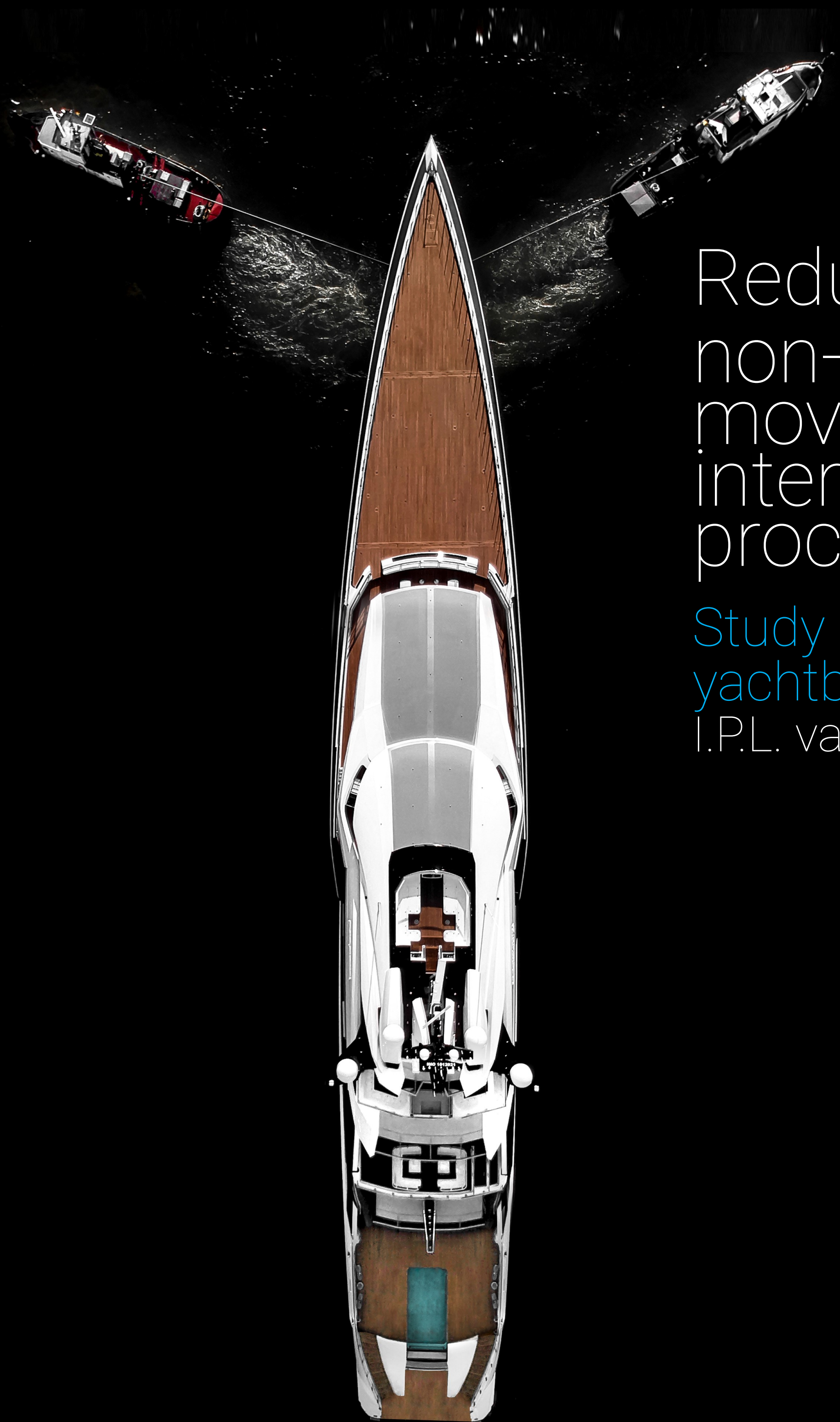

Reducing the non-value added movements in the interior logistics process

Study provided by yachtbuilder Oceanco

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TU Delft

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by

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Preface

This document describes my graduation project for the master study Ship Design, Production and Operation at the Technical University of Delft. During a graduation period intern at Oceanco, this research was conducted. The goal of this research is to reduce the non-value added movements in the interior logistics process by combining a set of improvement methods.

I would like to thank Oceanco for the opportunity to do my graduation project at the knowledge & Innovation department. Especially, I would like to thank Stefan Brandhorst and Jaap Kouwenhoven from Oceanco for their mental and knowledge support during my project.

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Abstract

In this thesis a set of improvement methods are combined that can be used to improve the non-value added movements in the interior logistics process on a shipyard. These set of combined improvement methods is built for yachtbuilder Oceanco. The main research question that is answered is: *To what level can the non-value added movements in the interior logistics process be reduced by combining multiple improvement methods?*

The supply for luxury yachts is growing which increases the competition between yachtbuilders. To stay ahead of competition, yachtbuilders reduce the production lead times and try to maximise the output with the available space. These puts extra pressure on the logistics process. At the yard of Oceanco the logistics process is inefficient. Not all the installation items can be stored at the shipyard itself. Therefore, Oceanco has an external storage location. This external saved inventory however creates unnecessary movements, which can be seen as waste in the logistics process. If the logistics department wants to keep up with the company growth and speed in the yacht building process, Oceanco's management needs to work on a more efficient process where the non-value added movements are reduced.
Improvements in the progress communication, the flow of items and the supplier process standards can help to reduce or even eliminate the non-value added movements. From the literature study the methods Lean and Lean Six Sigma are selected to improve the communication, flow and standards of the logistics process (Goldsby and Martichenko, 2005) (Bhuiyan and Baghel, 2005). These methods makes use of the five stage Deming's Define-Measure-Analyse-Improve-Control cycle (DMAIC) (Hoon and Anbari. Frank, 2006).

The two most important Key Performance Indicators which indicates the performance of the logistics process are the non-value added movements and the logistic expenses. These KPI values are derived by simulating an "as is" model, which simulates the current logistics process for yacht Y718. By this model the main challenge that increases the non-value added movements is derived; the interior production and previous installations delays at the start of the interior installation. During the interior process, less action on the inventory inflow of the collies were taken due to financial reasons. Oceanco receives money from her client when the complete fixed interior is delivered at the yard; this is one of the ten financial milestones during the total project. Which means that the inefficient logistics process generates cash faster, this is more beneficial from a financial perspective of Oceanco. Therefore, conclusion can be drawn that the mechanism of milestone related income is the main cause of increasing non-value added movements deliberately resulting in an inefficient logistics process.
Two financial milestone scenarios are drawn in this research. Scenario one divides the financial milestone over the timeframe of the interior process. Scenario two keeps the original financial milestone mechanism where the full payment is done when all fixed interior is on the yard.

The improvement tools, based on the selected set of methods, that can be applied on the logistics process are; lead time management & flexibility, just in time, frequency and lot size, levelled flow and additional standardisation. These improvement tools are implemented in an improvement model, which shows for both financial milestone scenarios the non-value added movements and logistic expense reduction related to the values in the "as is" model for yacht Y718. Combining the improvement tools in the model with suitable values, it is possible for Oceanco to reduce the non-value added movement in the interior logistics process in the order of 80% compared to the current situation. Resulting in an improved non-value adding movement level in the order of magnitude of twenty movements per project. This ensure a logistic expense reduction in the order of 50%. These reduction through logistics improvements can be reached by changing the financial milestone and by implementing the improvement tools. The actual total logistic expense reduction however will be lower due to interest payment over the loan that is needed when the financial milestone is not changed. Oceanco must decide which, of the two financial milestone scenario is feasible and has the best fit with their strategy for the near future.

The "as is" model and improvement model still must be validated with accurate data, supported by a lo-

gistics service portal system, by future building yachts. Thereafter the improvement model can be expanded over the entire logistics process of Oceanco instead of only the interior. Additionally, when the improvement model has been validated by multiple yacht simulations, the improvement model can be used as an prediction model. With this prediction model the impact on the expenses and the non-value added movements can be calculated when unexpected changes in the planning occur. For further research at Oceanco is it recommended to investigate the impact on the inventory of the half-full boxes which are placed for a second time in the inventory. Additionally, research into the applicability of machine learning on the prediction model can be of great value.

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Acronyms

5S Sort, Set, Shine, Standardise and Sustain.

BD Bridge Deck.

BPM Business Process Management.

BPR Business Process Re-engineering.

CI Continuous Improvement.

CoP Collaboration-oriented Performance.

DBR Drum, Buffer and Rope.

DMAIC Define, Measure, Analyse, Improve and Control.

FIFO First In First Out.

HVAC Heating, Ventilation and Air Conditioning.

HWF Hot Work Free.

JIT Just in time.

KPI Key Performance Indicator.

LD Lower Deck.

LIFE Lengthened, Innovative, Fuel-efficiency and Eco-friendly.

LSP Logistics Service Portal.

MCT Manufacturing Critical Path Time.

MD Main Deck.

MW1 Marineweg 1.

MW5 Marineweg 5.

PDCA Plan, Do, Check an Act.

POLCA paired-cell Overlapping loops card with Autorization.

QRM Quality Response Manufacturing.

RFQ Request for Quotation.

SCOR Supply Chain Operational Reference.

SIMPOC Supplier Inputs Measurement Procedure Outputs Customers.

TOC Theory of Constrains.

TPM Total Productive Maintenance.

TPS Toyota Production System.

TQM Total Quality Management.

UD Upper Deck.

VBA Visual Basic for Application.

VSM Value Stream Mapping.

Y718 Yacht number 718, Bravo Eugenia.

1 Problem introduction

In this era, there is a significant competition in the yachtbuilding industry. Additionally, the yachts become bigger and bigger (Prinses, 2019) (Frank, 2018). Yacht innovations, improvements on the yard and shorter lead times are necessary to stay ahead of competition.
It is a logistics challenge to keep up with the process speed. The logistics process must be as efficient as possible to keep the production process of the yacht on track. In this research the logistics process will be investigated of yachtbuilder Oceanco. In this chapter an introduction will be given of the problem statement of the logistics process at Oceanco. Starting with a small introduction of the company Oceanco. Followed by the problem background, research problem and research questions.

1.1. Introduction Oceanco

Oceanco is a yachtbuilder who builds one of the biggest superyachts in the world. Each year, on average about two innovative new yachts are produced. Oceanco is a project organisation in which project teams are accountable for the realisation of a project. The company works with an outsourcing business model, also recognised as an assembly model. This implies the following aspects. Firstly, Oceanco markets and sells the Oceanco Yachts. Secondly, Oceanco develops the project in close consultation with subcontractors and other external parties. Thirdly, the basic engineering will be executed together with the company Lateral in close consultation with the subcontractors. Lateral is a naval architect that works together with Oceanco. Last, Oceanco aligns the project realisation. The execution of the project is mainly performed by subcontractors and other external parties.

The yacht building project starts with the alignment with the client. After this alignment a selection will be made of designers and co-makers which do already some engineering work. When the co-makers and designers are chosen the basic engineering can start, followed by the detail engineering. After all the detailed drawings is done, the production of the bare hull of the yacht, the casco, can start. At the yard of Oceanco, there are no hot work facilities. The casco is built by the co-maker Zwijnenburg. If the casco is hot work free (HWF) the object is transported to the yard where the outfitting phase can start. At the yard the painting, installation of the electrical systems, last piping and interior takes place. Next step will be the commissioning, load out or float up and sea trials. If the yacht performs as it should and the installation of the yacht is all finished, it is time to hand over the yacht to the client. After finalising any ongoing issues, the yacht will be handed over to Oceanco's fleet support.
Applying the assembly model means that all co-makers built their item/parts of the yacht at their own facility. Only the installation of all these items/parts takes place at Oceanco's yard. The transport and storage of all these items that need to install on board is arranged by the logistic point at Oceanco. The logistics at Oceanco is arranged by the sub-contractor Maat.BV. Maat manages the entire logistics process on the yard while building a yacht. The main action of the logistic point is to store delivered items in the inventory and place the items on board. It is their target to get the right product to the right place at the right time in the right quality and condition at the lowest possible cost. Due to the assembly model, it is key to manage the coordination of the items flow and the progress communication during the process to keep the control of the logistics process at the yard.

1.2. Problem background

Five year ago, Oceanco build one yacht per year. Nowadays, the market for a yacht is growing and so the yacht building competition. Currently, Oceanco delivers two yachts per year with the same available floorspace. Besides building new yachts, Oceanco has the ambition doing superyacht refit projects. So for this growing company, lead time reduction and more efficient use of available space may lead to increased yacht output.
Oceanco preferably wants to use most of their floorspace for yacht building only. The consequences are that not all the installation items can be stored at the shipyard itself. Therefore, Oceanco has an external storage location at Nieuwland Park where the goods are stored, a driving distance of fifteen minutes from the yard. This externally saved inventory however creates unnecessary movements, which can be seen as waste in the logistics process. The external inventory is one of the biggest waste factors in the logistics process. The current inefficient logistics process can act as a bottleneck for Oceanco in realising the shorter lead time and increased yacht output.
If the logistics department wants to keep up with the company growth and speed in the yacht building process, Oceanco's management needs to work on a more efficient process where the non-value added movements are reduced.
The size of the impact on these unnecessary movements is mainly determined by the following three factors. Firstly, there are more than one subcontractor for the same system on the ship. For example, the interior on the yacht is produced by two or three different subcontractors. Each subcontractor has their own way of working. They produce, transport and install their goods with their own standards. Some different standards of the subcontractors are for example the lot size, box dimensions, deliver time, install principles etc. The different standard makes the logistic process complex which influence the efficiency of the yard.
Secondly, the progress communication between Oceanco and the multiple sub-contractors is of great importance during the processes. Changes in design, delays, etc. need to be communicated to all involved parties to make the project run as smoothly as possible without high risks. Changes in the schedule without clear communication results in an increase of the inventory level, which increases the extra movements.
The third factor that influence the impact is flow. The item flow at Oceanco is considered the coordination between the production of the items and the installation of these items on board of the yacht. If the items do not flow through the processes, the inventory will be overloaded and the extra movements will increase.
The above-named factors; different process standards by the subcontractors, communication and flow of the items influence the impact on the extra movements at Oceanco. Improvements in these factors can help to reduce or even eliminate the non-value added movements.

1.3. Research problem

In this paragraph the research objective, the research scope and the specific process will be defined.

