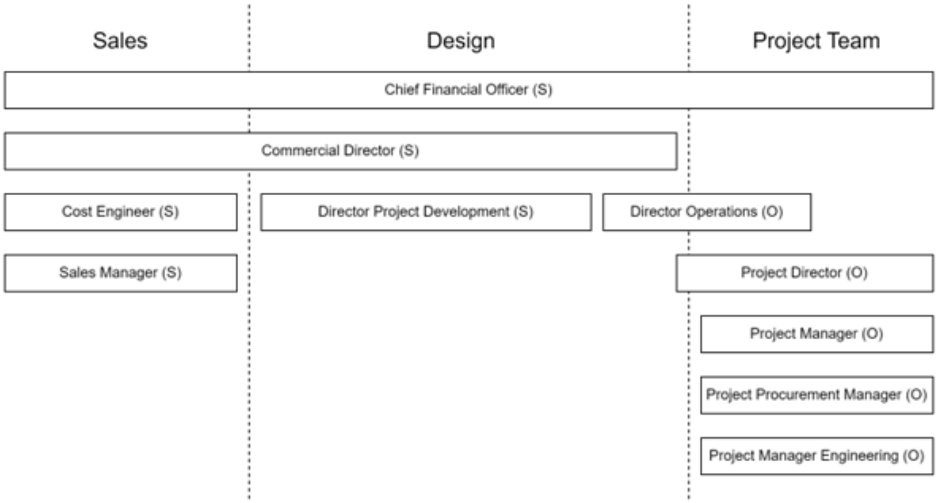

Figure 3.1: Interview participants

The interview protocol is based on 'Projective Methods', which is a method to let participant open up

on their work environment. All interviews are done with the same protocol. It starts with opening the interview and explaining the goal of the interview while offering the participants coffee and a typical Dutch 'stroopwafel' cookie to make them comfortable. Informing the participants and making them aware of the consequences is part of the informed consent. In this part, data storage and anonymization are mentioned. The questions exist in four parts: semi-structured, structured, and interactive.

1. **Associations including the case company**
   In this part, the 'projective methods' are used to stimulate participants to give their personal opinions with less influence from external factors. This helps participants to open up and give their actual opinion and their own interpretations. The method uses questions that ask about the participant's thoughts on information systems. The first thing that comes to mind is the most often used or the most important one. Also, giving something, in this case, the company, a personality and asking about character traits (Kubacki & Siemieniako, 2017). Because the managers of the company are participants, it is important to uncouple them from their social barriers and standard thoughts, which they normally carry out towards their project team or silo. The personality traits also show how the participants experience the culture. If answers to questions are unclear, after all four questions, additional explanatory questions are added.
2. **Questions in Information systems and S&OP**
   This part of the interview is semi-structured, questions will be asked according to the interview protocol in appendix A and additional questions will be asked if necessary.
   (a) To get the background of each participant, the first question is about their job. In a later stage of the interview, and during the analysis, this can give helpful insight.
   (b) The next question has the goal of getting all participants on the same page and talking about the same process, but it also shows how different departments use the process.
   (c) The next questions have the purpose of getting a grasp of how information is currently transferred and what the challenges are.
   (d) An important step in the process is the Kick-Off meeting, which is approximately the same moment as the decoupling point in the literature. Although it is an ongoing process, the kick-off meeting is an important step in the information transfer.
   (e) Furthermore, questions are asked to identify the most important step in the information transfer and the risks and how these risks can be reduced.
   (f) Moving on to the participant's knowledge about the S&OP process. The process at the company in literature is known as the S&OP process, but not always known by this name. If this question is answered negatively, the S&OP process will be explained.
   (g) From the S&OP model, the S&OP maturity model is explained and the participants are asked to categorize the company's process.
   (h) The final questions in this try to analyse which improvement in an information system will be used and what a participant's ideal information should look like. In addition to this ideal process, the direct question is to identify bottlenecks.
   (i) To identify important moments in the ideal information system, a question is posed asking which moments or gates should be included.
3. **Sketch of Information system**
   Activating the participants is done by sketching their ideals, and in the previous questions described, information systems give insight into the complexity of an information system. The ease with which a sketch is made indicates how the tacit knowledge is translated into tangible knowledge. The struggles with sketching indicate that the translation is complex, and the construct validity is less grounded. Because the process is tangible. On the other hand, easily sketching shows a widely carried and clear Information System.
4. **SWOT analysis of Information system**
   Finally, a structured and interactive SWOT analysis with pre-identified input is presented to the participants. This identifies their strongest and weakest links, as well as the opportunities and threats. After the analysis is filled in, the participants are asked to rank their answers

using a ranking scale from 1 to 5. The answers ranked with the number 1 are 'strongest link', 'greatest weakness', 'best opportunity' and 'quickest to stop threat'. The number 5 is the least important of the listed answers in the SWOT analysis. The SWOT analysis helps to understand the environment the company operates in and gives input to develop strategic plans. For this case study specifically, the SWOT analysis provides internal and external factors influencing the Information Transfer and the S&OP process. It helps to understand the strengths and how these strengths can take advantage of the opportunities. Weaknesses are points of interest for improvement, whereas threats are items that should be reduced. Starting the identification of commonalities and patterns in the search section, followed by the relationships between the sections. Based on this information, strategies van be developed to propose as recommendations.

During the interview, the researcher moderates, makes notes, observes, and tapes the discussion. The researcher also controls internal validity and asks critical questions if necessary. The output of the interviews is an audio recording. The recording will be transcribet to a text document. Sketches of the information systems and a handwritten SWOT analysis will remain physical.

3.6.3. Analyzing collected data

Analysing qualitative interviews with coding analysis method. The overarching goal is to derive a theory from the data, coding a systematic way to recognize patterns. There are three phases in the coding: open coding, axial coding and selective coding, according to Vollstedt and Rezat (2019). The first step in the analysis of the data is open coding and defining themes. A theme originates from the research question and emerges several times in the data. Themes include returning viewpoints, personalities, and patterns of meaning that are seen multiple times. Examples of the list of returning terms in the research are growth, information transfer systems, kick-off meetings, and understanding colleagues. The coding analysis had three phases, which are described in the following paragraphs. Analysing the data can be done both manually and in Atlas.ti section 3.6.3.

The first phase is to familiarize with the data and start **open coding**. Interviews done by the researcher give primary data, therefore the researcher will start the analysis with prior knowledge of the data and data collection. The interviews were face-to-face and recorded with an audio recorder. The recordings can be transcribed by the use of Microsoft Word or any other transcriber. To familiarize oneself with the data, active and repeated reading has to be done. Therefore, the first step is to shape the coded data in the original 'interview protocol shape' as much as possible. Marking these themes and taking notes will help in the following phases. Then, the open coding starts with reading the interviews thoroughly and breaking down the data into smaller parts. The researcher has to identify the detailed codes and categories. The final goal in this phase is to find out the core factors of the data. In the **axial coding** phase, overarching and theoretical codes are added over the open codes. Searching through the codes helps to refocus on the general patterns. The goal is to connect the related open codes. Categories and subcategories are indicated to find a coherent framework by focusing on conditions and actions. The last step is **selective coding** is adding more relations between the codes. Integrating the existing codes helps to extract the theory from the data. Selective coding helps to define the answers to the research question. The table 3.2 gives insight into the codes used for this project.

Table 3.2: Generating codes

Axial coding	Open coding	Specific coding
Independent variable		
Information Transfer System	Important steps	Which steps are important to include
	Important people involved	Which people should be in the loop of the information transfer system and when should they be involved
	Certain gates	Which moments are important in an information system
	Thoughts: them self	The thoughts of themselves in the associations question
	Thoughts: others	The thoughts of others in the associations question
	Challenges in transferring information	What are the biggests risks in transferring information
	Mitigation of challenges	How can the challenges be mitigated
	Idea's of changes	Checklist, dashboards, and flowcharts are suggested
Moderator variables		
S&OP	Maturity model	Indicates the current level of the S&OP system
	Silo's	Shows the distinction between silos in the process
ETO	Changes in project	Explain the information that is transferred upon a change in the project
	Long term	Effects of the long term horizon
	Flexibility	How is being acted upon change
Organizational support	Coordination	Coordination of the process steps by the management.
	Communication	Communication of information and maturity
	Understanding	Understanding of the tasks of collegues and how to help them
Other variables		
Personality	Status of personality	What is the personality, how does a department look at it, how is a culture extracted from the personality.
	Good personalities	Which personalities to keep.

Qualitative analysis, Atlas.ti

Atlas.ti is used for qualitative analysis and offers a systematic approach. Visualization, Immersion, Serendipity, and Exploration (VISE) are the main principles of the program. Visualization supports how humans think and approach solutions creatively and systematically. Immersion points towards the ownership of the data by reading and re-reading. The analysis sometimes leads to making discoveries you weren't even looking for with the Serendipity principle. Exploration is the constructive activities like theory building (GmbH, 2024)

Atlas.ti is used on a data level, which consists of activities regarding coding text and writing comments and memos. With these activities, word clouds and quotations can be made. Another part is hyperlinking, which is linking data segments to each other. Comparing segments leads to 'creative conceptualization and building theory (GmbH, 2024). Atlas.ti supports qualitative data analysis and can help coding by the use of the auto coding feature. However, the researcher still needs to read and correct the coding. The tools are designed to help the researcher, but to this day, computers still

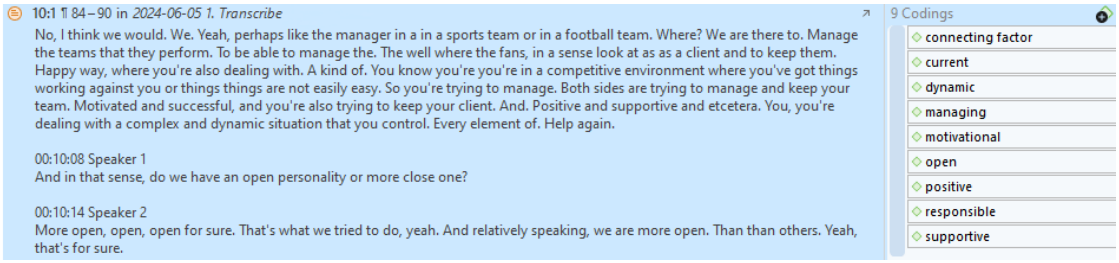

Figure 3.2: Example of coding in Atlas.ti

cannot think (GmbH, 2024).

The transcribed interviews are grouped into 'sales' and 'operations', and both consist of five documents. After adding quotations and codes, a theory is derived, and a summary is made. The coding is done according to the description in section 3.6.3. In figure 3.2 in the categories 'other variables' the personalities are codes. The first code is the 'like to have' indicating this is a personality the participant would like to see in the company. After categorizing the quote, the detailed codes are added. This can be done for all variables mentioned in the table 3.2.

Atlas.ti contains analysis tools to define theory. Codes and co-occurrence of codes can be combined to find results. This includes network graphs, bar charts, Sankey diagrams, word clouds and frequency tables. Results are presented in word clouds, used to analyse the personality of the company, and a frequency table, to define the information system.

3.7. Ethics

Working with human subjects comes with a responsibility to care for their privacy and safety. In combination with the university's Human Research Ethics Committee, a data management plan and informed consent document were made. The informed consent part can be found in appendix A and explains to the participants what the impact of the interview is and how the data is stored. The proper storage place is defined in the Data Management Plan. This plan explains where data is stored and when it is deleted again. It also contains risks involved in the interview process and how to mitigate those risks.

Codes of conduct govern how people behave during research. These codes should be followed by those who conduct the research, those who provide the data, and those who are interviewed. They are used at every step of the research process.

4

Case

Since Oceanco originated the study's original concept, the company will serve as the investigation's case study. The research objective is to explore the role of the S&OP process in an Engineer-to-Order environment to address real-world challenges.

4.1. ETO for yachts

Custom yacht builders are a special example of an Engineer-to-Order(ETO) environment. A yacht is highly customized, the production volume is very low, and a yacht is a high-level product. Designing a completely new yacht is a complex project with high variation in activities and relationships between organizations (Gosling et al., 2015, 3). The design only starts after a client has shown interest in a yacht, and the further development of the project happens after the order has been placed. The decoupling point is hard to define because the yacht is constantly customized and changes according to a client's wishes. Another challenge is the decoupling points in combination with the scope of the project. Each element on a yacht is engineered and, therefore, has its own decoupling point. This shows the flexibility of a project. The flexibility is needed to handle the unpredictability in ETO environments (Nujen et al., 2022).

For yachts, there are additional challenges. Yachts are large projects that require a large volume of both engineering and production (resource) capacity, resulting in long lead times. Therefore, engineering and production are often parallel. There is an overall integrated plan, but detailed planning is often on the department level, leading to complex plans that are sensitive to disturbances. To align the engineering and production activities, both departments must understand each other. A better understanding of the complete value chain, with a focus on the engineering dimension, can help clarify disagreements regarding design (Gosling et al., 2015, 3).

4.2. Oceanco

Oceanco is the case company that builds unique, full custom yachts of the highest class. These are the longest yachts in the world and are of the highest quality. Great challenges join these aspects in scope and design. This section explains the history of the yacht-builder. It also explains the organizational structure, planning, risks, and processes.

4.2.1. History

Oceanco was founded in 1987 by a group of entrepreneurs with a vision to be the most reputable yacht brand with a speculatively built product, that was even competitively priced. To reach this vision, the labour-intensive construction was outsourced, and by the time this work was finished, the half-build yacht would be shipped to Europe. Highly skilled Dutch craftspeople would finish the yacht, and in approximately 6 years, the first yachts were delivered. The yacht industry was something entirely new during this time, but after the delivery, the business model was proven (Verhoeff, 2024).

A new designer joined Oceanco, became a significant shareholder, and took the role of CEO. With the backing of a European bank, a shipyard close to Alblasserdam and a sales and marketing office were opened on the other side of the Atlantic. After a third yacht was built in 1995, a breakthrough order was placed for the largest three yachts ever built by the Dutch (approximately 90 meters), which placed Oceanco on the map. A new shipyard was bought and the orders contained, bringing Oceanco to the line-up of a respected luxury yacht builder. In 2002, Oceanco was acquired by a Greek shipping and steel magnate who set us apart from the competition, starting a 700 series yacht indicating yachts of 80 meters and above. These were sleek, modern and aesthetic yachts with lifestyle features never seen before (heated swimming pools, gyms, cinemas and beauty salons) (Verhoeff, 2024).

In 2008, the global financial crisis hit, and no sector was excluded. This led to a reduction of builders offering their services, creating difficult years for Oceanco. After this period, new opportunities came. In 2010, Oceanco got a new owner who planned to focus attention on the people and the brand. The gamble paid off because, from 2011 onward, new and even bigger yachts were ordered. At this point, the vision is to build completely unique, full-custom yachts. These projects seem challenging and even impossible, but things that seem impossible are merely challenges until they become possible. In 2016, the first yacht over 100 meters was built (Verhoeff, 2024).

Since 2019, Oceanco has acquired Mercury Yacht Construction, a Construction and Refit Facility located in Zwijndrecht. This enables Oceanco to carry out the initial phase of building independently. In the meantime, long-term collaborations are established with co-makers. As part of the development strategy, the growing fleet of yachts is supported by Life Cycle Support (Verhoeff, 2024).

Then, COVID-19 struck in 2020 and brought unavoidable challenges on a global scale. Although it had an impact on the lives of millions, the pandemic was a catalyst for the desire for freedom, adventure and family time, which increased the request for yachts. In 2023, Oceanco reinforced its presence on the market with an 80-meter Simply Custom, which is a new approach to building a custom, less technically focused yacht to meet the growing demand. Currently, three projects are being built (Verhoeff, 2024).

4.2.2. Organizational structure

Until 2016, the organisation was silo-based. This was reflected both in vertical (top to work floor) and horizontal (between departments) communication. People experience a low level of cooperation, alignment and sharing of information. The organisation was experienced as if it were a collection of islands. This was reflected within departments as well. The sense of being one Oceanco, or functioning as one team on a specific project was not widely spread; this was being experienced both internally as well as in the cooperation with co-makers. The presence of silos results in rising costs, lower production multipliers and lower leverage on suppliers. Besides that, the organisation was silo-based, it also shows that coordination and ownership for tasks are not situated at the right place within the organisation. This is also seen in the interaction between Oceanco and its co-makers, leading to the reactive behaviour of employees and co-makers. Unfortunately, this is contrary to how the ideal situation would look like; a pro-active attitude of employees and co-makers alike, where everyone takes ownership of her/his responsibilities. Ideally, the attitude shifts from ‘manage, direct and control’ to ‘observe, listen and align’. Pre-condition is that all roles and mutual responsibilities are clearly set from the start; this is lacking. The result of this is that expertise is not being utilised to its full potential and that risks are not identified and acknowledged in time and mitigated effectively (Verhoeff, 2024). To improve the silo situation, the organizational structure changed in 2016 to a project-based organization creating more corporations (Oceanco, 2024).

The main processes within the company are controlled by gate management. A gate (including its deliverables) should be passed before moving on to the next gate. This is used to control multi-disciplinary tasks, reduce costs, and improve quality. The focus of this study is between gate 0 and gate 6. figure 4.1. The client is the person willing to buy a new yacht and is called the owner. The Owner’s Representative conveys the idea of the owner throughout the building process, in which the Project Team is the counter partner. Multiple teams are supporting the Project team: ’Horizontal disciplines, Commercial cluster, Finance & Control, Human Resources, and Life Cycle Support’. During the Design Phase of the yacht, the first core members of the project team are involved. The more the project matures, the more members there are involved in the Project Team. The total number of employees is approximately 300, and they work in both non-project-related (HR, Facility) and

project-related jobs.

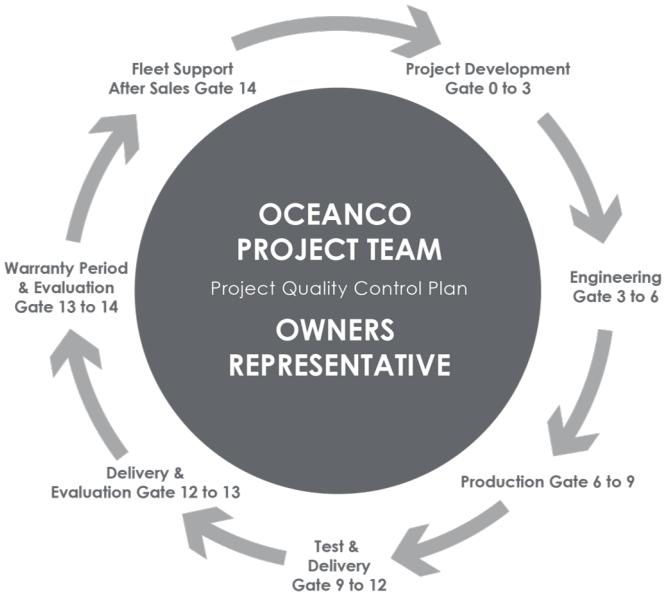

Figure 4.1: Oceanco gata management (Oceanco, 2024)

4.2.3. Planning and risks

Big new-build projects like these yachts need extensive planning. Not only for building slots but also for internally available resources (people in the Project Team) and externally available resources (capacity of the steel builder). Therefore, there is strategic yard planning for the slots in the yard, as well as planning and schedules at different detail levels to define milestones and activities. Common bottlenecks in the plannings are external forces (e.g. bankruptcy of a supplier, worldwide virus), supply chain uncertainties (e.g. delivery problems), design changes and rules & compliance (Oceanco, 2024). These uncertainties and risks can be mitigated by aligning the expectations and commitment of all parties in the value stream. Also, by developing project-specific elements such as technical specifications, full initial designs, and a clear general arrangement plan.

To define, maintain and share the vision of the company, there are six horizon goals, which are the drivers of the company (Oceanco, 2024).

1. **People** Be the employer of with highly qualified, professional, and motivated employees.
2. **Owner** Be the preferred choice of owners for a new build and refit yacht.
3. **Life Cycle Support** The yachts are commissioned, supported and refitted OSBIT (On Specification, Budget and In Time).
4. **Corporate Sustainability Reporting (CSR)** Accelerate sustainable innovation and establish responsible yachting.
5. **Co-makership** Have healthy and stable project results by working in aligned and embedded co-makership.
6. **OSBIT** (On Specification, Budget and In Time) Be a healthy and stable company to be resilient, grow and invest.

4.2.4. Design and Build processes of a custom yacht

To provide more insight into the building process of custom yachts Rankine (2024) wrote about both the design and build process.

Design phase

The design process is by Rankine (2024) described in five steps. First, a meeting with the shipyard to understand the client's vision and intended use. Secondly, a tour at the shipyard to feel the culture, look at ongoing projects and understand the yard's strengths. Thirdly, the yard offers the client an initial proposal with outlines of the design, planning and prices. In this step, the client can compare the offers from different yards and decide which builder to select. The selection is made official by signing a Letter of Intent (LOI). After the Letter of Intent, the design phase starts, in which the brainstorming sessions help to make the client's vision concrete. Also, performance parameters are defined, and pre-engineering work starts. In association with the owner's representatives, the designers and the co-makers, Oceanco optimizes the design and pricing before a yacht Building Agreement (YBA) is signed. Fifth and finally, the contracts and legal process, which already starts during the design phase. The main contract and its appendices are drawn up in the legal process to ensure all shareholders are confident in signing the YBA.

Transition phase

Information needs to be transferred between the design phase and the building phase. This is not an actual sequence of phases but a simultaneous process. This specific phase is the focus of this research. In this part, the so-called 'customer order decoupling point' is an important measurement.

Build process

The building process is by Rankine (2024) described as a seven-step process. The first step is also in the design phase, which is the planning. Outlining all requirements and expected costs helps to develop feasible plans. Second is the engineering. The pre-engineering is done before signing the YBA. After the pre-engineering, the designed items are engineered in detail and translated into workshop drawings. This is done simultaneously with the procurement department ordering the items. Thirdly, the steel cutting of the hull and superstructure, where 3D drawings are used as input. The steel parts are welded together as a big puzzle. Fourth is the outfitting, which includes installing machinery, pipes, and cable trays. Teak decking and large pools are placed outside the yacht glass windows, while the internal interior is placed. Before the yacht is completely operational, all systems should be commissioned. The sixth step is sea trials, where all systems are tested in open water and thereafter, the delivery. Lastly, the warranty and life cycle support for the yacht are organized.

4.2.5. Information transfer process

The information transfer process is the company process behind the process of section 4.2.4. This process is established based on the interviews and contains three important phases. These are the phase before the Letter of Intent (LOI), the phase between the LOI and the client contract, and the phase after the client contract.

Phase before Letter of Intent (LOI)

The Sales & Project Development team collects information about the wishes and requirements of the specific customer. When a request arrives, it is marked with a PA number. Technical, financial and planning-related data is collected. The information is used to make appendices for the LOI. The Sales & Project Development team makes an overview and prepares a letter of intent (LOI). This information is stored in the PA folder in the document management system (PDMS).

The appendices are;

- A Short Specification (Short Spec) with details about the yacht
- A design brief with the context of the design
- The General Arrangement (GA), which is the layout of the yacht
- A price calculation with the rough cost price of the yacht
- The expected delivery date of the yacht.

Uncertainties are the lead time of this phase before LOI, depending on the maturity of the idea. The lead time can be long or short. Some projects never reach an LOI, other projects are very mature when the LOI falls, and sometimes the LOI falls very quickly, and the project is underdeveloped/incomplete.

Phase from Letter of Intent to client contract (LOI)

The Sales & Project development team continues collecting information and supplements about the project and adds this to the PA folder in PDMS. In addition, the core team is involved in the PA project to transfer knowledge and project details. Ideally, the core team consists of a Project Director (PD), the Controller, the Project Manager (PM), the Project Planner (PP), the Project Manager Production (PMP), the Project Procurement Manager (PPM) and the Project Manager Engineering (PME). The first important co-makers are involved as well. In the meantime, the Sales & Project Development team's task is to manage the contract and compose a more elaborate and detailed information package.

In the phase from the LOI to the client contract, the following documents are drafted.

- A legally compliant customer contract
- A more detailed price calculation.
- A Building Specification (Building Spec) with more details about the yacht
- The appendices of the Building Spec, for example, GA and a makers list.
- A list of documents, also known as deliverables.

Phase after client contract

A Kick-Off meeting with the Sales & Project development team and the Project team is organized. During this phase, the documents and document list (Building Spec and Appendices) are transferred to the Project Team. In the document management system, the PA project folder is converted into a project with a construction number. The Project Team has now access to all documents in the project folder. Based on the documents in this folder, the Project Team can start pre-engineering and basic engineering.