1.3.1. Research objective

Based on the above problem statement, the following research objective can be formulated:

To eliminate the external storage at Oceanco by improving the logistics process using a set of improvement methods

1.3.2. Research scope

To study all logistic processes at Oceanco is beyond the scope of a thesis, therefore this research starts by looking into the largest logistics flow, the interior. The interior process at Oceanco will be explained in next section 1.3.3. The interior elements within scope of this thesis is the fixed interior, such as ceilings, walls, floors and fixed furniture's. Special interior, for example art are outside this scope. It is the intention to keep the suggested improvements to the logistics process as generic as possible to implement it as well for other processes, for example the HVAC systems and piping.
At Oceanco there are four major interior co-makers: List, Sinnex, Oldenburg and IHC. The logistic process for these four co-makers will be investigated. Interior can be split up into crew and luxury interior. Some of the above mentioned co-makers are responsible for the crew interior and others for the luxury interior. The

logistic process of both types of interior are the same. So for this research no distinction will be made between crew and luxury interior.
Oceanco has two halls, Marineweg 1 (MW1) and Marineweg 5 (MW5). The focus of this research is on MW5, because this hall has planned already some logistics improvements which can be used in this research. However, the outcome of this research must also be useful for MW1.
The applied improvement of the logistics process in this thesis are only related to the progress communication, flow of the items and different standards in the interior process of the co-makers.

1.3.3. Interior process

In this section the main factors which influence the interior process are explained. Each process at Oceanco consists of a design, engineering and production phase. Before the design phase of the interior a potential group of co-makers and an interior designer are already selected. The co-makers are selected by Oceanco and the designer by the client. If all plans of the project development such as construction plan, arrangement of technical spaces, deck height etc. are defined, the pre-engineering can already start in the interior department and the designers. The architect will create some documents and plans, which will be checked on the correctness by the interior experts of Oceanco. Examples of documents which are made by the designer are concept rendering, mood boards, concept lighting plan, etc. The interior department creates a Request for Quotation (RFQ) which contain as much available information needed for the interior subcontractors to be used as base for their quotations. When the contracts are all signed the basic engineering can start.
The designer works out the pre-design by creating a full design including AutoCAD 2D wall view drawings and ceiling plans. The interior engineers at Oceanco check the feasibility of the design. They also forward all the information of the designer to the interior sub-contractors. The interior co-makers start their basic engineering by creating detail booklets, mock-up drawings, provide information for electrical items, start-up wood samples procedures. etc. This is all checked by the interior department of Oceanco. When the basic engineering of the interior in finished the detail engineering can start. Here the procedures described by the basis engineering will be continued. The interior expert feed the co-makers with information which is needed for the production of the shop drawings. When the engineering package for the interior is completed and checked by the interior experts the co-makers can start their workshop drawings. When the shop drawings are signed these will become 'as built' drawings and ready for production.

The production of the goods takes place at the co-makers manufacturing location. Their production planning is based on the installation planning of Oceanco and is made by the co-makers themselves. They send the interior items to Oceanco when the interior parts are done and needed on the yard. Communication between Oceanco and the co-makers during the project is important due to changes of the total planning. The interior installation takes place at the end of the total building process where the likelihood of delays is increased. Changes in the planning and insufficient communication between the co-makers and Oceanco will result in high inventory levels at Oceanco resulting in unnecessary movements.
The interior production of Oceanco start with the arrival of the interior. The items are stored in the inventory of Oceanco until the items can be installed on board. It depends on the number of stored interior items if the goods can be stored internal or external. Installation of interior is a complex process, because the installation of the interior, piping and electrical systems are interdependent. Appendix A shows this complex installation process of the interior. There is a certain installation sequence through the yacht which Oceanco follows. The interior installation starts at the bottom-front of the yacht where the crew areas are located. Less complex systems and piping are located in this location where the interior installation can start directly. From the bottom-front of the yacht the installation moves slowly to the top-after side of the yacht. At the middle- and top-aft section of the yacht the luxury rooms are located where many electric cables and piping systems are located. At last the installation followed down towards the machine/system rooms where the most cables and electric cables are located.

1.4. Research questions

In this paragraph the main question and sub research question will be outlined.

1.4.1. Main research question

Based on the previous paragraphs the main research question can be formulated:

To what level can the non-value added movements in the interior logistics process be reduced by combining multiple improvement methods?

1.4.2. Sub research questions

Several sub research questions are set up in order to answer the research question.

1. Which improvement methods can be implement to improve the flow, communication and different supplier standards in a logistics process?
2. What is the current situation of the interior logistics process?
3. Which improvement tools can be used at the current situation of the interior logistics process?
4. Which combination of the chosen improvement tools can be implemented which improves the movements at the yard?
5. What should Oceanco do to implement the interior logistics improvements?

2
Selection methods

This chapter selects suitable improvement methods that will minimise the non-value added movements in the logistics process. In this chapter a selection of combined improvement methods will be made that focuses on the communication, flow and standardisation improvements. The goal of this chapter is to find the best combination of methods including an improvement cycle, which form the fundamentals for the framework to improve the non-value added movements. This selected improvement cycle will be the guideline during this thesis, which will answer the above-mentioned sub-questions. Firstly, the requirements to which the methods need to comply are explained. Secondly, the evolution of the improvement methods will be discussed. Thirdly, the improvement theories which can be used for this research are all explained separately, to give an indication on how good the improvement method matches with the requirements. Finally, a selection of the combined methods and their improvement cycle will be given, based on the requirements.

2.1. Requirements

By taking the problem statement into account, several requirements can be formed which are related to the improvements of the logistics process of Oceanco;

1. Reducing the logistics movement waste
2. Increasing the efficiency of the logistics process
3. Improving the flow of the interior goods/items
4. Improving the internal communication and the external communication with selected suppliers
5. Improving the various interior process standards of these suppliers
6. Oceanco must be familiar with the method

The first two requirements focuses on the direct problem of the organisation. The movement waste need to be reduced to increase the efficiency of the logistics process. Therefore, the non-value added movements at the external location needs to be reduced. These movements can be reduced by improvements that focuses on the communication, lot size and standardisation. The third, fourth and fifth requirements includes these three focus points. The last requirement is important for the implementation of the improvement. It is easier to implement improvements in the organisation when the company is familiar with the method. Next section will discuss the verification and the validation of these requirements, to reduce the likelihood of missing or invalid requirements.

2.1.1. Requirements verification and validation

Requirements verification ensures that each requirement has been satisfied. Verification of the requirements can be done by logical argument, inspection, modelling, simulation, analysis, expert review, test or demonstration (Bahill, 2005). The first two requirements are verified by analysing a series of logical deductions of the improvement model explained in chapter 7. Improvements of the lot size, flow and communication reduces the non-value adding movements and increases the logistics efficiency on the yard. The third and fifth

requirement can be verified by modelling. An improvement model is created where a selection of flow and lot size improvement tools are implemented. The fourth requirement can be verified by exerts review. By creating more control in the inventory, the progress communication between the suppliers will be less and more clearly. The experts can perceive the improvements in communication. The sixth requirement is verified by experts, where the experts know the applied improvement methods in the organisation.
Validation of the requirements ensures the correctness, completeness and consistence of the set of requirements (Bahill, 2005). This means that if one of the requirements is removed, the desired results of the research is not feasible anymore. For the above mentioned set of requirements only the second requirements can be merged with the first requirement. All other requirements approach different aspects that follow from the scope, which makes the requirements complete. Next to the correctness and completeness, all requirements are achievable due to the wide range of the improvement factors communication, flow and standards. In addition, validation of the requirements ensures that a model can be created that satisfied the requirement (Bahill, 2005). In this thesis an improvement model is created, where improvement tools are implemented which are primarily selected by the requirements and selected methods.

2.2. Evolution of improvement methods

In this section a global overview is given of the evolution of the improvement methods to get a better understanding in the improvement development during the years. Not all the improvement methods are mentioned here, only the ones which contributes to a significant development in the logistics process improvement.
The roots of improvement methods lay in the 1800s. The management encourages employees to improve the processes. These employees got extra money if they brought positive changes in the company. In 1894, the National Cash Registers Programs was developed. This program included reward schemes, employee development opportunities and improving labour-management relationships (Bhuiyan and Baghel, 2005).
Around 1900 Taylor's scientific management became important. This method helps managers to analyse and solve production problems using scientific methods based on controlled time-trials to achieve proper piece rates and labour standards (Bhuiyan and Baghel, 2005). In 1950 Deming introduced the Deming cycle, also known as Shewhart cycle or Plan-Do-Check-Act (PDCA). This method used the plan-do-check-act as an improvement solution. If the rotation is finished, the circle starts over again and continuously improvement take place (Salman et al., 2008). In the 1950s also the method Lean was introduced by the philosophy that originated from the Toyota Production System (TPS). Later on, around the 1980s, Womack and Jones documented and disseminate the Toyota approach (Salman et al., 2008).
The "gurus" of the improvement methods are: Shewhart, Deming, Juran, Ishikawa, Taguchi, Crosby and Shingo (Sheen, 2017). Most of the gurus have an American or Japanese nationality. Each guru provided a variable contribution and each emphasise a different aspect of process improvements. In the 1970's the "gurus" created business wide process improvement methods. Quality becomes important in the entire organisation and not only the production processes. The first method was Total Quality Management (TQM) (Bhuiyan and Baghel, 2005)(Sheen, 2017).
In 1970 also the method Theory of Constrains (TOC) was formed by Goldratt in his famous novel "the Goal" (Goldratt, 2014). This method focus on the constraints/bottlenecks. In 1985 the method Six Sigma became popular when Motorola Inc. started with it to measure process quality using statistical process control.
Around 1990, a new method developed which translated the objective of the organisation into measures, goals and initiative in four different perspectives. This method is called the balance scorecard (Bhuiyan and Baghel, 2005). In 1990 also the Business Process Re-engineering (BPR) took place. This method focus on the rethinking and redesigning of the business process, which achieve improvements in the organisation's cost, quality, speed, etc. (Salman et al., 2008). Due to all these different methods there was confusion of which methods companies must be used. The ISO-institute introduced the ISO9000 that record standards how companies can guarantees its quality (ISO, 2018).
In 1998 Suri published his book "Quick response manufacturing" (Suri, 1998). In 2010 Suri published his new book "It's about time", where he explains the developments of his theory (Suri, 2010). Quick Response Manufacturing (QRM) is a method that focuses on the reduction of the lead time internally and externally. QRM enhance the Lean, Six Sigma strategies to bring companies to the next level (Suri, 2010). In 1999 the supply chain council came up with the Supply Chain Operations Reference (SCOR). In contrast with the other mentioned models, these model cope with the entire supply chain. SCOR can be used as a model for evaluating and positioning the supply chain. The major objective of the SCOR model is to improve the alignment

between the suppliers (Huan, 2004). Around 2000, the Business process management (BPM) method was introduced. It is a method that support the organisation with the wants and needs of customers (Salman et al., 2008).
In the 2000s, also the evolution of the hybrid methods took place. It became clear that one method is not effective enough to solve all issues in a company. A combination of methods helps to overcome the weaknesses of one program to improve the operations in a company. Examples of Hybrid methods are Lean Six Sigma, agile, Scrum, etc.(Bhuiyan and Baghel, 2005). Nowadays, the hybrid methods still develop.
To summarise the above described history of the improvement methods a timeframe is given in figure 2.1. Five methods can be selected which matches best with the requirements of this thesis. Additionally, these methods are used most often in production organisations and have reliable literature available. The following five theories are selected;

1. Lean
2. Six Sigma
3. Theory of Constraint
4. Lean Six Sigma
5. Quick Response Manufacturing

These theories will be explained in more detail in the next section, where it will become clear whether the selected methods meet the requirements.

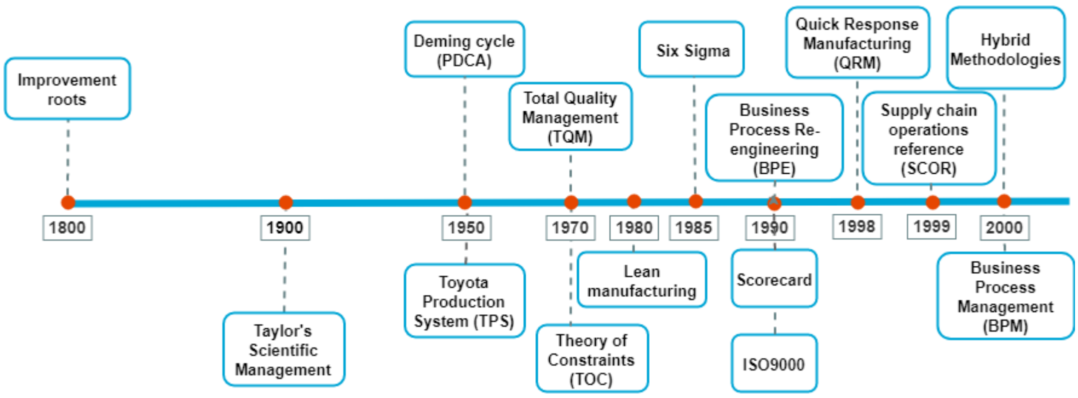


Figure 2.1: Timeframe evolution improvement methods

2.3. Types of improvements

In this section the five improvement methods Lean, Theory of Constraints, Six Sigma, Lean Six Sigma and Quick Response Manufacturing are shortly introduced and explained. These five methods are chosen to explain in more detail due to their significant match with the requirements. The goal of these method introductions is to give an indication on how good the improvement method matches with the requirements, which will be used in a multi-criteria analysis. This multi-criteria analysis is shown in table 2.4 in section 2.4. In the following subsections the correlation between the requirements and the improvement tools will be discussed.

2.3.1. Lean

During the early twentieth century Henry Ford developed Lean manufacturing when he noted mass production in his factory. The Japanese improved the method Lean manufacturing by identifying it as an approach to eliminating and identifying waste through continuous improvements by pulling the product through the process (Bhuiyan and Baghel, 2005).
In the 1950s, Japanese car company Toyota developed an efficient production system, Toyota Production System (TPS), which is now known as the pioneer of Lean thinking. TPS is designed to maintain a continuous flow of products in factories in order to adjust flexibility to change in demand. Only a small part of the process

actually add value to the product. These value adding processes need to be found and marked as important. Together with a principle that pulls the product through the process instead of pushing leads to a continuous flow.
In 1996, Womack and Jones described Lean thinking as "muda" the Japanese word for waste. With Lean thinking, Lean manufacturing and TPS are meant. Important aspects of Lean thinking are less inventory, less human effort and less time to develop products. The three principles of Lean manufacturing are: improve flow of material and information, focus on pull and commitment of organisations to continuous improvement (Bhuiyan and Baghel, 2005). Another important aspect for Lean systems is that the production must be standardised to eliminate unnecessary variations that causes waste (Thomas, 2018).
Lean identified 7 types of waste; transportation (unnecessary movement of goods), inventory, motion (unnecessary movement of people and machinery), waiting time, overproduction, over processing, and defects. For the logistics process at Oceanco the transport waste, inventory waste and motion waste are important.
Lean knows five essentials steps (Nave, 2002):

1. Identify which features create value
2. Identify the sequence of activities called the value stream
3. Make the activities flow
4. Let the costumer pull product or service through the process
5. Perfect the process

To achieve a Lean process that helps to complete the above mentioned steps, five Lean methods are developed (Arturo, 2018):

- Just-in-time (JIT) - tells to produce the right good at the right time
- Total productive maintenance (TPM) - helps to optimise predictive, preventive and corrective maintenance activities to achieve efficient production equipment
- Automation/ Jidoka - reduces quality defects
- Value stream mapping (VSM) - identifies and measured waste that result from the incapability, inefficiencies and unreliability of money, machines, people, information, space, time, tools, and material during a production process
- Kaizen/Continuous improvement (CI) - a platform for sustainment of Lean

The tools for each method are shown in figure 2.1.