The Project Manager Design (PMD) from the Sales & Project Development team remains involved in the background for the Naval Architecture. The Project Manager Design is responsible for the overall design of a project. This includes both the visible outdoor design (hull shape, exterior) and the indoor design (stability, propulsion systems, etc). The PMD handles customer requests for changes and monitors the project.

4.3. Case Results

This section summarizes the important requirements defined in the description of the case.

4.3.1. Q3. Which requirements should an information transfer framework for custom-built luxury yachts in an Engineer-To-Order environment meet?

The Information Transfer Framework must comply with the multiple and complex decoupling points in the ETO environment for luxury goods. This includes considering the multiple processes and gates happening simultaneously in different parts of the project.

The project-based organization needs employees to have a pro-active attitude and need to observe, listen and align. There should be task responsibility leading the company to use its full potential and mitigate risks.

Oceanco's vision has been continuously carried throughout its history and adjusts when times change. Currently, the vision is captured in the six horizon goals, which should be the company's drivers. The goals are people, owner, Life Cycle Support, Corporate Sustainability Reporting, Makers, and OSBIT.

Within the processes there are a few important and fixed steps, these are captured in the passes and are about the LOI and YBA contracts and the management around these contracts. Contract management is an important value for an outsourcing company like Oceanco.

5

Results

The next step in the research is to analyse the interview data and combine this with the theoretical and case data. The data is collected via interviews, and the interview questions can be found in appendix A. As mentioned in the previous chapter, chapter 3, first, the interviews are transcribed and added into Atlas.ti. This program, combined with the quotation and coding method, is used to analyse the data. The analysis will find the company's perspective on the need for an information system. The third research question will be answered after the analysis. Thereafter, the knowledge of the research questions Q1 and Q2 are combined with the answers to research question Q3 to find the answer to Q4. This is concludes in a result from data analysis and knowledge combination.

Q3. Which requirements should an information transfer framework for custom-built luxury yachts in an Engineer-To-Order environment meet?

Q4. How can an Information Transfer Framework for Engineer-to-Order environments in luxury products improve the Sales and Operations Planning process?

5.1. Initial idea of Information Sharing

This section focuses on the interview part, where the question is asked: 'What do you think when I say 'Information sharing'?' The analysis of the Information sharing data is done manually. This indicates familiarizing with the data, adding notes, and deriving theory. This chapter analyses and summarizes the results.

Technical and Commercial information

Information is a broad term and can include all kinds of explanations for information sharing. Within the company, two kinds of information sharing are identified. There is, on one hand, technical information and, on the other hand, commercial information. The commercial operations will eventually lead to technical information.

Commercial information starts in the sales department, and this starts as soft information, like a conversation with the client. Soon after, the information changed to include more design and contract information. Commercial information is closely linked to technical information and is essential for initiating technical work. It is derived from past data and experiences, which is necessary to transfer the Oceanco spirit towards the client, and it must be dynamic yet precise. Sales and project development teams often face challenges in aligning their information needs and priorities.

Technical information starts off vague and soft and originates from commercial information. It often becomes more precise as the design team processes it and later with the operations team. It is crucial for the operations team to receive accurate and detailed technical information from the sales and project development team to execute projects effectively.

Hard and Soft information

Furthermore, a distinction can be made between hard information (documents), soft information (meetings), and how data is managed in a data management system (for example, PDMS)

Soft information is a good way to transfer data between people. It encompasses the informal knowledge exchanged during (online) meetings or conversations. This type of information, although sometimes seen as inconsistent, is essential for initial planning and coordination. There is a call for more structured methods to capture and utilize this information.

Most of the processes in a yacht-building company rely on hard information. Hard information includes official documents, such as contracts, drawings, calculations, and e-mails. These are often formal records that are crucial for project execution and tracking. Some documents have additional metadata; preferably, the metadata includes the maturity of the documents. Effective document management systems are necessary to ensure that this information is consistently available and up-to-date.

Data management systems, like PDMS, play a critical role in bridging the gap between soft and hard information. Engineering departments have been recognized as leaders in using these systems, but there is a need for broader and more consistent use across other departments.

Official and Unofficial information

A distinction can be made between the official and unofficial documents and everything in between. There is an ongoing effort to bridge the gaps between these different types of information to ensure a seamless flow of data across the company.

Official documents refer to structured and documented data that is formally communicated within the organization. Examples of official information are client contracts, supplier contracts, project specifications (Building Specifications, Short specifications, General Arrangements), and compliance documents.

Unofficial information includes informal communications that occur through various channels, such as direct conversations, WhatsApp messages, informal emails, or ad-hoc meetings. While this type of information makes the company agile and flexible, it can sometimes lead to inconsistencies and people missing out on information.

5.1.1. Summary initial idea of Information sharing

There is an overall consensus that information sharing at Oceanco has improved over the past few years. Additionally, it is often mentioned that there is still room for improvement. This is mainly about information between departments, with a focus on consistency and uniformity for both internal employees and external suppliers. The organization aims to make information transfer more transparent and efficient, ensuring that the right information reaches the right people at the right time.

Improving these processes is essential for optimizing the Sales & Operations Planning process. Better communication between departments ultimately leads to better project outcomes and customer satisfaction.

5.2. Company personality

Questions about personality are asked to determine the overall trend in how the company and management behave. This question has two sides: the current personality and the personality a participant would like for the company. The transcription segments regarding personality are quoted and coded in both 'Personality' and 'current' or 'like to have'. Then, detailed codes containing character traits are added. Atlas.ti provides multiple analysis methods. Both the current personality and the preferred personality are analysed with the word cloud analysis tool of Atlas.it. More often occurring words are presented bigger than others. The current and the like-to-have personalities are shown. A frequency table of the codes is added in the appendix C, which supports the word cloud with the frequency of the words. For comparison, the overlap is presented in the figure 5.3. Finally, a Sankey Diagram is analyzed to show the differences between personalities mentioned by Sales and personalities mentioned by Operations (appendix C).

Figure 5.1: Current personality of company (Generated by Atlas.ti)

Figure 5.2: Personality the company likes to have (Generated by Atlas.ti)

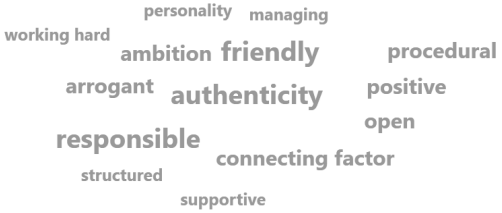

Figure 5.3: The overlap in personalities (Generated by Atlas.ti)

The analysis of these open codes in the axial code 'personalities' is done in Atlas.ti. The frequency table of code occurrences is shown in appendix C. The current personality shows a difference compared to how the interviewees would like the company to be. For further analysis, the codes are separated into multiple groups. Atlas.it generated Word clouds help to create insight into the personalities. This helps to analyse the status and compare this to the personality the company would like to have. Therefore, the groups are growth, organizational behaviour, team characteristics, and company traits.

Decision-making

The company's current personality is characterized by a dynamic and active approach, leading to frequent, sometimes hasty decisions. Decision-making is often rushed, focusing on short-term outcomes without considering long-term consequences. This rapid pace can result in inconsistent and unsupported choices, creating an environment that feels almost schizophrenic. The urgency to act quickly under time constraints highlights a reactive rather than proactive nature within the company.

The preferred character traits for the company focus on making well-supported, informed decisions based on previous processes and clearly defined responsibilities. This involves creating a more social character by fostering insight into various situations and roles across departments. Emphasizing transparency and collaboration will enable better decision-making, ensuring that choices are not made in isolation but with a comprehensive understanding of their impacts. A structured approach to decision-making, grounded in known and established processes, can improve efficiency and reliability.

Managing

Another prominent characteristic of the company is its role as a connector, striving to integrate various stakeholders involved in its processes. This sensitivity to the needs and changes of stakeholders showcases the company's adaptive and responsive nature. However, this outward appearance of organization and connectivity often masks the internal disarray. Behind the scenes, there is a significant amount of uncertainty, with processes that are not uniform or structured, reflecting an immature stage in the company's development. Despite handling larger and more complex projects, the company's internal processes have not evolved simultaneously.

Sensitivity to the needs and changes within the company remains crucial, but there is a strong desire to balance this with adherence to basic processes. This balance will provide a stable structure that supports efficiency and clarity. By embedding these foundational processes into daily operations and keeping them at the forefront of everyone's minds, the company can respond to changes without sacrificing its core stability. This approach underscores the importance of structure and consistency, even as the company adapts and evolves.

Organization

The company also displays a dual personality of compliance and chaos. While it adheres to regulations and standards, it simultaneously acts in an ad hoc and chaotic manner. This chaotic side is balanced by a kind and somewhat arrogant demeanour, reflecting overconfidence and a drive to secure its place in the market. Although the company is hardworking and eager to improve, it resists substantial changes, perhaps due to comfort in the current state, which is not overly challenging.

Leadership and responsibility are key traits the company seeks to cultivate. Employees should take ownership of their tasks and focus on factual, results-driven work. Good leadership should include a long-term vision that spans multiple projects, ensuring that the company stays on course towards its goals. A strong vision, combined with mechanisms to address and correct deviations, will foster a culture of accountability. Solving problems with a long-term perspective, rather than shifting blame, is seen as essential for sustainable improvement.

Golden boy

Lastly, the company embodies a blend of pride and friendliness. One of the interview participants referred the company as a "golden boy" with talent and opportunities but remains playful and underutilized. This pride sometimes comes across as arrogance, but it also stems from a desire to be unique and highly regarded. The company's role is similar to a football team manager, bringing together subcontractors and co-makers, motivating them to perform well, and supporting clients. This management position in a complex environment requires maintaining control and being open to assisting others, yet the company acts opportunistically, often without aligning actions with its long-term vision. The industry's inherent secrecy influences the company's internal information sharing, which remains protective and not fully transparent, crucial for maintaining client trust.

5.2.1. Personality differences between departments

The Sankey Diagram in the appendix in C.3 analyzes the personalities according to the departments. The personalities mentioned by the Sales department are more 'feelings' and 'interactions' and, therefore, are personalities that arise during an interaction. The personalities mentioned by the Operations department are more focused on 'timeliness' and 'behaviour', which are more focused on things that can be observed in a person.

5.2.2. Summary company's personality

The company aspires to be more steadfast and structured, maintaining its core identity while embracing necessary changes. This includes being open to external influences and learning from others to facilitate growth and improvement. The notion of the "golden boy" growing up symbolizes the need for the company to mature, taking on more responsibility and accountability. Maintaining friendly and trustworthy behaviour is important, but it should be balanced with a realistic and business-oriented mindset. Pride and confidence can drive the company forward, but they should be tempered to avoid overconfidence and the unnecessary reinvention of processes. Overall, the company should aim for optimism and transparency, with a clear vision for the future that guides its progress and helps it navigate complex and dynamic situations.

5.3. Information Transfer

The interview questions on Information Transfer indicate the most important steps in the Sales & Operations Planning process. The analysis starts with familiarizing the data and adding quotations and codes. The frequency of these codes is presented in the appendix C.The table shows a clear difference in the codes for important steps, risks and mitigation. The data analysis is executed both manually and with the frequency table. The analysis starts with the differences in important steps between the Sales

and Project Development team and the Operations team. Between the teams, there was no obvious difference in answers. Therefore, all answers are integrated into a large table with columns: 'Most important step, risk, and mitigation of this risk in the process. The table is added in appendix B. In the analysis, the three main categories of steps are identified. The categories are the communication and coordinating category, the information management and data accessibility, and finally, the process and execution.

Communication and coordination

Effective communication and coordination are important steps in a project, particularly during the basic engineering phase between the LOI and the contract. Key steps include understanding the tasks required during this phase and creating a detailed Building specification. Given the project's scope, every team member must know their responsibilities. Maintaining a clear progress overview helps assign tasks appropriately and manage resource allocation effectively. Additionally, transferring information and ensuring all parties understand the new information is important. Engaging the core team early creates a better understanding and builds a stronger client relationship. Risks include unawareness of tasks, forgetting responsibilities until the deadlines, and differences in interpretation, resulting in misunderstandings. There is also the risk of personal task priorities misaligning with project priorities, causing information misalignment and resource management issues leading to over or under capacity. To mitigate these risks, it is important to manage expectations before the contract is signed. Ensuring that team members understand both their tasks and those of others promotes better information transfer and alignment of priorities. Support from an EPC (Engineer-Procurement-Construction) triangle can enhance overall process knowledge. Additionally, creating a risk report to identify and monitor critical paths helps keep resource management on track. By addressing these risks proactively, communication and coordination within the project can be significantly improved.