Lean Methods	**JIT**	**TPM**	**Autonomation**	**VSM**	**Kaizen**
Lean Tools	One piece flow	Overall equipment effectiveness (OEE)	Mistake proofing/ Poka-yoke	Current state map	5S
	Pull system	Planned maintenance	Andon / visual control system	Future state map	Brainstorming
	Takt time	5S	Full work system	Flow diagrams	Continuous flows
	Levelled production	Quality maintenance			kanbans
	Cellular manufacturing	Single minute exchange of die (SMED)			Data checks
	Vision control	Initial control before starting production			5whys
	Kanban/pull production	Safety, hygiene and the environment			Pareto chart
	Multifunctional employees	Autonomuos maintenance			Gantt chart
	JIT purchasing				VSM
					Process map
					Mistake proofing/ Poka-yoke
					Run chart height

Table 2.1: Lean manufacturing methods and tools (Arturo, 2018)

All of the above mentioned Lean methods can be used in the interior logistics process at Oceanco. VSM of the logistics interior flow identifies sources of waste and discover the applicable tools for reducing the waste. The Lean method JIT will reduce non-value added processes which eliminate the waste movements in the logistics process. JIT focus both on the material and information/communication flow. Continuous improvements/Kaizen remains important due to often small logistics process changes. Being flexible to react fast on logistics changes is of great importance. Lastly, the remaining methods TPM and autonomation are important at the logistics support. Controlling and debugging is especially important in the logistics support. Concluding above explanation of Lean, the improvement method has a high correlation with the flow, waste reduction and efficiency requirements. In addition, Lean has a medium match with the communication and standardisation requirements due to the focus on the communicated information flow and continuous improvement, where standardisation is needed. Furthermore, Oceanco is familiar with the Lean method.

2.3.2. Theory of Constraints

The theory of constraints (TOC) is developed by Goldratt in the 1970s. It is a method that identify the most important limiting factor that affects the goal to improve the flow of the process. That limiting factor, called constraint, needs to be improved until it is not the limited factor anymore. The concept of TOC can be summarised as (Rahman, 1998):

1. "every system must have at least one constraint"
2. "The existence of constraints represents opportunities for improvement"

The TOC philosophy working principles consist of the five focusing steps and the drum-buffer-rope (DBR). The five focusing steps of the Theory of constraints are (Şimşita, 2014):

1. "Identify the system's constraint(s)"
2. "Decide how to exploit the system's constraint(s)"
3. "Subordinate everything else to the above decision"
4. "Elevate the system's constraint(s)"
5. "If in any of the previous steps a constraint is broken, go back to step one"

The Drum-buffer-rope method is a mechanism that protect the throughput of a system by using the time-buffer. Here the drum is the constraint, the rope is the communication between control points and the buffer protect the system from variation. There are three types of time-buffers. The shipping buffer provides the possibility of a fast response to the market. Secondly there is a buffer before the assembly with a constraining production line and a buffer before the constraint to maximise throughput. In this way buffer management is an important part of the inventory and work in progress management when TOC is applied (Rahman, 1998). It can be concluded that this method focuses on the constraints that have a negative effect on the flow in a process. Eliminating these constraints or placing buffers, results in shorter throughput times and increases the efficiency of the process. Therefore, the improvement method TOC has a high correlation with the flow and efficiency requirements. The TOC method has no match with the waste, communication and standards requirements. Besides, Oceanco is not familiar with the TOC method.

2.3.3. Six Sigma

The development of this technique started in 1980 at General Electric. Six sigma refers to a statistical measure of defects rate within a system (Pepper, 2010). From a statistical point of view Six Sigma means that there are only 3.4 defect on 1 million products. From a business point of view Six Sigma is a method to improve the effectiveness and efficiency of the process to fulfil the customers' demands. By a reduction in standard deviation the process can operate more uniform which results in less variation of the result or final product.
Six sigma is a comprehensive approach. (Hoon and Anbari. Frank, 2006) "Six Sigma = Total Quality Management + Stronger Costumer Focus + Additional Data Analysis Tools + Financial Results + Project Management". This makes Six Sigma a data driven approach supported by statistical tools and techniques. Six Sigma uses a more detailed cycle than Deming's plan-do-check-act cycle which provides more structure to the improvement. Six sigma uses the five stage cycle DMAIC: Define, Measure, Analyse, Improve and Control (Pepper, 2010). For each stage there are a number of tools/techniques to measure, analyse and improve processes. In table 2.2 an overview is given of the DMAIC process.

Six Sigma steps	Key processes
Define	Define the requirements and expectations of the customers Define the project boundaries Define the process by mapping the business flow
Measure	Measure the process to satisfy customer's needs Develop a data collection plan Collect and compare data to determine issues and shortfalls
Analyse	Analyse the causes of defects and source of variation Determine the variation in the process Prioritise opportunities for future improvement
Improve	Improve the process to eliminate variations Develop creative alternatives and implement enhanced plan
Control	Control process variations to meet customer requirements Develop a strategy to monitor and control the improved process Implement the improvements of systems and structures

Table 2.2: DMAIC process for Six Sigma (Hoon and Anbari. Frank, 2006)

Concluding the above findings Six Sigma can be described as a theory which focuses on reducing the variation of a process by analysing the data. This method increases the efficiency of the process by controlling and managing the process. This method has a high match with the standardisation and efficiency requirements. There is no correlation between the waste, flow and communication requirements. Besides, Oceanco is slightly familiar with the Six Sigma method.

2.3.4. Lean Six Sigma

Around 2000, the Lean Six Sigma philosophy was introduced by Sheridan. Lean Six Sigma focus more on producing a supply chains where effective communication leading to strategic alliances and visibility (Pepper, 2010).
Lean Six Sigma can be implemented in the logistics. In the book Lean Six Sigma Logistics Goldsby defines Lean Six Sigma as (Goldsby and Martichenko, 2005): "The elimination of waste through disciplined efforts to understand and reduce variation, while increasing speed and flow in the supply chain". In his book he introduced the Logistic Bridge Model. This model provides direction and insight on how to solve a logistics challenge and set the course for ongoing success. In this challenge a bridge is needed between the suppliers and their own process and another bridge is needed between their own process and the costumers. The bridge model is set up in three principles:

1. Logistics Flow
2. Logistics Capacity
3. Logistics Discipline

Flow describes the operational effectiveness of a company. Understanding flow gives an insight in the strengths, weakness, opportunities and constraints of a company.
Logistics capability focuses on the stability of the process. Reduction of the variations ensures for a stable logistic flow. Lean Six Sigma focuses to have standards and strive to continuous improvement, which eliminate the waste from the logistics system.
Logistics discipline will not be discussed in this research. Discipline focuses on the co-operation between the sub-contractors, which is not in the scope of this thesis.
Figure 2.2 shows an overview of the above mentioned principles with their focus areas. These focus areas will be discussed below.

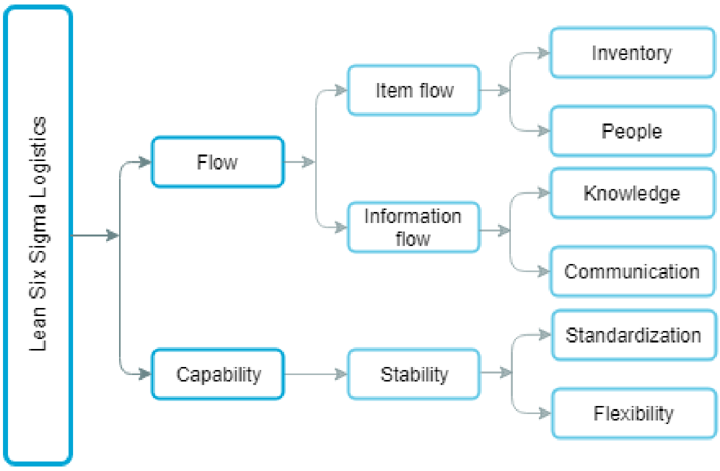


Figure 2.2: Logistic principles bridge model (Goldsby and Martichenko, 2005)

People flow
Logistics is about the transport between processes, and processes are about people. Each human has their limitation in quality and consistency, which effect the efficiency of the logistics process. People perfect order is the vision of each company, which means to have the right number of the right people in the right place, and all that at the right cost.
To reach this vision, the logistics process in the organisation need to be organised and structured. Therefore, understanding of the current process is needed. The following questions needs to be answered to understanding the current process (Goldsby and Martichenko, 2005):

1. "What are the logistics-related processes inside the company?"
2. "Who performs the logistics activities?"
3. "Where in the organisation are the activities performed?"
4. "What does it mean to be qualified to perform the activity?"
5. "How are we training and developing logistics team members?"

After understanding the current condition, the gap needs to be filled between where the company is now and where they want to be.

Inventory flow
Inventory flow needs to be managed proactively. That means that it needs to be examined, planned, measured and improved. There are two types of stocks. Cycle stock is about flow, where the inventory meets the customers demand. The safety stocks are the inventory that manage the difference or variation. In each company the goods demand follows some sort of pattern. Understanding this pattern ensures that an organisation can determine an accurate order cycle time, effective stocking locations and effective transportation systems.
The biggest waste inventory are the safety stocks. Although these stocks are most of the time necessary in companies. For example, in this case variation in planning of the yacht will lead to safety stocks of the interior goods.
Managing the inventory is a complex task. Almost every function inside a company can affect the inventory level. Therefore, inventory management is not just about managing inventory levels, but more about recognising the complex workings of the entire organisation.
A proactively management logistic system has two characteristics (Goldsby and Martichenko, 2005):

1. "Ordering, inventory control, transportation, and warehousing functions are planned and synchronised to the customer's demand, getting to the heart of pull systems."
2. "The real focus is not on managing day-to-day activities of the logistics, but on reducing the need for the logistics activities in the first place."

When we allow Lean Six Sigma to create synergies in operations, inventories will be reduced, transportation strategies will become more effective and floorspace will be lower.

Knowledge flow

The first order of business is for companies to recognise that knowledge flows in the same way as cash and inventory (Goldsby and Martichenko, 2005). Consequently, we must develop infrastructure that is designed for knowledge sharing. As knowledge flows through the organisation, the best practices can be seen and implemented in the process as standardised work. This standardised work will become a benchmark, creating a positive cycle of continuous improvement.

Communication flow

There are more communication problems down the organisation ladder. It seems that lower on the organisational chart the potential to make mistakes in communication increases(Goldsby and Martichenko, 2005). Most failures in the logistics are caused by limited communication.

Lean Six Sigma requires an effective communication flow. Effective communication makes the difference between reaching and not reaching the goal of the process. In this case the operational progress communication is important. Synchronisation between processes is needed for logistics success when Lean is implemented. An infrastructure is required that employees can follow for excellent communication. This infrastructure can be a standard report, meeting or call. The change is to keep the communication method effective by addressing both issues and opportunities.

Standardisation

Standardisation in the organisation is a key role. Without standards, it is not possible to effectively determine the current situation of the process. Without standards, it is not possible to improve continuously. Here the biggest challenge is to find the best standards of the organisation. The SIMPOC (Supplier-Inputs-Measurement-Procedure-Outputs-Customers) model helps to find the best stable solution for a process Goldsby and Martichenko (2005).

Flexibility

Standards are needed in logistics to react quickly by changes in the process. The lead time of the process is important in this case. Increases the lead time results in less flexibility of the logistics process and an increasing of the inventory level (Goldsby and Martichenko, 2005). Allowing flexibility to make changes in the process, managing planned versus actual, is the basis for effective measurement system. A logistic engineer is needed to have visibility on the actual condition. For flexibility constant communication is needed between the different involved parties.

Not only the above explained Lean Six Sigma theory leads to improved operational effectiveness, also practical knowledge and tools are needed. The tools for Lean Six Sigma are divided into three categories (Goldsby and Martichenko, 2005):

1. Strategy and planning
2. Problem solving
3. Operations

In table 2.3 an overview is given of the available tools in each category. Appendix B gives a short explanation of this tools.

It can be concluded that Lean Six Sigma has a high match with the efficiency, flow and standards requirements. Besides, the method has a medium match with the waste and communication requirements. Oceanco is slightly familiar with the requirements. Therefore, Lean Six Sigma meets all the requirements. The theory mainly focuses on improving the flow and the standardisation to make the process more efficient.

2.3.5. Quick Response Manufacturing

The developments of the theory QRM were published in 2010. Suri stated that today's manufacturing companies needs greater capability to respond quicker to variation in demand (Fernandes, 2006). QRM can be used for companies with a make-to-order or engineer-to-order basis. QRM focuses on the reduction of the lead time for the entire project. This means that QRM can be applied throughout all the production and supply

Strategy and planning	Problem solving	Operational
Voice of business and costumer VSM Pareto Analysis ABC classification XY-Matrix	DMAIC Brainstorm Cause-and-effect Diagrams Five-why	Just in time Lead time management Levelled flow Frequency and lot size Standardise work 5S

Table 2.3: Tools for Lean Six Sigma (Goldsby and Martichenko, 2005)

chain activities in an organisation. The theory focuses not only on the manufacturing but also on the office operation (Manzouri, 2013). QRM internally causes improving in the quality, reducing the costs, eliminate the non-value added waste and increasing the speed of response. Externally, QRM provides quick design and manufacturing of the product for the costumer (Fernandes, 2006). The indicator that QRM uses is the Manufacturing Critical Path Time (MCT). Reduction of this MCT will reduce the non-value added waste processes.

QRM have many similarities with the method Lean. However, there are a few differences. Lean focuses on high-volume, QRM focuses on low-volume and high variety production (Suri, 2010). Suri stated that in the twenty-first century markets the low-volume customised production will rise with today's technology (Suri, 2010). Both methods eliminate the variability in an operation to create flow. Lean eliminate all types of variability in the company where QRM only eliminates the dysfunctional variability and keeps the strategic variability's to maintain its competitive edge (Suri, 2010). Besides, Lean used the tools JIT and Kanban. QRM applies another tool called paired-cell Overlapping loops card with Autorization (POLCA), which is a alternative of the Kanban (Fernandes, 2006).
This method is mainly focused on improving the quality, lower costs and quicker response for the customer (Suri, 2010). QRM has a high correlation with flow and reduction of the waste requirements. The QRM method has a medium match with the standards and efficiency requirements. Besides, Oceanco is not familiar with this improvement method.

2.4. Selection set of combined methods

A selection of methods has been made that will form the fundamentals of the interior logistics improvement. The selection of the methods is based on the six requirements.
Table 2.4 shows the requirements multi-criteria scorecard, where the methods mentioned in section 2.3 are displayed. To establish the applicability of the methods, output weight from one to five is added to the requirements to rank the methods. A weight of one has a low match with the requirements and a weight of five has a high match. Table 2.4 shows that each method meets one or more requirement. Lean and Lean Six Sigma meet all the requirements. Combining these two methods will gives Oceanco the opportunity to optimise the item flow on the floorspace itself but will also improve the controllability and flexibility on the yard to respond by changes in the complex interior process. In this research no full application of these methods is done, only the improvement toolboxes are used to minimise the non-value added movements in the interior logistic process.
Figure 2.3 shows an overview of methods that can be applied by a specific process type and product type. The yacht building process can be seen as a flow shop. However, the interior logistics process at Oceanco can be seen as a line flow process. The process starts with the transportation of the interior boxes of the production facilities and ends when the interior box is on board of the yacht. Each interior box follows roughly the same route through the yard. Therefore, the interior logistics process can be quantified as a line flow process. Also, there is a limited amount interior box sizes and shapes. However, the interior process strives to standardise transport lot size and standardise box sizes of the interior items. The current logistics process together with their ambitions are located between process type 3 and product type 3 and 4. Therefore, using the method Lean and Lean Six Sigma, will help Oceanco to achieve the standardisation objective of the logistics process in the near future.

Requirements	1. Movement waste	2. Efficiency	3. Flow	4. Communication	5. Standards	6. Familiar theory	7. Total
Lean	5	4	4	3	2	3	21
TOC	0	4	4	0	0	0	8
Six Sigma	0	4	0	0	4	1	9
Lean Six Sigma	3	5	5	3	5	2	21
QRM	4	3	4	0	2	0	13

Table 2.4: Multi-criteria analysis improvement methods

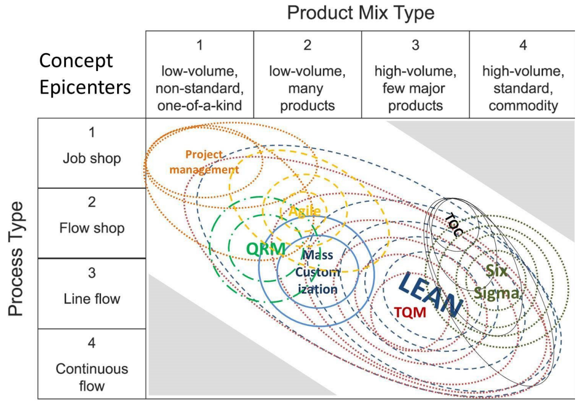


Figure 2.3: Overview usability improvement method (Hayes, 1984)

Both selected methods uses the five stage Deming's improvement cycle DMAIC. The DMAIC cycle is mainly used for improvements according the six sigma method. Next to Six Sigma, also Lean Six Sigma uses the cycle to find the improvement of processes. DMAIC is earlier explained in section 2.3.3 table 2.2.

A framework can be outlined when the DMAIC process, table 2.2, is combined with the Lean Six Sigma tools, table 2.3. In table 2.5 the approach framework to improve the logistics process at Oceanco is given. This framework will be used during this research.

	Key Process	Using tools/approach
Define	Requirements Research scope Process mapping	Voice of the customer and business Voice of the customer and business Process flow: VSM and Flowchart Communication: SCOR model
Measure	Insert data to the process map	Establish Key Performance Indicators and model the "as is" situation to measure the key performance indicators values Examples: number of external movements, inventory time etc.
Analyse	Analyse of the root causes	Analyse the KPI values in "as is" model and asking the why question
Improve	Improve the process	Use operational improvement tools
Control	Monitor and control improvements	Modelling improvement tools in a model and drawing a implementation roadmap

Table 2.5: Framework logistics interior process improvement Oceanco

2.5. Conclusion selection methods

The selection of the methods will be concluded by answering the related research subquestion.

Which improvement methods can be implement to improve the flow, communication and different standards in a logistics process?

A set of requirements is generated which focuses on the reduction of the non-value added movements by improving the flow, progress communication between Oceanco and the co-makers and the different process standards of the co-makers. A literature study was conducted to investigate which set of methods meet the requirements. A combination of Lean and Lean Six Sigma were selected by using a multi-criteria analysis.

These two theories reinforce each other by reducing the non-value added movements in the logistics process of Oceanco. To support these methods, the Deming's (DMAIC) improvement cycle is used. A framework is outlined where the DMAIC process is combined with the Lean Six Sigma tools. In table 2.5 the approach framework to improve the logistics process at Oceanco is given.

3

Current logistics process

In chapter 2 it is concluded that the set of methods which will be applied in this thesis are Lean and Lean Six Sigma. The improvement toolboxes of these improvement methods will be used. The improvement cycle which will be used is the Deming's cycle. In this chapter the first two phases of the Deming's cycle, shown in the framework in table 2.5, will be explained. First the define phase, which creates better understanding of the current logistics process. The second phase is the measure phase. This phase connects the available data with the logistics process. The goal of the measure phase is to find the Key Performance Indicators (KPI's) which indicate the performance of the logistics process.

3.1. Define logistics process

The define phase shows the current situation of the logistics process by takes the requirements, boundary conditions and process mapping into account. The research scope and the requirements are already explained in section 1.3.2 and 2.1. The scope and the requirements are established by the voice of the organisation. The logistic interior process is mapped by means of the following tools; value stream mapping, flowchart and the Supply Chain Operational Reference (SCOR) model. To give a better insight in the logistics process, a short explanation of the logistics process on the yard itself as well as the logistics process of the interior co-makers will be given. Thereafter, the three process mapping tools will be explained, which shows how the interior boxes flows through the logistics process. The goal of the define phase is to show where in the logistics process improvements are needed to minimise the non-value added movements.

3.1.1. Logistics process

The logistics process starts when the co-makers delivers the boxes with interior items. The interior co-makers transport the interior items in wooden boxes, called "collies". Discussed in the problem statement, Oceanco has two storage locations, one at the yard and one at an external location. Before the collies arrives at the yard, it is checked if collies need to store in the internal or external inventory. If the collies needed to be stored external, the collies are directly transported to the external inventory, managed by Maat. At the external location of Maat, the collies are removed from the truck and placed on the ground floor in the storage. When the collies are needed on board, the collies are transported to the yard of Oceanco by Maat.
Figure 3.1 shows the floor map of the yard of Oceanco. The black arrows in the figure shows the route of the logistics process at the yard until the collies are located in the inventory. When the collies arrive at the yard the truck follows the route through the security to the logistics service portal (LSP) located at Marineweg 5. Figure 3.1 shows only the floor map and logistics process flow of the storage locations at Marineweg 5. Marineweg 1 has their own logistics service portal. However explained in the scope, this thesis focuses only on Marineweg 5. The collies are registered by Maat at the LSP point and will be placed in the inventory. At the Oceanco's yard at Marineweg 5 there are three different internal storage places:

1. Workshop of the co-makers

2. Temporary storage at the back of the dock

3. Dock storage, when dock is not filled with water

Most of the collies which are delivered will be stored at their co-makers workshops located at the second and third floor. The collies are transported by an internal lift to these floors. If the collies are stored external, they will place the collies in the temporary storage space when the collie arrives at the yard. The dock storage is used for goods which will be stored for a longer period. When the collies are needed on board, the collies follow the route of the black arrows in opposite direction until the collies are placed on the ground floor. Thereafter, the collies will be placed on board of the yacht.

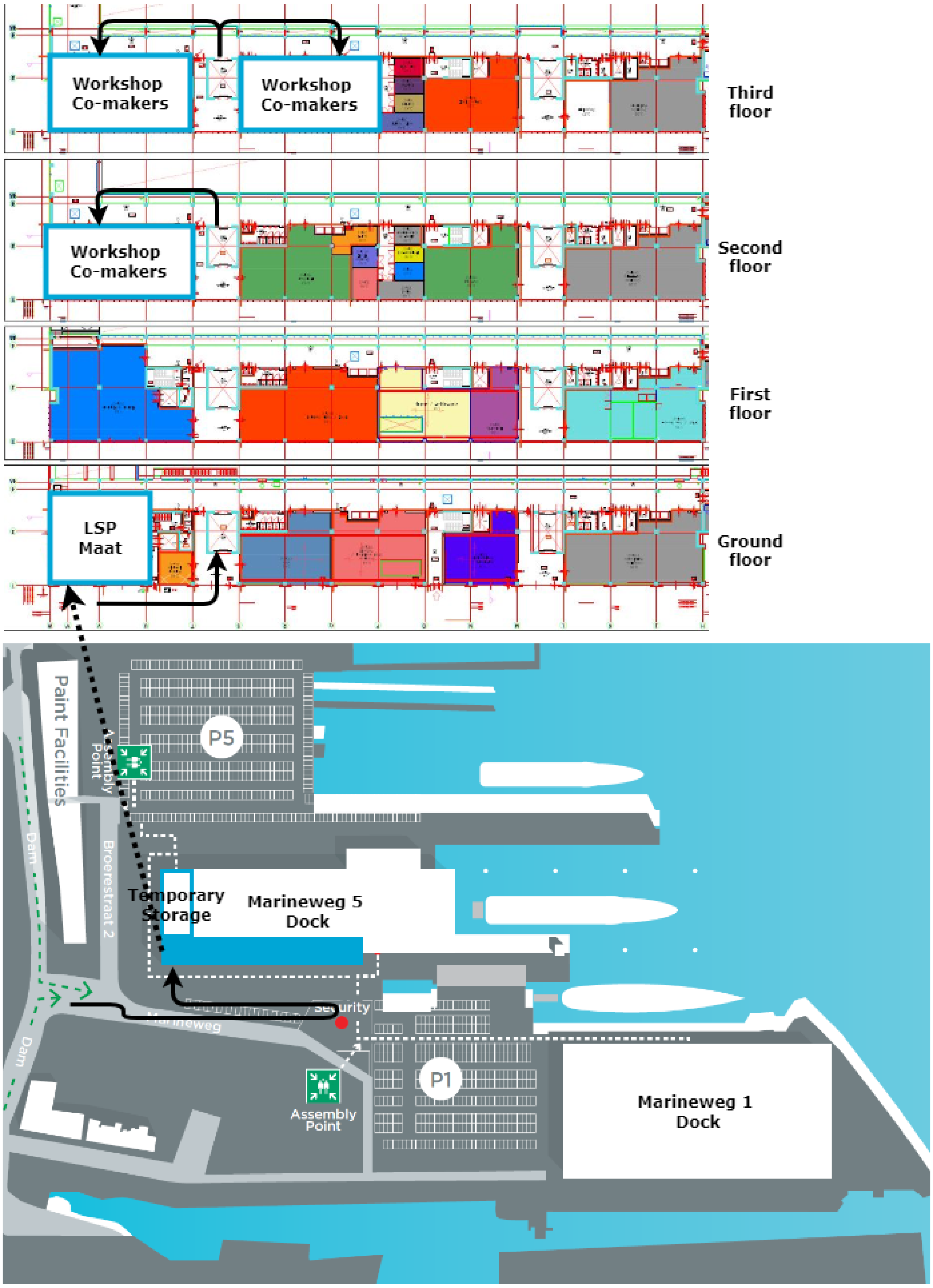


Figure 3.1: Map floor of the logistics process flow and internal storage

3.1.2. Co-makers process

Each co-maker has their own standards to transport and store their interior items. Figure 3.6 in section 3.1.5 shows the production facility location of the co-makers.
IHC is located close to Oceanco. This result in less transport expenses and duration which makes it possible to transport small batches of collies per drive. IHC transport four collies per drive. They make use of open standard size collies where some items are sticking out. This is possible due to the short drive where the chance is small that something happens with the collies. If IHC brings four collies to Oceanco they take the empty collies back for reuse. Collies are delivered when the goods are needed. IHC takes the progress of the yacht into account. If there are some delays, they inform the co-maker that the goods are not needed yet. This is not a problem for IHC because their inventory is big enough. If this can become a problem in the future, the outcome of this research can be applied. That is also why IHC does not strive to a maximal storage time. There is plenty of room and options for IHC to store their goods.
The production facility of **List** is located in Austria, which makes the transport process longer. They transport their goods in batches of seven to ten in all custom-made closed collies. These closed collies protect the goods during the long drive. For List it is difficult to change their planning when some delays on the yacht occurs. In general, half-full trucks will not drive. So, the pre-planned collie lot size will be all delivered despite of any delay in the interior installation. However, it cannot be prevented that they drive sometimes for small batches due to delays. List strive to an inventory time of four weeks, which Oceanco preferably reduces to around two weeks.
Sinnex is comparable with List. They are both located in Austria and cope with the same distance issues. The lot size of the truck is equal with the of Sinnex, around the ten collies per truck. However, this value is variable due to the varied pressure on installation. Sinnex sort their collies on rooms and way of installation. First, the floor templates are delivered, followed by the rough interior and as last the finished interior.
Oldenburg's production facility is located in Germany. Normally, they transport one or two collies at the time and they drive one or two times per week. This depends if there is a peak period or not. The arrangement of the collies is by Oldenburg project team or by the foremen of Oldenburg at Oceanco. Normally the collies are send according the time schedule. However, in reality the collies will be send over when the item of the collie are finished in production. The items in the collies are sort in Germany based on the rooms and components. For example; a part of the ceilings will be delivered in one collie for rooms which are close to each other.
Most of the co-makers try to batch their collies in a logical way. The collies are batched based on the layout of the yacht rooms. The collie layout is fixed before the production of the interior items starts. Installation of all these interior items is a complex process, which takes place at the end of the total shipbuilding process where the likelihood of delay is greatest. Rooms are not ready for installation or the production of the interior items are behind schedule. This makes it difficult to manage the logistics process.
Table 3.1 shows an overview of the above described difference in logistics process between the co-makers. However, it must be noticed that these differences is highly influenced by the amount of work to be delivered per co-maker.