Information management and data accessibility

An efficient Information Transfer Framework ensures data accuracy and accessibility throughout a project. Important steps include providing all team members with up-to-date document revisions and reducing the risk of errors from outdated or incorrect data. In contract management, the correct order of information collection is necessary, ensuring that data gaps are filled with accurate and relevant details. By maintaining a clear PDMS data management structure for project information, the system creates access to necessary documents. Risks in this area include decisions based on outdated or incorrect data and the delivery of low-quality or incomplete information at critical moments. To mitigate these risks, regular updates and notifications about document revisions are essential for maintaining data integrity and promoting a consistent understanding of project specifications. Additionally, insight into the status of the information and ensuring that correct information is available when needed, enhancing data reliability and supporting effective project execution.

Process and execution

Process and execution are fundamental to delivering OSBIT projects (On Specification, Butget an In Time). Key steps include having a well-executed contract management system that is created in sufficient time for reviewing and understanding contractual criteria and specifications. Proper planning and consistent process adherence ensure that project requirements are met, reducing the risks of delays and financial uncertainties. The transition of projects from sales and design to execution teams must be smooth, with clear communication and adequate preparation to prevent undercapacity issues. Risks in this category include insufficient time to review contract documents, financial and time uncertainties, and delays in delivering quality and maturity. Mitigation strategies involve good contract management, creating a risk report, and maintaining consistency in the process. Additionally, balancing project maturity with timely delivery is crucial for achieving the desired quality and performance standards. By implementing strategic planning and rigorous process management, organizations can ensure that all project components are executed efficiently, leading to successful project outcomes.

Atlas.ti analysis

Additionally, from the Atlas.ti frequency table presented in appendix C. Important steps are the acceptance of the process and the information system and the creation of a standard. These steps

create a solid process in which all employees are aware of the tasks and understand what is coming, indicating the expectations are managed. It also creates awareness of the revisions, quality and availability of the data. Helping to calculate the value, understand the assumptions and calculate the risks. The challenges are weaknesses that need attention; otherwise, they can become risks to the process. The challenge frequently occurring in the table is acceptance of the Information Transfer Framework (ITF). Without support, the ITF cannot exist. Another challenge is managing the expectations and assumptions between teams, which are closely related to the delivery of documentation. The hardest challenge in this Engineer-to-Order environment is to balance between the flexibility on one side and the structure on the other side. The mitigation is mainly driven by the balance of these two elements in a framework and getting this framework accepted by the stakeholders working within the process.

5.3.1. Summary of Information Transfer

An effective information system must contain good communication, data accuracy, and efficient execution. Important requirements include up-to-date document revisions, a clear structure and policy for PDMS, and clear task assignments. Early core team involvement and proper contract management are essential. Regular updates and risk monitoring mitigate financial and timing uncertainties. Consistent planning and resource management support the timely delivery of projects within budget.

5.4. Interview Data analysis summary

This paragraph summarizes all collected data from the interview to answer the research question. Where chapter 2 highlighted the theoretical side of the problem, this chapter analysed the practical side of the problem.

5.4.1. Q3. Which requirements should an information transfer framework for custom-built luxury yachts in an Engineer-To-Order environment meet?

With the insights from the interviews within the case company. An information transfer framework must ensure consistency and uniformity across all departments and external co-makers and suppliers, both within projects and within the company. This creates transparency and efficiency. Managing document revisions and accurate data is important for effective decision-making and project execution. Structured processes, such as clear policies for PDMS and gate management, along with well-defined task assignments, improve the work atmosphere. Early involvement of the core team and integration of suppliers and co-makers foster better collaboration and understanding. Clear communication channels and proper ownership of documents prevent misunderstandings and keep projects on track. Regular meetings between the departments and risk monitoring mitigate financial and timing uncertainties. Balancing data-driven processes with human interaction and maintaining an integrated planning approach address weaknesses and exploit strengths and opportunities. Encouraging an optimistic and transparent company culture, guided by a clear vision, helps navigate complex and dynamic situations effectively, ultimately supporting the company's goal of delivering OSBIT (On Specification, Budget, and In Time) projects.

Summarizing the data analysis in the following requirements of an information transfer system:

- Create consistency and uniformity throughout the company
- Accurate and structured data management (PDMS)
- Early involvement of the core team and important co-makers
- Create an open environment for smooth communication
- Including regular update meetings
- Balance between flexibility and structure

5.4.2. Q4. How can the Sales and Operations Planning process influence an Information Transfer Framework for Engineer-to-Order environments in luxury products?

This subquestion links the knowledge and results from the literature, the methodology, the data analysis and the results. It defines how an Information Transfer Framework is influenced by the Sales and Operations Planning process, while operating in a complex and unique Engineer-to-Order environment. Therefore, this question is a combination of the theoretical knowledge of subquestion 1. (section 2.7.1) and 2. (section 2.7.2) and combining this with the requirement found in subquestion 3. (section 4.3.1 and section 5.4.1).

The Sales and Operations Planning (S&OP) process influences the Information Transfer Framework (ITF) in Engineer-to-Order (ETO) environments for luxury products. S&OP involves creating integrated planning and breaking down silo cultures. Breaking down the silo culture started in 2016 when implementing the project-based organization. The S&OP process will ensure information flow between departments. Regular meetings between the relevant stakeholders and shared goals and visions, which are described in the companies horizontal goals. This helps to refocus the silo-specific goals towards project and company goals and create a collaborative culture. These goals contribute to translating the Information Transfer Framework into consistent and uniform data structures. High stakeholder commitment, created by long-term co-maker contracts in S&OP also aligns everyone with project goals and timelines, enhancing task ownership and proactive information sharing.

Expectation management and forecasting benefit the S&OP process, but it is particularly challenging in luxury ETO companies due to high customization, varying lead times, and unique problems. An effective Information Transfer Framework ensures that detailed, accurate, and qualitative information is shared between departments, enabling sales department and project management to make more precise forecasts early on. Real-time and up-to-date data organized via revision management helps predict potential changes and adjust forecasts accordingly. This structured data management reduces uncertainties related to demand and supply, facilitating better decision-making and resource allocation.

Addressing ETO-related uncertainties, such as early decoupling points and quality management, is another critical role of S&OP. Through detailed planning, S&OP helps manage the complexity of luxury ETO projects. Ensuring timely information transfer and flexibility to changes. Real-time data and feedback loops incorporated in the S&OP process support quality standards and flexibility, which are essential for maintaining high customization and quality in luxury products. Furthermore, balancing data-driven processes with human interaction ensures that the S&OP process remains both efficient and adaptable, managing the dynamic nature of ETO projects effectively.

The effectiveness of the Information Transfer Framework relies on the connection between silos, proactive attitudes, and data consistency promoted. Silo culture can lead to poor coordination between sales and operations. An ITF creates better communication and collaboration by establishing consistent and uniform processes and ensuring constant information flow. Early involvement of the 'core team' and integration of suppliers and co-makers can bridge the gap between sales and operations, aligning their goals and improving overall coordination. Clear communication channels and proper ownership of documents prevent misunderstandings and keep projects On Specification, Budget and In Time (OSBIT). The luxury ETO environment, with its unique demands, underscores the necessity of a structured process with enough room for flexibility. This shapes the ITF's operation and performance, ensuring clarity and quality in communication.

6

Design of Information Transfer Framework

In this chapter, the Information Transfer Framework is being designed by the use of relations from the SWOT analysis. The interview participants fill in this analysis and contain strengths, weaknesses, opportunities and threats of Information Transfer within the S&OP process. This is combined with the results of research questions three and four, explained in chapter 5. Finally, the framework is explained, and recommendations are being made which will answer the main research question.

The main question is: How should an information transfer framework improve the exchange of information within the Sales and Operations Planning process to reduce uncertainties in custom-built luxury yachts?

6.1. SWOT analysis

The last part of the interview was an analysis of the strengths, weaknesses, Opportunities, and threats. The SWOT analysis helps to understand the environment the company operates in and gives input to develop details for the Information Transfer Framework. For this case study specifically, the SWOT analysis provides internal and external factors influencing the Information Transfer and the S&OP process. It helps to understand the strengths and how these strengths can take advantage of the opportunities. Weaknesses are points of interest for improvement, whereas threats should be reduced. The identification of commonalities and patterns in the search section is started, followed by the relationships between the sections.

At the end of the interview, after a sequence of questions on the company, Information Transfer, S&OP and Information systems, the SWOT analysis with a list of possible inputs is presented. This helps the participants to be involved and know the subject of the analysis and helps to focus their output. The SWOT analysis consists of two steps, starting with filling the boxes of the analysis. On average, three inputs were given per box. Thereafter, the participants were asked to rank their answers in order of importance. All SWOT analyses were combined into one integrated SWOT analysis, which can be found in the appendix D; this SWOT analysis is used to retrieve the data. In the integrated analysis, the most important items are listed first. The items are split into the answers from the sales department and from the operations department. The identification of commonalities and patterns in the search section is started, followed by the relationships between the sections. Based on this information, strategies van be developed to propose as recommendations.

6.1.1. Commonalities and patterns

A general pattern is that the answers can be split into document, process, and communication categories. The commonalities analysis is done according to these categories.

Strengths

The Strength section can be split into different parts. Starting at the operations side with the most important one which is the Building specification. Later in the list, the Short Spec can be found as well. The Short specialization is the short version of the building specification and is often composed as a deliverable in the Letter of Intent. The building specification is a document with all the detailed specifications for a yacht. This is stretched from the colour of the hull to the materials on the interior walls. The document is very important for the engineers in the operations department, one might say it is the holy bible of the engineers. The Building specification (or short Building Spec) contains hard data, supported by a contract, and only exposed to change with an official notion. Therefore, the Building Spec and Short Spec are noted as strengths in the current process. Other document-related strengths are the deliverables checklist, which is part of the planning procedure and contains dates when something has to be delivered, and the document list with the existing documents and metadata of the documents. The documents are separated into specific packages stored and shared in the data management system and can be accessed by all shareholders; this system is perceived as a strength according to the operations department. Looking more into the process, the operations department identifies 'consulting suppliers in an early stage', which means the phase before LOI, as a strength, involving them creates more willingness to cooperate and systems can be better implemented in the cost calculation and design. The process step of freezing the existing documents at LOI, meaning no more changes will be done to the documents at LOI is a strength. Gate management is a process describing the complete project from start to end, each gate comes with deliverables, after a gate is completed the next gate starts. Finally, the operations department indicates some elements of communication as strengths. These are periodic meetings and sharing the client experience, which help the department gain regular background knowledge about a project.

The sales department mentioned this document management system, PDMS, as a strength and also includes BIM360, which is a similar document management system, mainly for sharing documents with external suppliers. A strength mentioned by the sales departments is the Revision management of the documents; this gives both departments insight into the most recent version of the documents. Many strengths mentioned by the sales department can be found in the process side. Starting with the customer design process is the first process of the project and tries to maintain good collaboration with the client to understand the wishes for their yacht. The design team has to implement these wishes. This process makes the yard unique and a very important competitive advantage. Currently, the company has this competitive advantage and uses it as a strength. Further in the process, the sales department denotes the early involvement and flexibility of co-makers and suppliers, as well as the project manager design and the members of the core team (part of the project team), as strengths. Aligning the project's stakeholders in an early stage pays off in the later stages. When zooming out from the project level to the horizontal level, there are strengths in using the currently in-development Engineer-Procurement-Construction triangle, which is the horizontal and over-coupling people with knowledge. They help in projecting knowledge to the sales department working on the project. On the communication level, periodic/regular meetings and sharing the client profile are mentioned as well; this is similar to the strengths of the operations department. The sales department added the Kick-Off meeting as a strength, indicating its importance.

To summarize, key documents include Building specification, Short Spec, and deliverables checklist, managed via PDMS and BIM360. Process strengths involve early supplier consultation, document freezing at LOI, Gate management, customer design, and early involvement of co-makers. Communication is enhanced through periodic meetings, client profile sharing, and Kick-Off meetings.