	IHC	**List**	**Sinnex**	**Oldenburg**
Transport lot size	4 collies	7-10 collies	7-10 collies	1-2 collies
Drive frequency (per week)	Twice or three times	Once or twice	Once or twice	Twice
Collie properties	Open, standard	Close, custom	Close, custom	Close, custom
Storage own location	Yes	No	No	No
Using external storage	No	Yes	Yes	Yes

Table 3.1: Overview of the difference in logistics process co-makers

It can be concluded that all co-makers, except IHC, are not taken the inventory level and storage time at Oceanco into account by delivering their collies at the yard.

3.1.3. Value stream mapping

The value stream mapping (VSM) tool maps the process by making use of flowchart techniques. This tool identifies the waste in a process by identifying the non-value adding processes. Non-value adding processes are processes which does not change the product or assembly. However, the goal of a logistics process is transporting an item to the next step in the process by using the inventory. This does not help change the

product to the final state, which makes it a non-value adding process. Nevertheless, a distinction can be made in processes that are crucial in the logistic and which are unnecessary and can be seen as waste.
First the start activity/supplier and finish activity/costumer of the interior logistic process need to be determined. The logistics process starts with the transportation of the collies of the production facilities and ends when the interior box is on board of the yacht. Before the interior parts arrive at the yard, communication between Oceanco and the co-makers is important to run the logistic as smooth as possible. The end-user of the process is not the owner of the yacht but the co-makers which assemble the goods on the yacht. The responsibility of the goods is again transferred to the co-makers.
There are two major logistics process flows at Oceanco, due to the limited space at the yard. These two logistics processes are:

1. Inventory at internal location
2. Inventory at external location

Inventory at the internal location means that the collies are stored directly at the yard. This is the ideal situation, where the collies are located close to the yacht, which makes the logistics process flexible and efficient. Ideally, most collies should not go to the internal storage but will go directly to the yacht. However, this complex and unique yacht building process needs storage capacity to counter the unforeseen aspects. The second process type describes the process where the collies are stored at the external location of Maat. Collies are placed at the external location when the storage space at the yard is full. Heavy goods, which cannot be stored at the available inventory places at Oceanco, will be placed at the external location as well, if not needed directly on arrival. The value stream map of these two processes are shown in figure 3.2 and 3.3. The displayed flow describes the process per collie. The number of operators, cycle time (C/T) and uptime (U/T) are shown in the two value stream maps. Each process can be performed by one operator and the availability of machines (uptime) are assumed to be 100%.

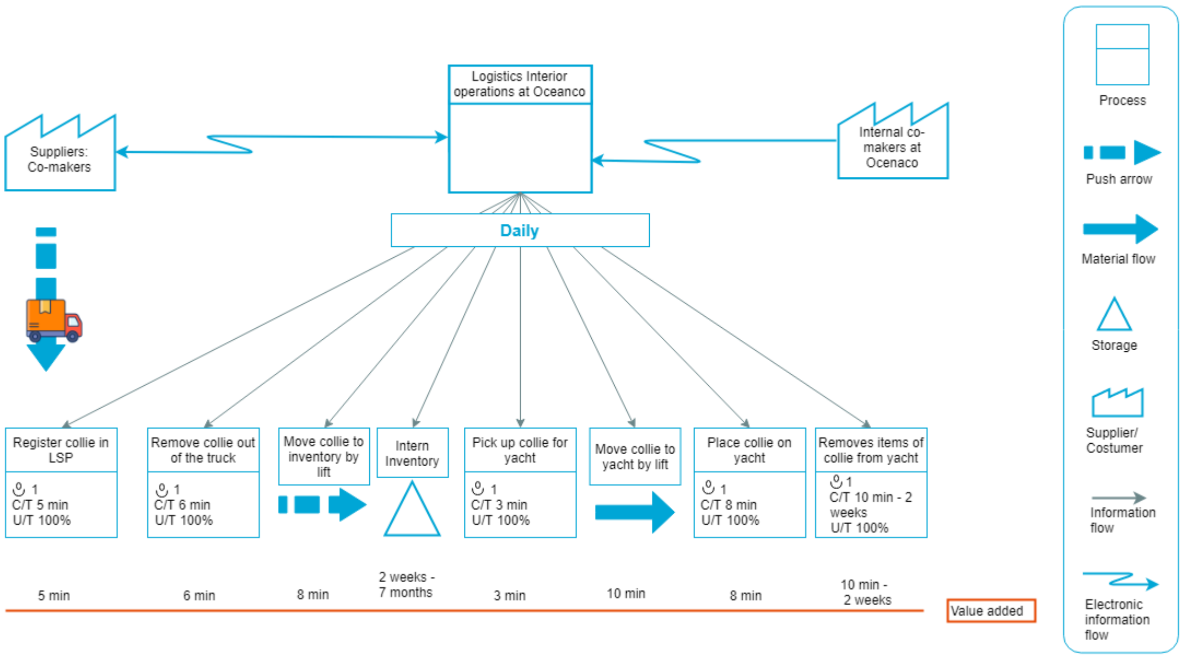


Figure 3.2: Value stream map of the internal inventory process

The internal logistics process starts by the arrival of the collies at the yard (figure 3.2). The collies be registered by arrival in the logistics service portal. The collies will be removed from the truck and moved to the storage. Most interior collies are stored in the workshops of the co-makers on the second or third floor. When the collies are needed on board, the collies are transported to the ground floor where the collies are lifted with a crane on board. The collies are emptied by the interior co-makers. Figure 3.2 shows the cycle time of the

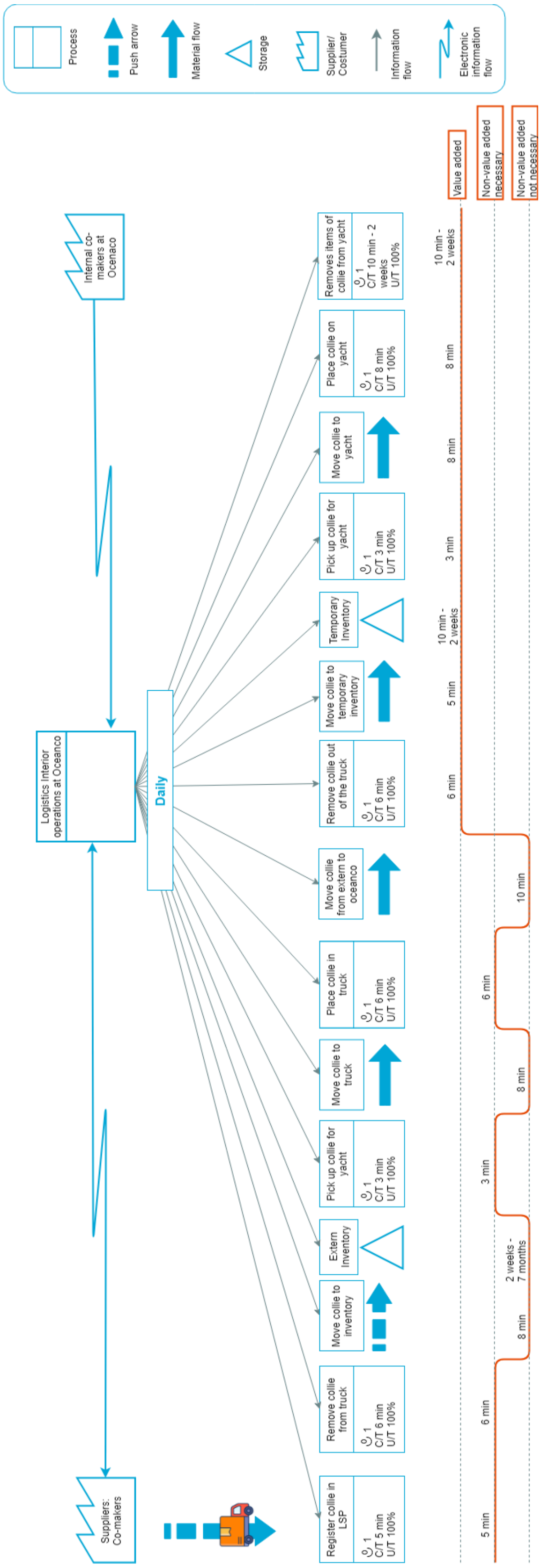


Figure 3.3: Value stream map of the external inventory process

internal logistics process. No accurate data can be given for these cycle time due to the limited data. The wide range of the storage time is the effect of the limited data available during the logistics process.
The external inventory logistics process consist of more process steps (figure 3.3). The collies arrives at the external location of Maat. The collies are registered in the logistic service portal and placed in the inventory. When the collies are needed on board, the collies are placed in a truck from Maat which transport the collies to the yard with a minimum lot size of five collies. By arrival, the collies are placed in a temporary inventory on the ground floor until the collies are needed on board. Thereafter, the collies will be placed on board and emptied by the co-makers. Also for this logistics process type, the wide range of the cycle time is the result of the limited data available.
Beside these two processes types it sometimes happen that the collie does not reach the yacht. Co-makers removes the items from a collie when the collies are located at the inventory. This is done when only a few items of the collie are needed on the yacht. In this research this type will be neglected. It also happens that a collie returns in the inventory for the second time, this occurs when the collie is not fully emptied on the yacht and the space on the yacht is required for a new collie. Second time inventory will be neglected in this research.

In both figures there are three important chart symbols shown. The squares identifies processes, the arrows movements and the triangles inventories. These three symbols can be divided in value adding processes and non-value adding processes. Non-value adding processes can be split in necessary and unnecessary processes.
In this thesis it is assumed that all processes, movements and storage at the internal location (process type one) adds value to the process. Despite the wide variation in inventory time due to missing data, the inventory is also considered as value added. All these steps are needed to go to the next step of the process, the interior installation. The logistic operation at the external location (process type two) needs rework steps before the logistic step is done. Transportation and temporary inventory are these rework steps. Therefore all the steps at the external location can be seen as non-value adding processes. However, a distinction within these non-value adding movements can be made between necessary and not necessary. The process squares are necessary in the process to store the items. The movements and the inventory are not necessary. Therefore, the movement arrows and inventory triangles at the external inventory are non-value added and not necessary and can be seen as waste. The difference in value added, non-value added necessary and non-value added not necessary is shown in figure 3.3.
It can be concluded that process type two has the only impact on the total waste caused by many non-value added movements. Since it is the goal of this research to eliminate the non-value added movements, the focus will be on process type two. A more systematic view of the value stream map of the logistics process is shown in appendix C.

3.1.4. Flowchart

A flowchart has comparisons with a value stream map. They both maps the process. However, the flowchart is more focused on the existing relationships and responsibilities between departments. It gives a better insight in the communication infrastructure of the logistics process. Figure 3.4 shows the flowchart of the logistic interior process. This figure shows which party is responsible for the actions explained in the value stream map. There are seven parties involved within the logistics process. Project team means the area managers of the interior. Co-makers external means the production facility location of the co-makers. Co-makers internal means the co-makers which install the interior at Oceanco. The decisions, shown with a diamond, are related to the selection of the different types of process discussed in the value stream map. Besides, two parties are able to transport the collies from the inventory to the main floor. This creates an additional decisions during the process.
The figure shows that Maat bv. works closely with the internal co-makers. Frequent communication between these two are needed to run the process smoothly. These communication goes by phone or face-to-face.
The figure also shows that the project team is not involved by the logistics process. In terms of progress communication, the project team is indeed involved with the logistics process. They have the overall insight of the planning and progress of the yacht. The communication with the project team will be discussed in the next section. From this section it can be concluded that the collaboration between the co-makers internal and Maat is really important to efficiently run the collies through the process.

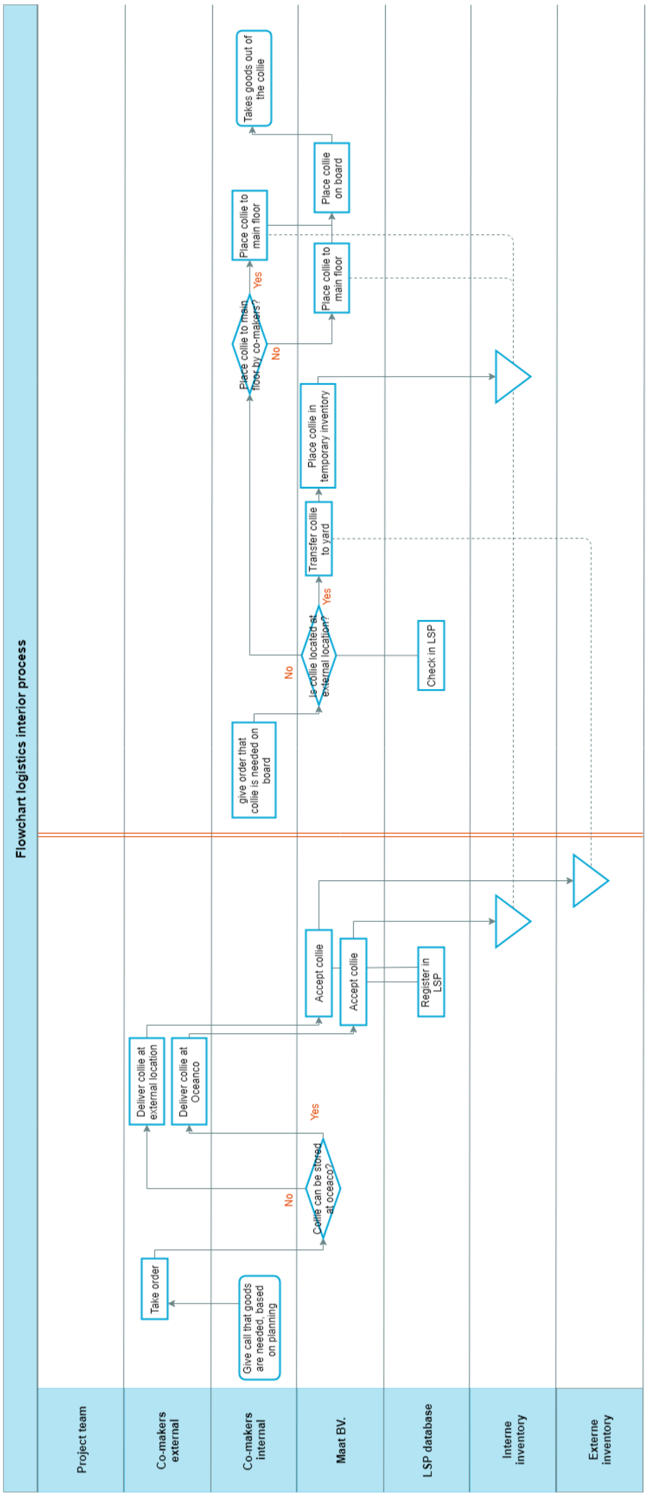


Figure 3.4: Flowchart of the interior logistics process

3.1.5. SCOR model

Supply Chain Operations Reference (SCOR), mentioned in section 2.2, is a model which evaluate and improves the supply chain operation. It is a model with standard descriptions, framework of relations between supplier organisation and customer and a standard metrics to measure process performance (Prakash, 2013). The SCOR model consist of four levels which evaluate these performance. The first level distinguishes five types of SCOR core processes; plan, deliver, source, make and return. Level two brings further differentiating

into these core processes. level three contains the elements of the particular process. The last level, level four, focuses on the implementation of the process elements. In this research the SCOR model will be discussed in level two, configuration level, because this level is detailed enough to say something about the relationships and communication between the suppliers and Oceanco. The goal of the SCOR model is to give a better understanding of the communication and the performance of the process.
The outcome of the SCOR model can be viewed and analysed in three different diagrams:

- Business scope diagram - figure 3.5
- Geographic map - figure 3.6
- Thread diagram - figure 3.7

The business scope diagram in figure 3.5 shows the connection between the suppliers, organisation and customers. The flow of the items and the communication flow are shown in this figure. The co-makers mentioned in the suppliers box are the external co-makers who work at the production facility and the co-makers mentioned in the costumers box are the internal co-makers working at the yard. The items flow from the interior production facilities to the logistic point at Oceanco and finally to the yacht. The communication flow between the involved parties is more complicated than the flow of the items. Talking with the interior area manager of yacht Y718, it became clear that there are no standard communication lines. Each project/supplier communicate with their own ideal idea of communication. However, figure 3.5 shows the preferred communication line. A few communication lines are important to address:

1. The internal communication between the co-makers is about the timing of the delivered items and the progress on the yard.
2. The communication between the external co-makers and the project team is about the progress of the production and installation planning.
3. The communication between the area manager and the internal co-makers is about the installation progress on board.
4. The communication with the area manager and Maat is nil. Only the communication about available places on board for the collies is via this communication line.
5. The communication between the co-makers and Maat is the most important one. The co-makers inform Maat when the collies arrive at the yard an when collies are needed on board.

The communication flow cannot assumed to be standard. Each co-maker, each project team and each employee of Oceanco communicate in a different way. Most of the time they communicate by phone or email.

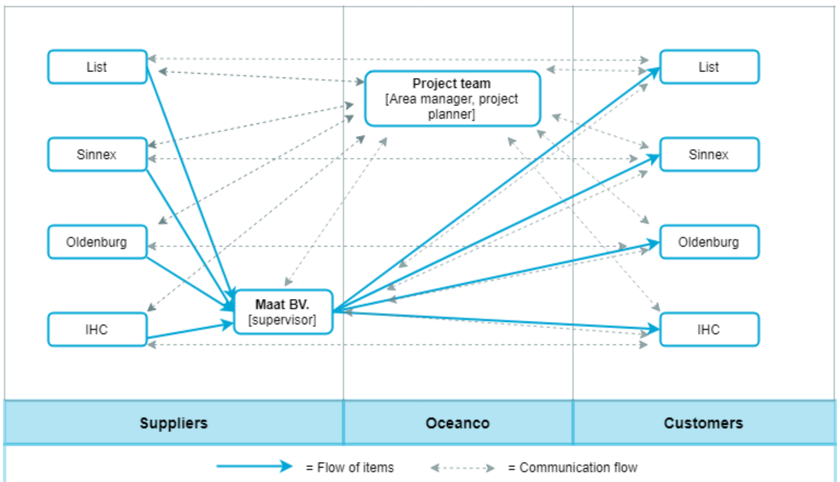


Figure 3.5: Business scope diagram of Oceanco's interior supply chain

Figure 3.6 shows the geographic map of the supply chain of Oceanco. This figure makes clear where suppliers are located, which gives a better understanding in transport time, number of collies per drive and communication possibilities. The codes which are shown will be explained in the thread diagram figure 3.7.

Figure 3.6: Geographic map of Oceanco's interior supply chain

Figure 3.7 shows the thread diagram. This figure shows who delivers, sources and plan the actions. The number three behind the deliver and source action means that they deliver only goods which are special engineered on order. In this diagram also the goods- and information flow are investigated. The goods flow corresponds with the insights in the business scope diagram. The parties which plan the action are interesting in this figure. All the delivers of the collies to the yard and to the yacht are planned by the co-makers themselves. The source of the goods at the yard are planned by Maat and the source of the collies at the yacht are planned by the internal co-makers. On top of the source and deliver planning there is the supply chain planning. The project team control the overall actions and communicate this with the co-makers. Maat controls and manage the overall actions of the logistic at Oceanco and communicate this with the project team.

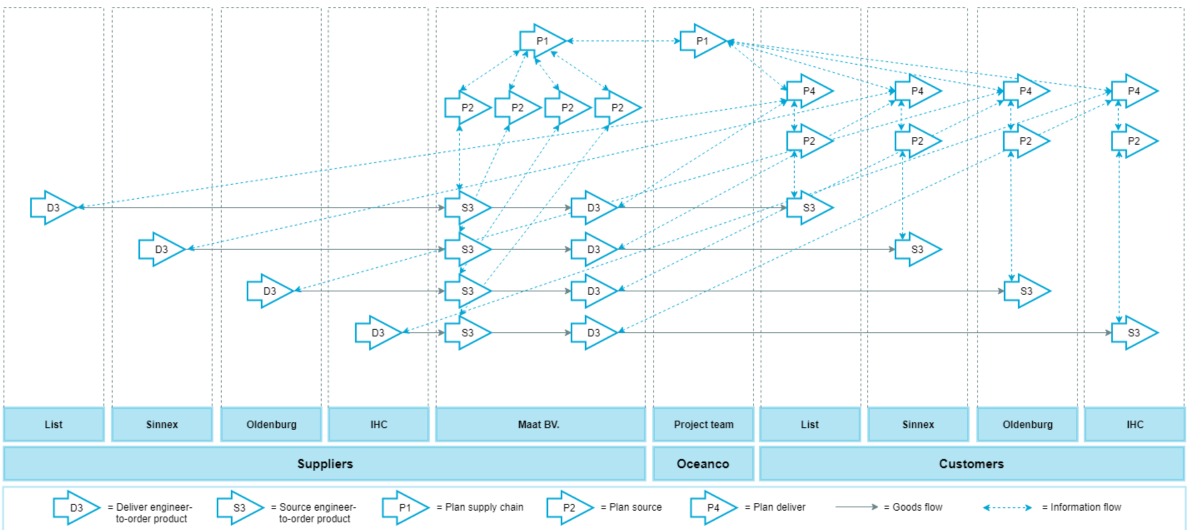


Figure 3.7: Thread diagram of Oceanco's interior supply chain

These three diagrams shows that Maat and the internal co-makers are responsible for the progress of the logistics process. Close cooperation between these two parties contributes to future improvements.

It can be concluded that from the value stream map of the logistics process that improving the flow in the external inventory will decreases the non-value added movements. Additionally, by showing the flowchart and the SCOR model, it seems that the cooperation and communication between all parties can be improved. The speed of the process mainly depends on the communication between the internal co-makers and Maat. Therefore this is the most important factor. The process is more controllable when all co-makes follows the same logistics process.

3.2. Measure logistics performance

The measure phase consists of data which follow from the define step. The purpose of this phase is to find the Key Performance Indicators (KPI's) which indicate the performance of the logistics process. Using the KPI's the main challenges that increases the non-value added movements can be found. Going in more detail of these challenges, the root cause can be determined. In this section the selection of the KPI's will be shown followed by the explanation of the available measure data.

3.2.1. Selection KPI's

The KPI's can be determined by making use of the collaboration-oriented performance model (CoP). This model is chosen due to the lack of literature in Key Performance Indicators by the methods Lean and Lean Six Sigma in the logistics. Some important indicators need to be measured, which illustrate the impact of the collaborative benefits. Many performance models and studies which focus on the performance in supply chains defined some common key performance indicators categories: reactivity, flexibility, reliability, quality and cost (Forme, 2007). The collaboration-oriented performance model can be split up in four processes. Figure 3.8 shows these processes of the collaboration supply chain. For this thesis the supply logistics and the Lean manufacturing are important. The supply logistic concerns the activities bound to the storing of components from the supplier to the stock (Forme, 2007). The flow and communication between the co-makers and Oceanco are related to this supplier logistic. Thereafter, the Lean manufacturing concerns all the operations to improve and to optimise the efficiency of the company (Forme, 2007). This process focuses on the efficiency of the logistics process at the yard of Oceanco. Resulting that this thesis focuses on the internal and downstream process. In addition, this case focuses only on the company facing indicators and not on the customers facing indicators.

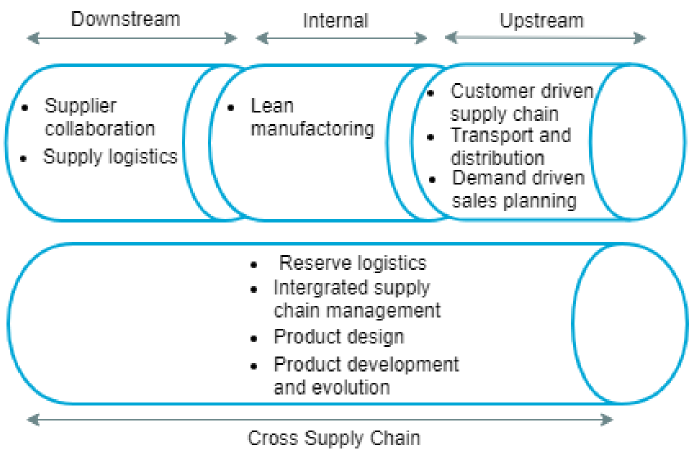


Figure 3.8: Organisation processes of the collaboration supply chain (Forme, 2007)

By taken the classification of the cost category into account, the KPI logistic expenses are found, which contains the inventory expenses, the transport expenses and the action expenses (resource utilisation rate). By the category flexibility the inventory stored internal and external are selected as KPI. These KPI's take the capacity of the inventories into account. The inventory storage internal and external are the benchmarks for the flexibility of the logistics process. An important KPI in the reactivity category is the inventory time. The inventory time is the source cycle time of the logistics process, which have a significant impact on the efficiency of the logistics process. In this thesis there is no focus on the quality of the logistics process. The last category reliability identifies also the inventory time, the inventory stored external and the total collie weeks. The KPI total collie week external combined the inventory time with the number of collies stored in the external inventory. These KPI's are benchmarks for the reliability and accuracy of the logistics process. These KPI's shows the effect on the logistics process by changes in the planning of the interior. Table 3.2 shows the above mentioned KPI's for this thesis. For each KPI the target value is given. Oceanco strives to an inventory time of ten working days. The target for the internal inventory is to store all the collies at the internal inventory. The inventory stored external and the collie weeks external must be zero, since this is the objective of this research. It is not possible to give a KPI value for the logistic expenses due to the unknown height of these expenses. However, a reduction of one third on the current expenses is a feasible target according to experts.

KPI	**Description**	**KPI target**
Inventory time	The time that each collie is placed in the inventory	Ten working days
Inventory stored internal	The total numbers of stored collies internal	All number of collies
Inventory stored external	The total number of stored collies external, which is linked with the number of movements external	Zero collies
Total collie weeks external	This KPI combined the time and the inventory level at the external location	Zero collie weeks
Logistic expenses	This are the total logistic expenses for Oceanco	1/3 reduction

Table 3.2: Key performance indicators for the logistics process

The KPI's are all correlated to each other (Cai, 2009). Figure 3.9 shows the relationship between the KPI's. All KPI's have a sequential relationship with each other. Other word for sequential relationship is cause-effect relationship, where one KPI affects the other.

Figure 3.9: Sequential relationship KPI values logistics process Oceanco

The inventory time indicator is of high importance, because the inventory time of a specific collie shows where errors have been occurred in the process. The inventory time is the time between the collies arrive at the yard and when the collies are placed on board. The range of the inventory time, shown in figure 3.3, is wide due to not accurately determination of these total storage time. The time that the collies arrives at the yard is known, but the time that a collie is placed on board is unknown. This makes it impossible to give an accurate estimation of the inventory time per collie.

The second KPI, the inventory stored internal, shows the number of stored collies in the internal inventory over the total logistic duration. Also, the same issue arises that the time that a collie goes on board is unknown. When the installation date and the constant internal capacity of the storage spaces is known, the inventory stored internal can be established. Unfortunately, at Oceanco there is no known fixed limit to the internal storage. Explained in section 3.1.3, the collies can be stored in the workshops and the dock. In reality, the collies are also placed in the halls next to the workshops. This makes it difficult to give an exact level of the internal inventory capacity during projects.

The third KPI, the inventory stored external, is linked with the number of movements. This KPI tells how many collies are stored external and gives insight in the logistic expenses that are related to the transport of the external inventory to the yard. However, due to the missing internal storage capacity and the missing installation date the number of stored collies external is also unknown during the complete logistics process.

The fourth KPI, the collie-weeks external, shows the volume of the external inventory over time. This KPI not only tells to the number of stored collies external, but also the duration of the external stored collies. It gives a better insight in the total external storage expenses instead of only the external transport expenses. However, also this KPI misses the internal inventory capacity and installation date which makes it difficult to establish the total external collie-weeks.

The fifth KPI, the logistic expenses, must be minimised in the organisation. These expenses are dependent on the number of transport actions, number of stored collies external, etc. The height of the logistic expenses can be determined if the above explained KPI's are known.

3.2.2. Current logistics data

From the above explained KPI's it can be concluded that two import data are missing: the date that the collies are placed on board and the internal inventory capacity. However, for a small given timeframe, Maat features a document where the total external stored collies are noted which can help to create a model where the installation date and internal capacity can be determined.

Maat registers the number of collies which are stored at the external inventory, because Oceanco paid for the numbers of square meters that they use. Due to the exceeded document by Maat, the data is only available from January to October 2018. The data exist of the number of collies that are placed per co-maker in the external inventory per week. The specific collie numbers and the storage time of the specific collies are not noted. Figure 3.10 shows the total number of interior collies per co-makers in the external inventory. During the given time duration three yacht were in the outfitting phase, yacht project Y717, Y718 and Y716. Yacht Y717 is delivered on July 2018 (week 27) where only some last finish interior collies were located in the external inventory. The most collies in the external inventory where from yacht Y718 and Y716. Both of these co-makers worked on installing the rough interior and started with the finished interior. The reduction around week eight in external storage is mainly due to the fact installation continues while no new collies are coming in from yacht number Y718 and Y716. Most collies have already been delivered. Besides, there was no new project number which was already located in the outfitting phase.