Weaknesses

Looking at the weaknesses mentioned by the operations side, first look at the documents. The first weakness is that it is not always clear who owns a document, leading to inconvenience in case of questions. A resource schedule is mentioned. According to the project director, there is a resource schedule, but it is not used enough. This indicates that currently, there isn't enough knowledge and insight into the use and future requests for resources. The criteria and standard specification are the criteria from the company to build the yacht, these criteria are lacking and therefor creating a weakness in the process. This includes the (owner's) decision schedule, which is a document containing moments when a decision should be made by the client. An example of a decision is the shape of the pool, this

isn't necessary at the signing of the contract, but it can delay the engineering process if this decision is too late. Not being detailed or not including this document at all creates a weakness. The information is these documents is detailed and should be drawn up by the sales and design team and the project team. Not working together and not reviewing the documents creates weaknesses in the early stages, leading to problems in later stages. The management of the process is earlier mentioned as a strength, but also as a weakness because it is complex to capture a unique, long-term project in gates that often happen simultaneously. Within the communication the operations department indicated weaknesses in the communication with the client, in not correctly managing the expectations. This originates from the contract, where there can be differences in opinion about what is included in the contract and what is additional work to the scope. In this case, there is a difference in how the different departments are informed, sales have to make the contracts and operations have to work with the document. This makes it logical operations denote this as a weakness. To be prepared for changes like this, operations want to be informed with a client profile telling which elements of the contract are important.

The weaknesses mentioned at the sales side is the standard specification which is not yet established, this lead to engineer and cost insecurities whereas a standard specification could solve this. Another weakness is making designs without taking into account the buildability of the yacht and keeping in mind to make the design OSBIT (On Specification, Budget and In Time). After the signing of the LOI the the customer journey is a big part of the process which takes a lot of time. During this process the yacht is designed into detail. This detail creates a weakness for the delivery on time. A process weakness is limited detailed planning per discipline, currently the plannings the integrated planning is not completely detailed, the detailed plannings are uncoupled from the integrated planning. Currently not properly managing and following the contracts creates weaknesses. Another weakness is the connection of the Project Manager Design (PMD) with the Project Team, the PMD should stay connected for the context of decisions. Decisions are sometimes made on data driven process without much human interaction, leading to weaknesses because context of documents will get lost.

To summarize, document ownership is unclear, and resource scheduling is underused. Criteria and decision schedules are often missing or incomplete. Gate management is complex, and designs sometimes ignore buildability. The customer journey post-LOI is time-consuming, and planning lacks detail. Communication issues arise from poor client expectation management and contract discrepancies.

Opportunities

One of the proposed opportunities is to have a more functional Building Specification, indicating a balance between detail and flexibility in choosing a design and suppliers that deliver a slightly different product with the same functionalities. A standard specification also has opportunities to create a more solid base of technical standards to work from. Adding to these documents is a Master Document list (MDL), including the status seen and agreed upon by both design and engineering to provide insight into what documents are to be delivered. The lack of integrated planning (level 2) for all departments creates an opportunity for a integral project planning connected to the detailed plannings per department, this should include progress and changes. A process with data-driven structures can offer opportunities to make quick decisions, but the context should not get lost in the data. Therefore this is an opportunity with constraints. PDMS, creating one environment for internal document storage and sharing, and BIM360 for interaction with the client can support these data-driven structures. The gate management is as well proposed as an opportunity, although we have seen it as well in the strengths and weaknesses sections, the opportunity of gata management is to have control on the requirements before moving on. Opportunities in communications can be found in a personalities and behaviour match between the sales and project development and the project team, this offers better opportunities in quick communication. Sharing the client profile more elaborated on the important elements creates understanding for the project. Another opportunity is focusing more on the OSBIT (On Specification, Budget and In Time) mindset to increase the understanding of connected tasks within a team. An EPC (Engineer, Procurement, Construction) triangle can help the operations give input and knowledge to the other departments.

The opportunities identified by the sales department also indicate standardization in the documents and in the process. Standardization is an opportunity to make the financial understanding better. Integrated planning is mentioned as well for the same reasons as the operations department. The document

management system (PDMS) is already an established data management tool, but adding a notification when a new document is uploaded can help the revision management of the documents. Another opportunity defined by the sales department is a risk report, containing the risk that might arise during the project. The process can be data-driven, but there are a lot of opportunities to support data-driven systems with human interaction. This systems should be defined with the correct requirement so it fits with the contract management and data management. Other information can be communicated in the regular meetings, this includes feedback on the budget, and the client profile. The mentioned opportunities are a kick-off meeting at the moment the project is handed over to the Project team, periodic meetings with sharing the client profile and helping to get everyone working uniformly. Finally using the input and knowledge of an EPC (Engineer, Procurement, Construction) triangle had a great opportunity to keep and share knowledge between the projects and within the company.

To summarize, enhancing the Building Specification for balance between detail and flexibility, and standardizing specifications can solidify technical standards. A Master Document List and integrated project planning could improve oversight. Data-driven structures and PDMS/BIM360 can aid decision-making. Better communication through matching personalities, detailed client profiles, and OSBIT focus are key. Standardizing documents and adding notifications for revisions will improve process efficiency.

Threats

The most important threat to operations is not proper communication. Starting off with not communicating and sharing context about documents and just placing the document in PDMS. PDMS is a great tool, but not a tool that can take out the human factor between the Sales and Operations. No control over the use of PDMS leads to wrong usage and contamination of the data in the system. That causes the handover improper handover. The threat of unknown maturity and quality of the data leads to uncertainties about when the documents can be used. Then the resources aren't in place, the process stops, therefore making a resource planning and using this is important. Another important process step is putting limits on the customer design process. Having boundaries, and keeping those helps to keep the process going instead of unlimited designing with the client. Communicating the client profile is both a threat and an opportunity, one part of the threat is for the client about the trustworthiness of the company in keeping the client secret. The other part is for the internal communications, without client profile there are risks of distribution of the focus of the project. The final indicated threat of the operations side is working with an individual attitude, not willing to work together as a team.

The sales departments have indicated threats about uncertainties when in the contract documents and the storage of documents on other places than PDMS or Teams. Also the document checklist attitude, instead of thinking things through. Standardization can help to get the process and the documents in the correct order. The process is threatened by too much involvement in early stage, the design process is a creative process. To get the best outcome, there should not be too much involvement for other people than the sales and design team. The Project Team should get involved early enough but with the goal of adding knowledge instead of influencing the design. In this process, there is a threat of presenting impossible things like planning, quality and completeness at a specific point in time. Part of this is as well keeping ownership and responsibilities on the budget. Another threat is the 'not invented here' syndrome, indicating not taking care of the co-maker's and suppliers' work.

To summarize, poor communication and inadequate use of PDMS can lead to data contamination and improper handovers. Uncertain data quality and resource shortages halt processes. Unlimited customer design requests and lack of client profile confidentiality are risks. Sales threats include document storage issues, over-involvement in early design stages, and the 'not invented here' syndrome affecting collaboration.

6.1.2. Relationships between sections

By analysing the input from the sales and project development team to the operations side, it is clear that the operations side is more document- and hard-information-driven. In contrast, the sales and project development side is more process, and soft information is driven. This can be found by comparing the answers in the different 'document, process and communication categories'. This is explained by the operation departments operating more on the technical, data and document-driven parts and seeing

more strengths in the documents. Meanwhile, the sales team operates in a more freely organized development structure. Some inputs are mentioned in both the strengths and weaknesses and the opportunity sections. This indicates the willingness to work with the systems but not the alignment and participation in all systems. Furthermore, in a SWOT analysis, the different sections are compared to each other to find the relationships.

Strengths - Weaknesses

The strengths in documents, such as the Building specification and the use of the data management system, contrast with weaknesses like unclear document ownership and limited use of resource planning. Document management systems can support process weaknesses like gate management, Weaknesses such as incomplete criteria and missing decision schedules highlight gaps in the documents structure. The complexity in gate management, noted as both a strength and a weakness, suggests that while structured processes are in place, their execution is hampered by the lack of detailed planning and effective document management.

Strengths - Opportunities

The strengths in early supplier consultation and detailed Building specifications present opportunities for further enhancement. By balancing detail and flexibility in the Building specification and establishing a Master Document List, the foundation for technical standards and oversight can be established. Involving the core team and the suppliers in an early stage can help to create more integrated planning and improve decision-making. The opportunity to better align communication practices, such as matching personalities and focusing on OSBIT, complements the strengths of periodic meetings and detailed client profiles, promising improved efficiency and project alignment.

Strengths - Threats

Strengths in communication, such as periodic meetings and client profile sharing, are threatened by issues like poor communication and data contamination from inadequate use of the data management system. Robust processes like early supplier consultation and document freezing face threats from uncertain data quality and resource shortages, which can influence the success of the project. While Gate management is a strength, its complexity also poses a threat if not managed well. The opportunity to enhance the Building Specification and integrate planning addresses these threats by improving clarity and coordination across documents and processes.

Opportunities - Threats

Opportunities to enhance documents and processes, such as standardizing specifications and improving integrated planning, are crucial in addressing threats like poor document management and data contamination. The chance to implement a more functional Building Specification and integrate a data management system can mitigate risks related to uncertain data quality and resource shortages. However, the threat of excessive early involvement and the 'not invented here' syndrome can hinder the effective use of these opportunities. Addressing these threats while capitalizing on opportunities to improve communication and process integration will be key to enhancing overall project management and efficiency.

6.1.3. Summary SWOT

The analysis shows a strong connection in the various sections of this SWOT analysis. The strengths and opportunities provide ideas to address the weaknesses and mitigate the threats. By improving the use of the data management system, integrating the suppliers, co-makers and core team in the early stages, and focusing on structured processes like gate management, the departments can improve their management activities. Weaknesses can be addressed by standardization, integrated planning and maintaining a balance between data-driven processes and human interaction. This can further strengthen the departments' abilities to deliver OSBIT (On Specification, Budget and In Time) projects. Clear communication and clear ownership of documents are critical in mitigating threats and ensuring that projects remain on track and aligned with client expectations.

6.2. Design of Information Transfer Framework

One of the original aims of this study was to define an Information Transfer Framework which can fill the academic knowledge gap about information transfer within the Sales and Operations Planning

process in a luxury and complex ETO environment. This is done by first defining the variables impacting an Information Transfer Framework that arose from the literature study in sub-questions Q1 and Q2 (section 2.7.1 and section 2.7.2). Then, the concepts and requirements were retrieved from case study data in sub-question Q3 (section 4.3.1 and section 5.4.1) and through linking the literature, methodology and results. The link between the elements is made in sub-question Q4 (section 5.4.2).

6.2.1. Requirements of the Information Transfer Framework

The requirements of the Information Transfer Framework are split into five main categories: the information senders, the information itself, the knowledge activities for Information transfer, and the drivers to share information and the uncertainties. Underneath is listed as the content a category should contain. This content is derived from the linking sub-question Q4 (section 5.4.2). The elements categorize the key aspects of the Information Transfer Framework, ensuring a structured approach to effective communication, coordination, data quality and coordination efforts across all departments involved in the S&OP process of luxury ETO projects. These recommendations are implemented in an Information Transfer Framework based on the framework of Holi, Wickramasinghe, and van Leeuwen (2008) which can be found in figure 6.1.

- **Senders** These are the departments, teams, and other stakeholders like suppliers and co-makers.
- **Information** This contains the information that's being shared like demand information, resources and technical background.
- **Knowledge activities** This addresses activities being done to share information, including network creation, structured data management process, and early involvement of the important stakeholders.
- **Drivers** Breakdown of the silo culture, the pro-active attitude and overall coordination and alignment.
- **Output** This contains uncertainty reduction and other improvements.

6.2.2. The Information Transfer Framework

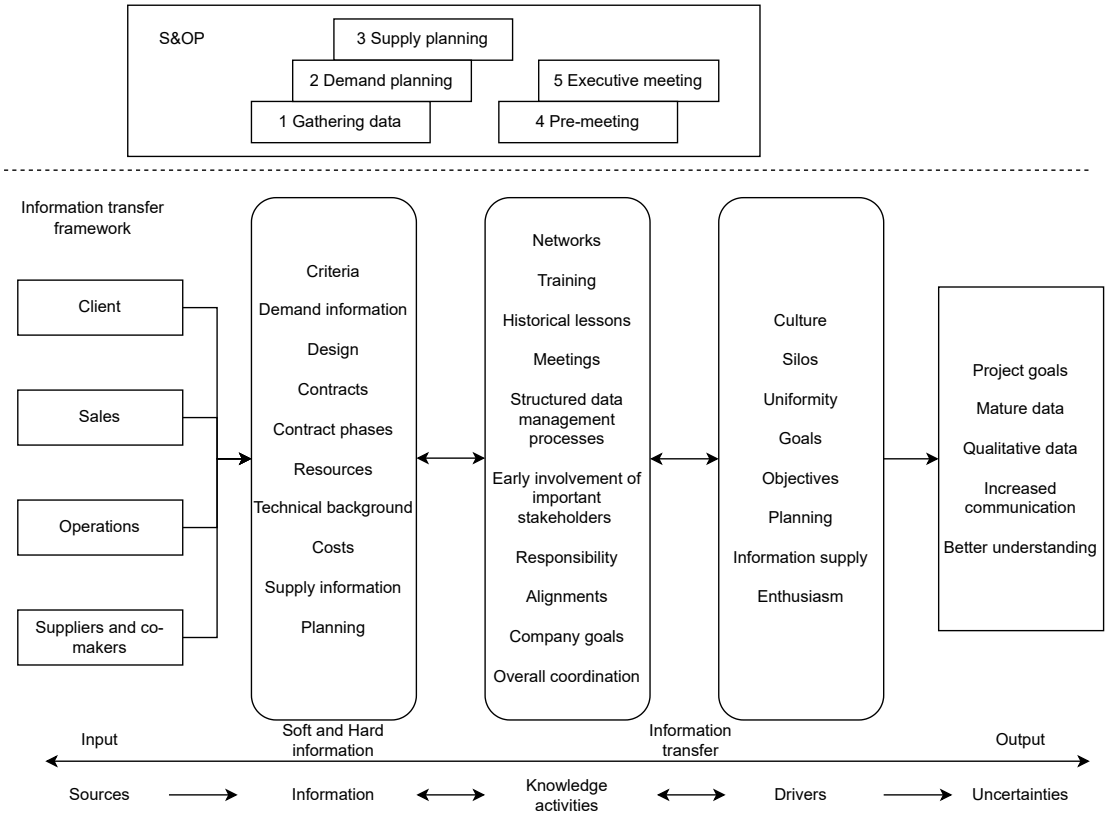

Figure 6.1: The Information Transfer Framework, inspired on Holi, Wickramasinghe, and van Leeuwen (2008)

6.2.3. Explanation of the Information Transfer Framework

Input

The input are the 'sources' for an ITF comes from people and organizations sharing information. In luxury, custom-built Engineer-to-Order environments, a client always requests the design. A sales team sells the yacht, and a design team simultaneously designs the luxury product. Due to the scope of the project, an internal operations team is responsible for the engineering side of the project, and co-makers are responsible for a part of the project's scope.

Soft and hard information

The information shared in the Information Transfer Framework can be both hard and soft information. It includes all necessary information transfer to finish a process successfully. Soft information is often qualitative data containing context that is subjective and harder to quantify or verify. This type of information usually comes from personal experiences, opinions, insights, and judgments. Soft information can be gathered in interviews, conversations, or observations. This information is often transferred verbally and is hard to trace. Due to the verbal delivery, the information not only brings context but also gives insight into the receiver's understanding. When transferring the information, nuances can added, and background stories can be explained. It gives the reasoning behind decisions. Miscommunications or wrong interpretations are mitigated when delivering soft information. Hard information is often quantitative data that is objective, measurable, verifiable and documented. The information often contains formal records like e-mails and technical drawings. It is processed with structured databases and often delivered per e-mail or in the database. Because the information is verifiable, the receiver gets the exact information at the exact moment. In the notes sections, some extra information can be added, but there is no control over understanding or interpretation differences. With hard information, it is more complex to explain nuances in the documents.

Information Transfer

Transferring information from one person to another or from one storage place to another takes action. This is indicated with a knowledge action. The actions range from easily understandable to captured in a complex process. All sources who are sharing information must know these knowledge actions. The knowledge activities are supported by the drives. Drivers are the elements that drive a 'source' to share or not share information. These can be hard and rigid drivers, for example a planning or goal. Or a soft driver, like the culture. Combining a driver and a knowledge activity leads to information transfer in a department or cross-functional.

Output

Improvement of information transfer can be perceived in one of the outputs of the Information Transfer Framework. These outputs are uncertainties that are normally created by the lack of information transfer. Therefore, the uncertainties are added to the information transfer system as an output which should be optimized.

6.2.4. Relations in the Information Transfer System

To link the variables mentioned in chapter 2 to this framework. The framework is the independent variable that affects the dependent variable, which includes collaboration and the way information is communicated. The dependent variable is connected to the uncertainties, which can be found as outputs in the information system. The moderator variable is the S&OP process, which is an overcoupling process in the ITF. The challenges of the ETO environment and the organizational support are included in the knowledge activities and drivers.

6.3. Practical recommendations for an Information Transfer Framework

The second part is the practical knowledge gap of a company operating in the luxury, complex and custom-build Engineer-to-Order environment needing an Information Transfer Framework that improves business operations, with a focus on the maturity and quality of the data. Finally, reduce overall uncertainties in the information share process.

6.3.1. Integration and collaboration

The first recommendation is to enhance integration and collaboration between silos as a first step to closing the knowledge gap on information transfer. This involves creating structured communication channels between the silos and regular meetings between the departments. It is better to regularly meet and maintain the network than not networking at all. Establish regular Sales and Operations Planning (S&OP) meetings with representatives from sales, design, operations, and key suppliers to align objectives, share progress updates, and address issues collaboratively. Implement a clear data management structure and process that allows real-time updates and data sharing among all stakeholders, centralizing information to ensure all teams have access to the latest data. Additionally, maintain good connection with the project manager design and the core team to stay up to date with the latest changes and tasks throughout the project and even after the project to generate a useful feedback loop and to foster better understanding to more seamless information transfer.

6.3.2. Data Management and Quality

Improving the maturity and quality of data is crucial for effective information transfer. The company should invest time in robust data management to understand the current motives and patterns. This pattern can be used to describe and implement a uniform way of working in the project and throughout the company. This results in accurate, consistent, up-to-date and available information. The framework should be governed by policies for data entry, storage, revision control, and access, ensuring data consistency and reliability. Invest in data quality tools to regularly audit and clean data, identifying and correcting errors to ensure accurate information for decision-making. Conduct regular training sessions for employees on data management, including proper data entry techniques, the importance of data accuracy, and the use of data management tools.

6.3.3. Soft and Hard information

Staying flexible while working structured is the key. Balancing the use of soft and hard information is key to effective communication and decision-making. The company should develop strategies to capture, share, and utilize both types of information. Establish centralized knowledge repositories for both soft and hard information, including document management systems for technical drawings and formal records, as well as knowledge bases for insights, experiences, and verbal communications. Encourage informal knowledge sharing through regular workshops, brainstorming sessions, and informal meetings, allowing employees to share insights and experiences that might not be captured in formal documents.

6.3.4. Pro-active problem solving

The Information Transfer Framework should encourage a proactive attitude and clear ownership of tasks and documents among all team members. Regular updates, structured communication channels, and early involvement of the core team and suppliers ensure that potential issues are identified and addressed early. This proactive approach helps to resolve problems that could lead to uncertainties, ensuring that projects remain OSBIT.

By focusing on these areas, the company can significantly improve the maturity and quality of its data, leading to more effective information transfer, better overall project outcomes and reduced uncertainties in the luxury custom-built yachts ETO environment.

6.4. Information Transfer Framework Summary

This chapter concluded the research and closed the knowledge gap on Information Transfer within the Sales & Operations Planning process within the unique and complex Engineer-to-Order environment. With all the background information collected, the main research question can be answered.

6.4.1. Main Question: How should an information transfer framework improve the exchange of information within the Sales and operations planning process to reduce uncertainties in new-build yachts?

The framework should bridge the gap between sales and operations by aligning their goals and improving overall coordination. Clear communication channels and consistent processes prevent misunderstandings and keep the project moving forward smoothly. By fostering a culture of collaboration and open communication, the Information Transfer Framework helps ensure that all stakeholders are working towards the same objectives, thereby reducing uncertainties related to project execution and delivery.

The Information Transfer Framework designed with these principles can improve the exchange of information within the S&OP process, leading to reduced uncertainties in new-build yachts. By enhancing cross-functional collaboration, improving data management and quality, leveraging both soft and hard information, encouraging proactive problem-solving, and ensuring overall coordination and alignment, the Information Transfer Framework creates a foundation for effective and efficient project execution. This approach not only mitigates risks but also ensures that all stakeholders are well-informed and aligned, ultimately contributing to the successful delivery of luxury custom-built yachts.

7

General Discussion, Conclusion and Limitations

The main aim of this research was *How should an information transfer framework improve the exchange of information within the Sales and Operations Planning process to reduce uncertainties in custom-built luxury yachts?* The research objective was introduced as: To explore the role of an Information Transfer Framework in the Sales and Operations Planning (S&OP) process of an Engineer-to-Order (ETO) company, focusing specifically on a company that builds unique custom-built yachts. This chapter includes the General Discussion of the theoretical and practical contribution of the research. Additionally, a conclusion, limitations and finally, recommendations on future research.

7.1. General Discussion

The methodology used is a case study, with a case as unique as an average person would not even think of. The Information Transfer Framework was researched within the luxury custom-built yachts up to 140 meters. The case provides exclusive insight into the uniqueness and complexity of the process; in a niche market full of status, prestige and luxurious lifestyles, there is always a need for something. This time, it is the novel, state-of-the-art research and cutting-edge design of an Information Transfer Framework during the Sales and Operations Planning process of this luxury good.

This research contributes to the theoretical and practical understanding of information transfer within the S&OP process in ETO environments. By developing a detailed Information Transfer Framework and providing actionable recommendations, it addresses critical gaps in the existing literature and offers valuable insights for improving communication and project outcomes in complex, custom-built Engineer-to-Order contexts. These contributions are essential for advancing both academic knowledge and industry practices, ultimately leading to more efficient and effective project management in ETO settings.

7.1.1. Theoretical contribution

This research advances the theoretical understanding of information transfer within the Sales and Operations Planning (S&OP) process. Currently, the more data-driven and even Artificial Intelligence-driven information transfer is scarcely presented in the literature. Additionally, graphical representations of information transfer frameworks are rarely found, and if found, for a specific case or group. This study addresses these gaps by developing a comprehensive Information Transfer Framework (ITF) tailored specifically to the context of an Engineer-to-Order (ETO) environment, focusing on luxury Engineer-to-Order.

This research increases the theoretical understanding of information transfer within the Sales and Operations Planning (S&OP) process, particularly in the context of Engineer-to-Order (ETO) environments such as luxury yacht manufacturing. Firstly, linking the Information Transfer Framework to variables in a theoretical framework, with the ITF being the independent variable moderated by the

ETO environment and the S&OP process. This creates an integration of the theories and environment characteristics. It introduces a comprehensive Information Transfer Framework (ITF) that addresses the current gaps in the literature concerning data-driven information transfer, which is still leaving a gap in AI-driven information transfer. By distinguishing between soft (qualitative, subjective) and hard (quantitative, objective) information, the framework provides a nuanced analysis of how different types of information impact project outcomes.

The ITF also incorporates knowledge actions and drivers discovered in the case study, emphasizing that information transfer is influenced by specific processes and underlying motivations. This dual perspective enriches our understanding of the information flow within an organization. Furthermore, the study's graphical representation was an enormous challenge. Capturing the complexity of the problem, including all variables impacting information transfer. That created a wide perspective of actions to be captured in the ITF. Systematic design and a relatable case study (Holi et al., 2008) in Information Transfer enhanced clarity and applicability, illustrating the complex interactions and flow of information within the S&OP process. By linking effective information transfer to reduced project uncertainties and improved collaboration, this research offers valuable insights for both academic and practical applications in ETO environments.

7.1.2. Practical contribution

This research provides substantial practical contributions to the translation of tacit information-sharing knowledge to a logical and graphical Information Transfer Framework. The scope and long history of the case company in this research show the challenges in understanding and improving information transfer. Thereby improving the collaboration between silos, maturity and quality of data and reducing the uncertainties during a project. Addressing the knowledge gaps in information transfer within companies operating in Engineer-to-Order (ETO) environments, particularly in luxury custom-built yachts. The developed Information Transfer Framework (ITF) offers actionable strategies for enhancing the maturity and quality of data management and communication practices in these complex settings.