It can be seen that most of the collies are from the co-makers List and Sinnex. During this period these two co-makers worked on all the ongoing projects Y716, Y717 and Y718. Besides that, these co-makers both have a large distance to bring their collies to Oceanco. The relative large transport batches causes peaks in the inventory level of these co-makers as consequence that the external inventory is needed. Oldenburg and IHC are located closer to Oceanco which can transport their collies more often in smaller batches. IHC is located really close to Oceanco and do not use the external inventory of Oceanco. Their own location is big enough to store the collies.

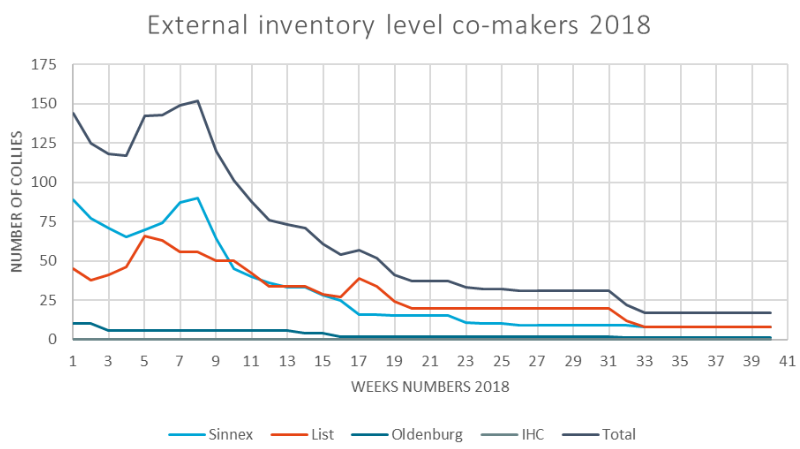


Figure 3.10: Total number of collies per co-maker at the external inventory 2018

To give an indication of the use of the external inventory per yacht, figure 3.11 and table 3.3 is shown. Figure 3.11 shows the number of stored external collies per co-makers and per yacht. This data is from week eight which is the peak period of the external inventory level. At the end of February 2018 (week eight), the final installation of the yacht Y717 and the interior installation of the yachts Y716 and Y718 took place. Figure 3.11 shows that next to yacht Y717, Y716 and Y718 collies are placed in the external inventory of yacht Y712 and Y715. These yachts are already delivered in 2016 and 2017. Examples of these items are goods which are removed from board due to production errors or dissatisfaction of the goods by the owners. These items are stored for possible reuse in future building yachts.

Table 3.3 shows per yacht number the total external collie weeks of the given timeframe. This table confirms the large use of the external inventory in the given timeframe by yacht numbers Y718 and Y716 by their high total collie weeks external. Furthermore, it shows that the total collie weeks for the already delivered yachts are relative high for their number of stored collies. This affects the height of the logistics storage expenses.

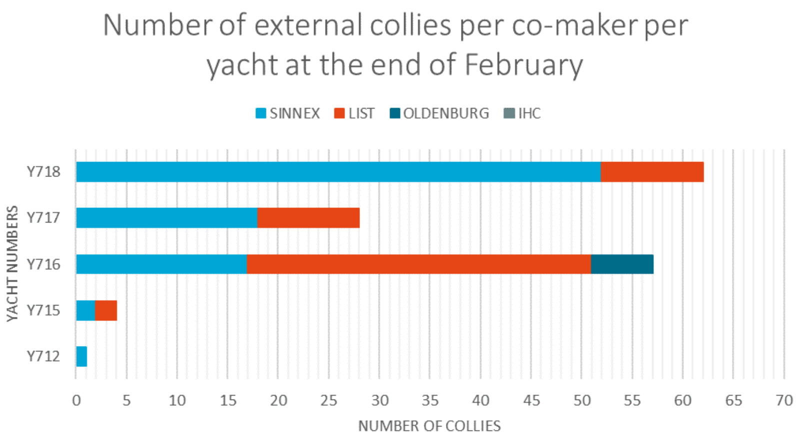


Figure 3.11: Number of collies per co-makers and per yacht in week eight 2018

	Y718	Y717	Y716	Y715	Y712
Total collie weeks external	872	468	974	90	32

Table 3.3: Total external collie weeks per yacht number in timeframe 2018

In this research there is mainly focused on the logistics process at Marineweg 5, because Oceanco has already made logistics improvements at this location. During January and October 2018 yacht Y718 were built at Marineweg 5. The three co-makers of the Y718 are List, Sinnex and IHC. Figure 3.12 shows the external inventory level which is used for yacht Y718. It can be seen that Sinnex makes the most use of the external storage and IHC makes no use of the external inventory.

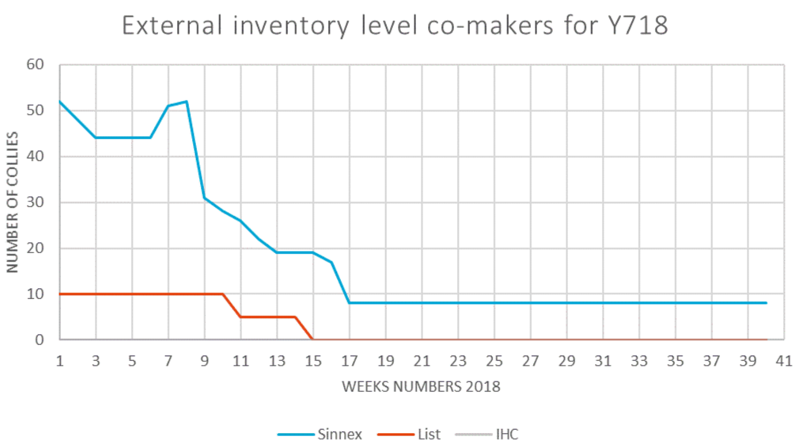


Figure 3.12: Number of collies at the external inventory for yacht Y718

The number of external inventory and the collie weeks are given for a small timeframe. However, outside this timeframe the KPI values are still missing. This makes it impossible to give the reliable values for the KPI's of the entire yacht building process. To find the root cause of the limited space, the KPI values over the complete timeframe must be known. Hereby, a model can be made to simulate the current course of the process. The installation date and the internal inventory capacity will be variable values which need to be determined. As indication of the accuracy of the model, the available external inventory data will be used. This means that the inventory level of the model corresponds to the inventory level shown in figure 3.12. Generation of this model makes it possible to find the internal inventory capacity and the installation date resulting in a value for all the KPI's for the entire duration of the process. Besides, the model will show challenges where improvements are needed to reduce the non-value added movements. Chapter 4 will explain the model which estimates the values of the key performance indicators.

4

"As is" model

This chapter contains the last part of the measure phase, see the improvement framework in table 2.5. In this chapter the "as is" situation will be simulated to find the values for the missing installation date and the missing internal inventory capacity of Oceanco. This will give the relevant KPI values of the current situation. Analysing the course of the inventory levels which follows from the "as is" model together with the KPI values shows the main logistics challenges that increases the non-value added movements.
The "as is" model is modelled in Excel which making use of the developer Visual Basic for Application (VBA). The goal of the "as is" model is to find the unknown KPI values by simulating reality. The benchmark is the external inventory level, which can be simulated with the available data from Maat. This model focuses on yacht Y718 at Marineweg 5, due to the lack in data. Besides, during this research the final interior installation took place, so knowledge about this process was readily available on the yard. Next to Marineweg 5, the model can also be used for other yachts at Marineweg 1 by changing the storage capacity values. In this chapter, first the features of yacht Y718 will be explained. Then, the data that is available at Oceanco which is the input data for the model will be given followed by an overview of the model structure. Thereafter, the approach for the installation date will be explained that makes it possible to model reality. Afterwards, the assumptions that has been made and some aspects that are neglected in the model will be discussed in more detail. Followed by the verification and validation of the "as is" model. Next, the results of the model will be shown which give answers to all the above non-specific KPI values. Finally, an explanation of how the model can be applied to different yachts is given.

4.1. Yacht Y718

The "as is" model focuses on yacht Y718 build at Marineweg 5. Section 3.2 showed that from the three interior co-makers of yacht Y718 only List and Sinnex stored their collies at the external inventory. This means that only for these two co-makers the "as is" model can be designed, because Maat noted the number of stored collies in the external inventory of these co-makers which is used as benchmark in this model. IHC is no longer taken into account in this thesis. Additionally, the interior builders for the coming projects will only be List and Sinnex, which makes these two co-makers for Oceanco the most interesting ones.
Project Y718 is a 109-meter superyacht build by Oceanco, named Bravo Eugenia. The yacht was launched in November 2018. The yacht is characterised by its LIFE design, which stands for Lengthened, Innovative, Fuel-efficient and Eco-friendly (Oceanco, 2018). The yacht consists of five decks, the bottom deck, the lower deck, the main deck, the upper deck and the bridge deck. For the interior the last four decks are of interest. Sinnex and List are both responsible for the luxury interior, where Sinnex is accountable for most of the owners rooms and List is responsible for the guest rooms. The interior installation duration depends on the area of the concerned rooms but also on the detail level. The production and installation of the interior item of the owners area takes more time than the guest rooms. Table 4.1 and 4.2 in section 4.2.3 shows for both co-makers the specific rooms and there installation time.

4.2. Input data model

In this section three different available input data of the model will be explained. Started with the benchmark, the external inventory level, which is also already shortly explained in section 3.2. Followed by the planning of sending the collies by the co-makers. The last data that will be discussed is the installation planning of Oceanco.

4.2.1. External inventory level

Understanding the flow of the external inventory levels makes it easier to match the model level with the real level. Started with the external inventory level of Sinnex which is shown in figure 4.1. The highest inventory level might have taken place before the start of 2018. In the beginning of 2018, the external inventory level decreases gradually, with most of the time a reduction of four/five collies per pick up due to the truck lot size that drives for a minimum of four/five collies from the external location to the yard. The reduction takes place until week seventeen. Thereafter, the level stays constant for a long unknown duration. The items in these collies are probably wall panels which are not needed anymore. These wall panels can be used for other yachts, which makes that these collies are placed in the inventory for a longer duration. These collies stay in the external inventory until a new project starts with installation of the rough walls. In the model, these collies are not taken into account. All items that are placed in collies that arrives at the yard are installed on board. This makes mainly the speed of reduction of the external inventory level important. In other words; the shape of both graphs need to by synchronised, a certain offset can exist.

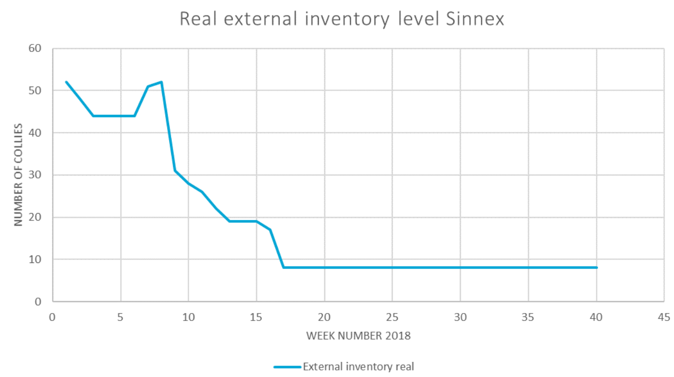


Figure 4.1: Real external inventory level - Sinnex Y718

Figure 4.2 shows the external inventory level of List. What immediately stands out is the constant external inventory level compared with Sinnex. Possible reason could be that List is more aware of which collies are stored externally. Collies which are not directly needed at the yard can stored in the external inventory, which result in not constantly incoming and outgoing collies at the external location. However, this cannot be modelled in the "as is" model. In the model the collies are not linked with an exact arrival date, which means that the model applies the First in First out (FIFO) principle. The collies which arrives as first on the yard are installed as first on the yacht. The FIFO principle influences not the inventory level, but it does influence the inventory time. Furthermore, by the external inventory level of List it cannot be seen if the level is coming from a higher level, which remains a question during modelling.

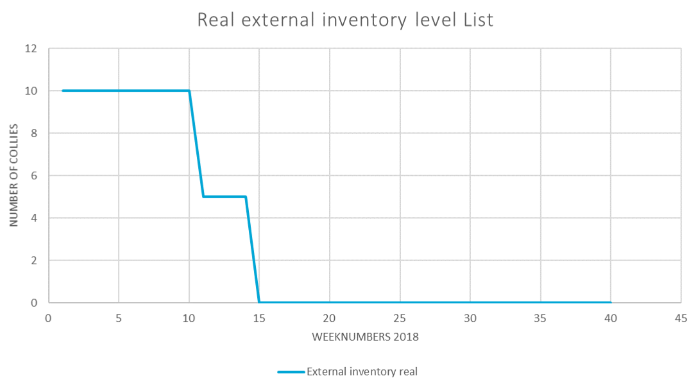


Figure 4.2: Real external inventory level - List Y718

From the two graphs it can be concluded that Sinnex makes more use of the external inventory than List. However, it could be that Sinnex is responsible for more rooms than List at the yard which result in a higher number of collies. This is investigated in the next two subsections.

4.2.2. Sending planning co-makers

Both Sinnex and List keep track of the collies that are send to Oceanco. These collies are fixed before the production starts. However, within Oceanco there is doubt as whether the layout of the collies is fixed. With collie layout, the specific items located in a collie is meant. In this thesis it is assumed that the collie layout is fixed. In appendix D the documents that the co-makers keep up is displayed. In these documents the following important data is noted:

1. Collie number
2. Specific room and area where the collie/parts of the collie is meant for
3. Description of the items that are located in the collie
4. Date that the collie in send

4.2.3. Installation planning Oceanco

Oceanco keeps a schedule during the installation process of each co-maker. During the process delays are noted and added to the total installation duration. Appendix E shows the final planning of installation of both co-makers. The following main aspects are implemented in this planning:

1. Which room is installed by which co-maker
2. Final start date and finish date per room

The planning shows that Sinnex is responsible for ten rooms at the yacht and List for six rooms. This explains the difference in number of collies, but also the difference in external inventory level. However, it still tells nothing about the magnitude of the difference, because the timeframe of installation for both co-makers is not yet investigated. In table 4.1 and table 4.2 the rooms, start date, finish date and total duration is given. To makes this planning visible a Gantt sheet, arranged on deck level, is made for both co-makers. Figure 4.3 and 4.4 shows these Gantt sheets. An important note is that the yacht is not completely finished, while the yacht has already been delivered at the 13th of February 2019. The yacht is coming back to Oceanco in August to finalise the last production processes of the yacht. However, this influences the total duration for each room in an unrealistic way, which affects the upcoming approach. Therefore, by the rooms which are not finished a duration of two months is added instead of eight months.