One key practical contribution is the recommendation to enhance integration and collaboration between departmental silos. The study suggests implementing regular Sales and Operations Planning (S&OP) meetings, establishing structured communication channels, and maintaining a clear data management structure. These practices ensure that all stakeholders have access to up-to-date information, facilitating alignment of objectives and collaborative problem-solving.

Furthermore, the research emphasizes balancing soft (qualitative, subjective) and hard (quantitative, objective) information. By developing strategies to capture, share, and utilize both types of information, companies can ensure comprehensive communication. The study recommends for centralized knowledge repositories and encourages informal knowledge-sharing practices, such as workshops and brainstorming sessions, to capture valuable insights not documented formally.

Additionally, the Information Transfer Framework promotes a proactive approach to problem-solving, encouraging clear ownership of tasks and early involvement of core team members and suppliers. This proactive stance helps identify and address potential issues early, reducing uncertainties and ensuring projects stay on schedule. These practical recommendations can significantly improve information transfer and project management, leading to better outcomes in ETO environments. However, the perfect balance between the flexibility needed in an luxury ETO environment on one hand, and the structured processes on the other hand is yet to be defined.

7.2. Conclusion

Qualitative research was conducted in order to answer the research question. The study began with a thorough literature review, finding the Sales and Operations Planning (S&OP) process, (luxury) Engineer-to-Order (ETO) and Information Management as important terms that can be attributed to the literature research of this study. The link between these terms is defined in a theoretical framework with the independent variable, which is the researched Information Transfer Framework. The S&OP process, ETO process and technical and operational support formed the moderator variable influencing the relationship between the independent and the dependent variable. The dependent variable contains

the recommended improvements to reduce uncertainties.

The study was followed by a case study. Gathering data through desk research and interviews. The findings of the desk research show the important historical events, helping to analyse the organizational structure which changed in 2016 from a silo culture to a project-based culture. The desk research indicated the existing processes with a focus on the current information transfer process. This is a gate management process with important gates that are often connected to the important contract phases in the process. The first two phases are part of the 'sales and project development' team in which the yacht is designed to the wishes of the client. Thereafter the operational 'project team' takes over the tasks, who are in charge of engineering and building the yacht. This helps to understand the need for a structured Information Transfer System. The interviews showed not only the current process but also the challenges in this process and how to mitigate these risks, including the missing understanding of the 'standard' information transfer system, creating a challenge in expectation on documentation which needs to be managed.

All results are systematically analysed leading to the critical role of an Information Transfer Framework in optimizing the S&OP process for luxury ETO companies. By integrating both soft and hard information, enhancing collaboration, and improving data management, the ITF can significantly mitigate the complexities and uncertainties inherent in ETO projects. The findings and recommendations provided by this study offer valuable insights for both academic research and practical applications, contributing to more efficient and effective S&OP processes in the luxury yacht manufacturing industry.

The study highlights that a newly designed Information Transfer Framework can contribute to a more efficient S&OP process. Better information transfer allows for more accurate resource prediction and allocation, which is particularly critical in the shipbuilding industry where large projects depend on the coordinated efforts of multiple suppliers. By creating consistency and reliability in resource planning, companies can achieve more stable and efficient project management.

7.3. Research limitations/ implications

Although this research provides insight into the Information Transfer System within a Sales and Operations Planning process by a case study. The study is limited to the exclusive and unique luxury, custom-built yacht industry, which indicates a complex ETO environment. Therefore, this study is not one-to-one applicable to any other (complex) ETO environment. The Information Transfer Framework should be adjusted and conceptualized to the necessary setting and tested to the uncertainties and challenges in the specific settings of ETO environments.

During the interviews for the case study, the goal was to clearly describe the Information Transfer Process and visualize this. Therefore, the sample of suitable participants was limited to the higher hierarchical layers of the company, creating a great source of managerial and ideal process level that lacks the view of participants of the information transfer in lower hierarchical levels. Assumptions being made, these employees experience different challenges and uncertainties within the same process but from a different perspective. Due to time limitations, the knowledge activities and drivers found in the Information Transfer Framework are gathered from the same sample as the interview, creating the same possible bias.

The final important limitation is the translation from tacit knowledge to tangible knowledge. During the interview, the challenge in this translation became clear when some participants were unable to sketch even a simple version of the current information transfer. Even the help of example figures didn't increase the ability to sketch. Therefore, a limitation is the interview setting or the way of this question.

7.4. Recommendations

Future research should focus on three main directions derived from this research. Including an in-depth focus on the knowledge activities and drivers within the Information Transfer Framework, defining organizational levels defining the function of the ITF, and instead of this data-driven research, create an AI-driven research in the same environment.

The first recommendation for future research should delve into the specific knowledge activities and drivers within the Information Transfer Framework (ITF) to understand how they impact its effectiveness in luxury Engineer-to-Order (ETO) contexts. Examining how knowledge creation, sharing, and organizational culture influence ITF performance could offer valuable insights for optimizing information transfer processes. Another avenue of research should explore the ITF's operation across different levels of collaboration, from strategic to operational. Understanding how the ITF functions at each level will help tailor its implementation to enhance efficiency and effectiveness in ETO projects. Lastly, investigating AI-driven approaches to the ITF could revolutionize data management and decision-making. Exploring how AI technologies can improve information transfer by providing advanced analytics and real-time processing may address existing challenges and enhance the ITF's capabilities in luxury ETO projects.

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A

Interview protocol

A.1. Opening of the interview

Thank you for the willingness to participate in the interview and thus the research for my Master Thesis. During the interview I will be asking you questions about the current Sales & Operations planning process and the information transfer between the Sales & Project Development team and the Project Team.

A.2. Explain the goal of the interview and research

The goal is to identify the obstacles and needs from both the Sales & Project Development and the Project Team. The results will lead to recommendations on an information system between these two departments.

A.3. Informed consent

Before we proceed, the TUDelft prescribes that in case of interviews you need to inform the participants about the following. After this it is important that you understand the information and agree to participate.

- The interview is recorded with an audio recording.
- After the interview I'll make a transcription and thereafter an anonymized summary. The summary will be send to you afterwards.
- The recordings are stored in OneDrive and within a month after graduation will be deleted.
- Anonymized quotes may be used if necessary.

The ultimate goal is to formulate recommendations for integrating an information system within the S&OP process, as outlined in the thesis report.

So for the Human Resource Ethics committee, can you repeat something in along the lines of: 'I understand the information and agree to participate in the interview'

A.4. Questions

A.4.1. Part 1 Associations

Part 1A Questions

1. What do you think of when I say 'Information transfer within Oceanco'?
2. What do you think other people, from outside the company, think when I say 'Information transfer within Oceanco'?
3. If Oceanco were a character in a story, what kind of personality / character traits would Oceanco have?

4. What kind of personality would you like Oceanco to have?

Part 1B Reflections
You gave the following answer to this question. Can you explain that?

A.4.2. Part 2 Questions related to S&OP and Information systems

Introduction personal
Q. Which department do you belong to, what is your job description? For how long have you been working for Oceanco, and how long have you been in this position?

Summary of information transfer process
Q. I will now provide a summary of the information transfer process. The question for you is whether you are missing any steps or other comments in this process.

Phase for LOI
The Sales & Project development team collects information about the wishes and requirements of the specific customer. They make an overview and prepare a letter of intent (LOI).

- Add PA number to the application
- Short Spec, Design letter, General Arrangement (GA), delivery data and first cost price at LOI.
- Information is stored in a locked document folder in PDMS.

The lead time for this phase for LOI can be long or short. Some projects never reach an LOI, other projects are very mature when the LOI falls and sometimes the LOI falls very quickly and the project is underdeveloped / incomplete.

Phase from LOI to contract
The Sales & Project development team collects information and supplements it in PDMS. In addition, the core team is involved in the PA project. The Sales & Project development team puts together an information package with

- Price calculation
- Contract with the customer
- Bouw Spec
- Appendices of BouwSpec (completeness depends on available time in the LOI phase). Examples are GA and makers list.
- Contact with co-makers about (engineering) assignment, pre-contract.
- Short Spec and Design letter and General Arrangement at LOI.
- Information is stored in a locked document folder in PDMS.

Phase after contract
A Kick-Off meeting is organized in which the documents and document list (Construction Spec + Appendices) are transferred to the Project Team.

- The PA project is converted into a project with a construction number in PDMS. The conversion changes the rights for the Project Team in the PDMS.
- The Project Team does the pre-engineering and basic engineering with the Construction Spec and Appendices (list of documents).

The Sales & Project Development team remains involved in the background for the Naval Architect, customer requests and monitoring.

Q. In your role, how do you send and receive information about a new project?

Q. Do you recognize personal challenges when exchanging information between departments? (no response to email, no time for consultation, etc?)

Q. What should a Kick-Off meeting be about? Who must be present in the Kick-Off meeting?

Q. What do you think is the most important step in the information transfer process? What needs to go well and at the right time to make the information transfer successful?

Q. What are the biggest risks / challenges in information transfer?

Q. How can these risks be reduced and the information transfer process improved?

S&OP
Q. The described information transfer process is known in the literature as the Sales & Operations planning process. Are you familiar with this process?

No: S&OP is a process that makes a prediction about production and resource availability. It combines multiple projects, material, engineering and production availability. In an engineer-to-order (ETO) environment, the main planning task in S&OP is setting a delivery date. Other factors are the product complexity, customization and risks. The S&OP process in an ETO environment contains the following schedules:

- Sales planning
- Engineering planning
- Purchasing planning
- Production planning

Combining these plans and information flows is described in the S&OP process.

S&OP maturity model
The S&OP process is arranged in a 'Maturity Model', this model has 4 stages. The internships are described as follows.

1. Marginal Process Disconnected schedules, multiple repositories
2. Rudimentary Process Formal, fully integrated planning process, incomplete participation
3. Classic Process Formal fully integrated planning process, full participation
4. Ideal Process Supervising process improvements

Q. What stage do you think Oceanco's S&OP process is in?

Information system
Q. What do you think an information process should look like? (A process with gates, checklist per department, Overall checklist)
Q. What are the bottlenecks of that information process system?
Q. What are the gates/moments when information should be transferred? Is there a model for this now?

A.4.3. Part 3 A diagram of a process
Q. Sketch an information transfer system for information from the Sales & Project development team to the Project Team.

A.4.4. Part 4 SWOT analysis
Q. Rank the comments for each category when transferring information from the Sales team to the Project Team. The following input can be used.

PDMS (training, PA freeze map, one environment)
Teams, C: drive, BIM360
Kick-Off meeting (core team, coordinators)
Periodic meeting
Share Client profile / design visie with core team
Involve Engineering-Procurement-Construction triangle
Bouw Spec
Standard specifications
Revision management, document ownership
Detail planning per discipline
Document list (validate / checklist)
ShortSpec / GA / Design Brief with LOI
Gate management
Data driven process
Involve co-makers in early stage
Master Building Schedule,
OSBIT mindset
Contract management
Customer design process

Strength	Weakness
Opportunity	Threat

A.5. Additional space for extra questions

Give the interviewee space to give additional comments, feedback and opportunity to ask questions on the topic.

A.6. Closing the interview

Thank you again for your time and effort. I will provide you with a copy anonymized summary of the interview and will keep you updated on the way the results have been used in the research. There will be an second reportage feedback group session with participants to discuss the outcomes of the interview. At the end of the research I'll update you upon the outcome of the research.

B

Information System items, risks and mitigations

Table B.1: Important steps, risks and risk mitigation in Information Systems

Most important step	Risk	Mitigation
Understand what is coming between LOI and contract	Suprises in tasks that need to be done	Clear system that people can follow. People understanding own taks and the maturity of their input. Managing expectations before contract.
Always access to the latest revision of documents.	Decisions based on incorrect or outdated data.	PDMS notification when new revision is uploaded. Automatically update revisions.
Building specification document, to know what needs to be build.	Differences in interpretation between departments and the client	Managing expextations and contract management. Proper information transfer between departments on the other.
The awareness of the task devision.	Forgetting about tasks and creating delays. Missing document leading to no firm basis to start from.	Communicating about the status of a task. If necessary make a plan to take on the task. Be aware of the critical path. Create clarity and work together with the other departments.
Correct order of collecting information in the phases before contract.	Delivering low quality, incorrect, or incomplete information at the wrong moment. Therfore filling the information gaps without supported project knowledge.	Insight in the status of the information. Wait untill the correct information is available Go ask for the information.
Well executed contract management.	Unsufficient time with client to properly note the criteria. No consensus on the scope. Not enough time to review the contract documents. Not understanding the specifications during development phase by internal and external partners	Putting time and thought in contract management. Giving clarity on things that are 'special'.
The balance between maturity and time. To deliver project information on time, and with good quality.	Time shortage and delay to deliver good quality and right maturity.	Consistency in the process.
Communication on the status of the project.	Not fitting in time and financial and technical resources.	Clear project and contract management. Creating a risk report, and communication. Create support on a horziontal level with EPC triangle.
Relations, understandings and expectations of the client team, correctly transferred to the next team.	People having no priority to explain the other team. Focus area's getting lost in the transfer causing additional work and suboptimal client relationships. Misunderstandings between the company and the client.	Get the understanding to people who werent involved in the process. Including project team earlier, not needing to go back to a previous gate. Create awareness and understanding in the project team and project development team.
Correct understanding of the transferred information.	Differences in interpretation.	Control questions about the transferred information. Well executed contract management.
A feasible planning, with correct time to release information in early phases	Delay in the process from concept to project.	Consensus on when information is available between internal and external partners

C

Atlas.ti Analysis

C.1. Frequency tables

	current Gr=10	like to have Gr=10
chaotic Gr=3	3	0
child Gr=3	3	0
dynamic Gr=4	3	1
friendly Gr=4	3	1
active Gr=2	2	0
ambition Gr=3	2	1
arrogant Gr=3	2	1
connecting factor Gr=3	2	1
growth spurt Gr=2	2	0
passionate Gr=2	2	0
playful Gr=3	2	1
positive Gr=3	2	1
resistance against change Gr=2	2	0
schizophrenic Gr=2	2	0
ad hoc Gr=1	1	0
authenticity Gr=4	1	3
compliant Gr=1	1	0
empathy Gr=1	1	0
gentleman Gr=1	1	0
golden boy Gr=1	1	0
immature adult Gr=1	1	0
managing Gr=2	1	1
marketing Gr=1	1	0
motivational Gr=2	1	1
narcissistic Gr=1	1	0
not transparent Gr=1	1	0
open Gr=3	1	2
open to change Gr=2	1	1
opportunistic Gr=1	1	0
personality Gr=3	1	1
polite Gr=1	1	0
procedural Gr=3	1	2
protective Gr=1	1	0
reliability Gr=3	1	1
responsible Gr=5	1	3
sensitivity Gr=1	1	0
short term Gr=1	1	0
solution-oriented Gr=3	1	1
spoiled toddler Gr=1	1	0
structured Gr=2	1	1
supportive Gr=2	1	1
working hard Gr=2	1	1
accountable Gr=1	0	1
aware of the process Gr=1	0	1
collaborative Gr=1	0	1
efficient Gr=2	0	2
firm Gr=1	0	1
honesty Gr=1	0	1
long term Gr=1	0	1
looking ahead Gr=2	0	2
mature Gr=1	0	1
resilience Gr=2	0	2
transfer skills Gr=1	0	1
transparent Gr=1	0	1

Figure C.1: Frequency table personalities, Atlas.ti

	IT important step Gr=10	IT challenges Gr=15	IT mitigation Gr=11
Acceptation Gr=2	4	5	5
Assumptions Gr=1	3	4	4
Automation Gr=1	3	2	3
Expectations Gr=6	3	5	1
Revision management Gr=2	3	2	0
Act Gr=1	2	2	4
Availability Gr=1	2	2	2
Awareness Gr=1	2	2	2
Completeness Gr=2	2	1	1
Consensus Gr=1	2	0	1
Feedback Gr=1	2	2	1
Risk report Gr=1	2	1	0
Understand Gr=12	2	0	0
Balance Gr=3	1	5	2
Building Spec Gr=3	1	1	2
Changes Gr=2	1	2	2
Client Gr=9	1	2	1
Critical path Gr=1	1	1	1
Deliver Gr=1	1	5	1
Documentation Gr=7	1	3	1
Early stage Gr=2	1	1	1
Help each other Gr=1	1	0	0
Interpretation Gr=2	1	2	0
Lose information Gr=1	1	0	0
Meetings Gr=3	1	0	0
Nuances Gr=1	1	0	0
One environment Gr=3	1	0	0
Planning Gr=1	1	0	0
Process Gr=7	1	0	0
Relationship Gr=1	1	3	0
Software Gr=2	1	0	0
Specific Gr=1	1	1	0
Startpoint Gr=1	1	0	0
Strategy Gr=2	1	1	0
Timing Gr=9	1	0	0
Transfer Gr=5	1	0	0
Value Gr=2	1	2	0
Baseline Gr=4	0	0	2
Between teams Gr=1	0	5	2
Budget Gr=1	0	0	2
Clear Gr=7	0	0	1
Communication Gr=6	0	0	1
Context Gr=1	0	1	1
Contract Gr=5	0	0	1
Control on process Gr=1	0	0	1
Coordinate Gr=1	0	0	1
Coorporation Gr=1	0	2	1
Culture Gr=1	0	0	1
Data management Gr=1	0	0	1
Details Gr=1	0	0	1
Development Gr=1	0	0	1
Differences Gr=1	0	0	1
Disciplines Gr=1	0	1	1
Financial Gr=2	0	1	1
Finish process Gr=1	0	2	0
History Gr=1	0	1	0
Improving Gr=1	0	1	0
Information Gr=4	0	1	0
Involvement Gr=2	0	1	0
Kick-off Gr=6	0	2	0
Knowledge Gr=3	0	1	0
Lose context Gr=1	0	1	0
Management Gr=3	0	1	0
Match Gr=1	0	1	0
Maturity Gr=5	0	1	0
No surprises Gr=1	0	1	0
Overview Gr=1	0	1	0
People Gr=6	0	2	0
personality Gr=3	0	1	0
reliability Gr=3	0	1	0
responsible Gr=5	0	1	0
solution-oriented Gr=3	0	1	0
Standard Gr=4	0	1	0
Status of project Gr=1	0	1	0
System Gr=3	0	1	0
Tasks Gr=3	0	1	0

Figure C.2: Frequency table Information Transfer Framework, Atlas.ti

C.2. Sankey diagram, Atlas.ti

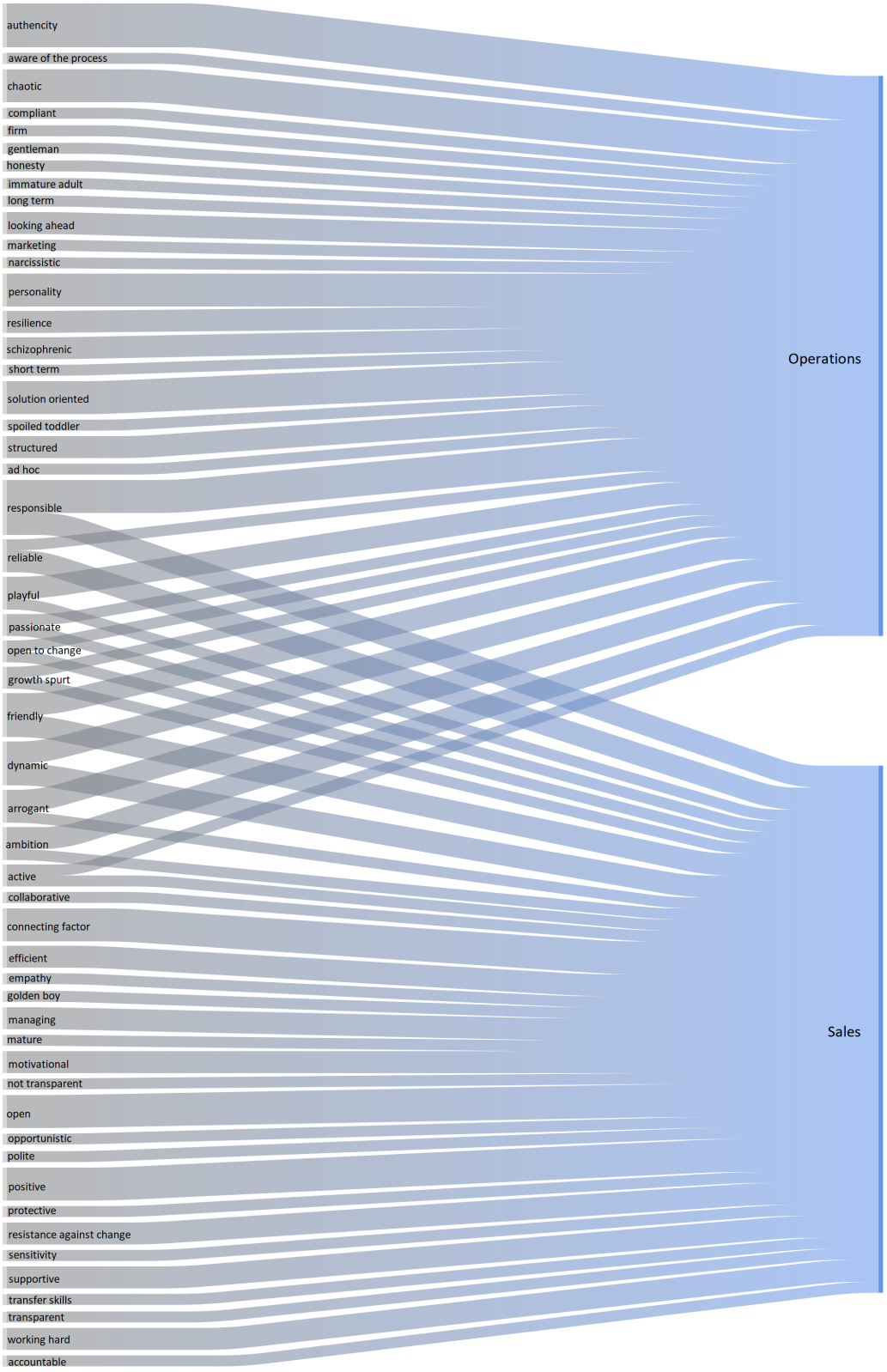

Figure C.3: A Sankey diagram in the differences of sales and operations regarding the personalities

D

SWOT analysis

Table D.1: Integrated SWOT analysis

All strengths ranked		**All weakness ranked**	
Operations	**Sales**	**Operations**	**Sales**
Building Specification	Include co-makers in early stage	Not share client profile	Contract management
PDMS	Customer design process	High over information as basis for building spec and costing for suppliers	
Consult suppliers in early stage	EPC triangle	No review from PT at LOI phase	No detail planning per discipline and not keeping progress
Deliverables checklist	Flexibility DP / PT	Resources schedule	Data driven process instead of human communication
Document list	Involve PD / core team	Expectation management with client team	Buildability
Periodic meeting	Coorperation of CC, PT, horizontal)	Gate management	OSBIT awareness in design
Short Specification	Periodic meeting	Communication on ownership document	Yard standards / technical spec
Freeze PDMS folder at LOI	PDMS	Decision schedule	Customer design process (building only the perfect yacht)
Gate management	Short spec / GA / DB at LOI	Criteria	Not involving co-makers early enough
Package management	BIM 360	External distribution of documents	Desisions based on data
Client experience	Revision management	Standard specs	Customer journey
	Kick-off meeting	Connection between design and PT after contract	
	Share client profile		
All ranked opportunity		**All threat ranked**	
Operations	**Sales**	**Operations**	**Sales**
Shared planning (L2)	EPC triangle	Not sharing client profile	Unrealistic expectations towards: planning, quality, completeness
More functional building spec	Data-driven	Sales & Operations not aligned	No ownership / responsibility at budgets
Agreed MDL incl status from Design to Engineering	Share client profile	Client input / demand	Non standardization
Matching personalities / behaviour	Kick-off meeting	Not all information visible	Uncertainties in contract
EPC triangle	Financial understanding	Data sharing	Checklist attitude
Share client profile	Risk report	PDMS as tool for S&O	LOI into and refering to yachts
Standard spec	Standardization	Resources	Not invented here syndrome
Include co-makers (expectation difference)	Info transfer in regular meeting	Non collaborative attitude	Too much involvement in early stage
PDMS one environment	Include core team (for standard spec)	Unclear data quality	Teams, C:drive
BIM360 -> interaction with client	PDMS notifications	Handover not properly	Connection with PT through the build
Data-driven	Contract management	Storing files in multiple locations	Limited supplier pool (to deliver information)
Gate management	Feedback loop (on the budget)	Customer design (un)limited	
OSBIT mindset	Integrated planning	Client profile (use as source of information)	
	Gate management	No PDMS policy	
	Periodic meetings	No data-driven process	