Deck level	Room	Start	Finish	Duration [working days]
Bridge deck (BD)	Corridor/lobby	04/09/2017	13/04/2019	420
Upper deck (UD)	Owners area 89-108	26/06/2017	13/04/2019	470
Upper deck (UD)	Owners area 80-88	07/08/2017	13/02/2019	398
Upper deck (UD)	Saloon/Dining	02/10/2017	13/02/2019	358
Upper deck (UD)	Lobby	19/02/2018	13/02/2019	258
Main deck (MD)	Saloon	14/08/2017	13/04/2019	435
Main deck (MD)	Lobby	19/02/2018	13/04/2019	300
Lower deck (LD)	Lobby	19/02/2018	13/02/2019	258
Lower deck (LD)	Beach lounge/SPA	02/10/2017	13/04/2019	400
Lower deck (LD)	Beach club	02/07/2018	13/02/2019	163

Table 4.1: Start and finish date interior installation of responsible rooms - Sinnex Y718

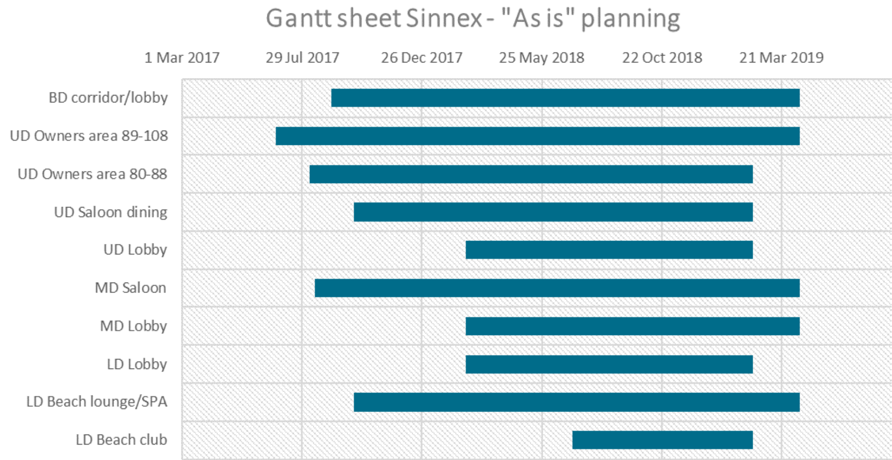


Figure 4.3: Gantt sheet current interior installation planning - Sinnex Y718

Deck level	Room	Start	Finish	Duration [working days]
Bridge deck (BD)	Wheelhouse	11/09/2017	13/04/2019	415
Bridge deck (BD)	Captains interior	06/11/2017	11/02/2019	331
Main deck (MD)	VIP Cabin 1	17/07/2017	12/02/2019	412
Main deck (MD)	VIP Cabin 2	17/07/2017	12/02/2019	412
Main deck (MD)	VIP Corridor	30/10/2017	11/02/2019	336
Lower deck (LD)	Guest area & corridor	02/10/2017	13/04/2019	400

Table 4.2: Start and finish date interior installation of responsible rooms - List Y718

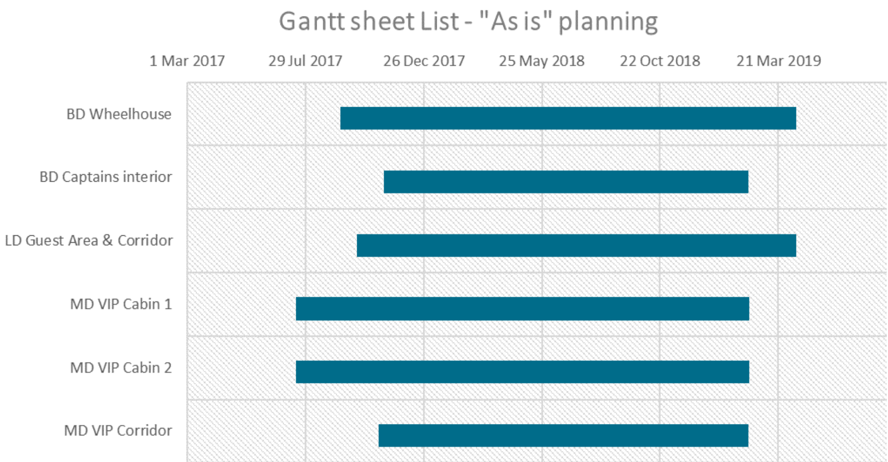


Figure 4.4: Gantt sheet current interior installation planning - List Y718

From now on, there is a better understanding of the available data. The following section will explain how the "as is" model is built up to estimate the installation date of the collies and the internal storage capacity to quantify the KPI's.

4.3. "As is" model overview

The goal of the model is to find the KPI values in order to find out what to improve. The method used matches the model external inventory level with the external inventory level in reality. The real external inventory level is shown in section 3.2 in figure 3.12. Thus, the modelled output data must be approximately the same as the external inventory level in figure 3.12. The model is simulated based on assumptions and simplifications

which makes it impossible to give an exact match with the real external inventory. Figure 4.5 shows the structure of the model. It can be seen that the model consist of four process parts, namely the date that collies arrive at the yard, the date that collies are placed on board, the total inventory level and the external inventory level. Knowing the day that a collie arrives at the yard and the day that a collie is placed on board gives the total inventory level, consisting of both the internal as the external inventory. However, the internal inventory capacity is unknown. By changing the value for the internal inventory, the offset of the modelled output for external is changed until it matches with the actual external inventory. The shape of the graph of the inventory level stays the same, when only the internal inventory capacity changes. Figure 4.5 shows for which process in the "as is" model the input data, explained in section 4.2 is needed. Furthermore, process two needs an installation approach to determine the date that a collie will be installed on board. This will be explained in section 4.4. Thus, to match the modelled external inventory with the real external inventory, the model has two variable values, the installation approach and the internal inventory capacity. Changing these values will minimise the surface error between the real external inventory level and the model external inventory level. After matching the modelled output with the actual data, an estimated value of the inventory time, inventory stored external and internal, total external collie weeks and the logistic expense can be given. Using this analysing model, an estimation of the unknown KPI values is made.
In the following section the functionality of the four process steps in the model will be explained.

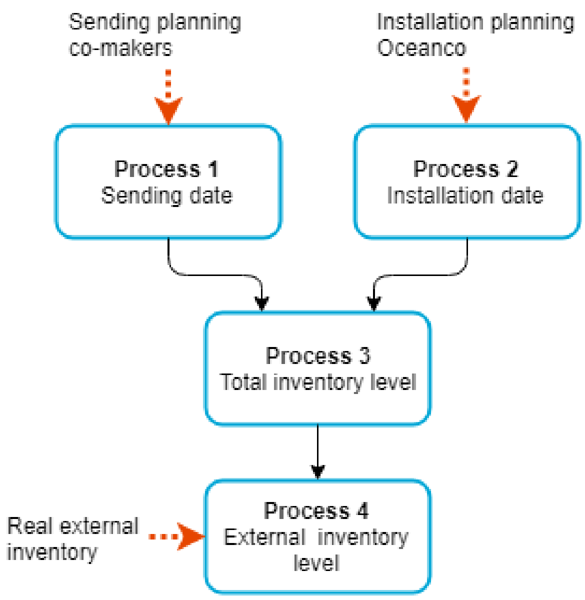


Figure 4.5: Overview of the structure of the "as is" model yacht Y718

4.3.1. Functionality process steps

In this section each simulation step will be explained with a simplified steady state model. Figure 4.6 shows the simplified steady state model.
For each process step the input, output, requirements and results will be given. The transformation zone, control zone and evaluate zone of the model will not be discussed in this research. This section discuss the results per process which are not KPI's. The KPI results inventory time, internal and external inventory, total collie weeks and logistic expenses will be discussed at the end of this chapter. Besides, the requirements become clear during this chapter. Table 4.3 shows the values of the steady state model for all steps.

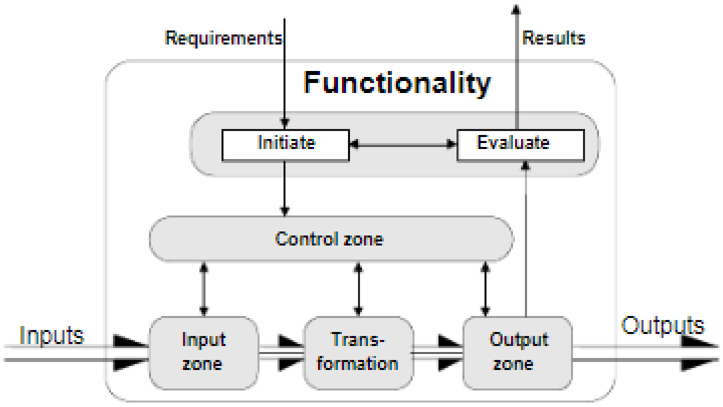


Figure 4.6: Simplified steady state model (Veeke, 2003)

	Process 1 - Sending date	**Process 2** - Installation date
Input	• Send date • Collie number	• Installation date per room
Output	• Sending date per collie	• Installation date per collie
Results	• Number of drives • Total number collies • Total sending duration • Sending rate • Truck lot size • Transport expenses co-makers	• Installation rate
Requirements	• Two days drive time	• Using installation approach • Two months extra on delivery date because yacht is not finished

	Process 3 - Total inventory level	**Process 4** - External inventory level
Input	• Sending date per collie • Installation date per collie	• Total inventory level model • Real external inventory level
Output	• Total inventory level per collie	• External inventory level
Results	• Inventory time	• Total collie weeks • Inventory stored internal • Inventory stored external • External storage expenses • Transport expenses Maat
Requirements	• First in first out principle	• Using constant variable capacity • Model matches with reality • Surface error below 10%

Table 4.3: Values of the simplified steady state model "as is" model

Process 1 - Sending date
From process one some interesting information can be noted. Table 4.4 shows an overview of the data that follows from the planning of the co-makers. Table 4.4 shows the sending rate per week for both co-makers. However, these rates are discontinued due to the non-constant truck lot size and transportation frequency during the process.

Type of information	Sinnex	List
Total number of collies	390 collies	252 collies
First sending and last sending	10/02/2017 - 12/01/2019	22/05/2017 - 08/02/2019
Total duration sending	501 working days	450 working days
Amount of drives to Oceanco	114 drives	66 drives
Lot size of the truck	Maximum: 13 collies Minimum:1 collie Average: 3 collies Median: 3 collies	Maximum: 9 collies Minimum:1 collie Average: 4 collies Median: 3 collies
Sending rate	7 collies per week	9 collies per week

Table 4.4: Sending data of the collies - List and Sinnex Y718

Process 2 - Installation date
Table 4.5 shows the installation rate per week for both co-makers. The first start date and last finish date of tables 4.1 and 4.2 are taken. In contrast to the sending rate, this installation rate can be considered continuous, due to the linear distribution over the timeframe by the installation approach, which will be explained in next section. Section 4.7.1 will explain the cause and consequence of these difference in installation rate between the co-makers.

Co-maker	Start installation	Finish installation	Duration [Working days]	Installation rate [Per week]
Sinnex	26/06/2017	13/04/2019	470	4 collies
List	17/07/2017	13/04/2019	455	3 collies

Table 4.5: Interior installation rate - Sinnex and List Y718

The results of process 3 and 4 consists only KPI results which will be discussed in section 4.7. However, first the installation approach, assumptions and validation of the model will be discussed in more detail before explaining the KPI results.

4.4. The installation approach

One important approach is made in process two to get the external inventory level out of the input data, due to the fact that the time that a collie goes on board is not registered. There is no planning when a specific collie is placed on board. If a collie is needed on board, the co-makers consult with the logistic point if the collies can be placed on board. Nothing is logged and stored. So, in the model an installation approach is needed that indicates the current installation date. Two important aspects need to be determined that the approach will use. These two aspects are the number of collies per room and the interior installation method.

Starting with the estimation of the number of collies per specific room. This is done with the data the co-makers deliver. Collies that consist of items for more than one room are divided by the total number of rooms in that collie. This way the smaller rooms also have collies, instead of all collies being assigned to the large rooms. Table 4.6 and 4.7 shows the rooms with the total number of collies for both Sinnex and List. Table 4.1, 4.2, 4.6 and 4.7 shows that the length of the duration per room influence the total number of collies. Longer room installation duration resulting in higher total number of collies.

The interior installation method consist of three main parts. These three main parts are; floor template, rough interior and finish interior. Floor template is a template which is placed on the floor where the layout is outlined in real scale. The floor template is temporary and will be removed when the final floor installation start. With rough interior the rough ceiling and rough walls are meant. Finish interior consist of finishing the ceilings, walls and floor and placing fixed furniture in the rooms. Figure 4.7 shows the framework of the installation method where the three parts are divided over the total installation duration of the interior. Also, it can be seen when the peak periods of the three installation parts take place. This figure shows the general method of installation, each co-maker can apply a slightly adjusted version.

Deck level	Room	Number of collies
Bridge deck	Corridor/lobby	23
Upper deck	Owners area 89-108	68
Upper deck	Owners area 80-88	26
Upper deck	Saloon/Dining	35
Upper deck	Lobby	36
Main deck	Saloon	55
Main deck	Lobby	31
Lower deck	Lobby	19
Lower deck	Beach lounge/SPA	76
Lower deck	Beach club	21

Table 4.6: Allocated number of collies per room - Sinnex Y718

Deck level	Room	Number of collies
Bridge deck	Wheelhouse	57
Bridge deck	Captains interior	54
Main deck	VIP Cabin 1	36
Main deck	VIP Cabin 2	36
Main deck	VIP Corridor	36
Lower deck	Guest area & corridor	33

Table 4.7: Allocated number of collies per room - List Y718

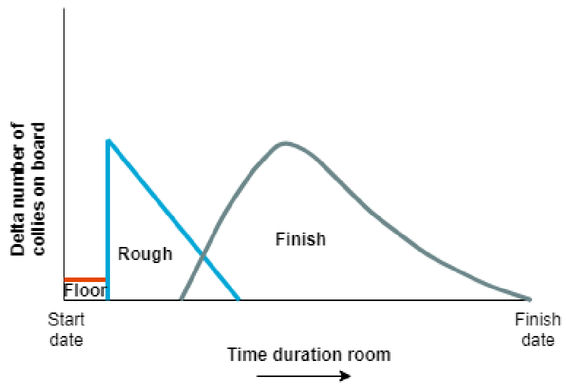


Figure 4.7: General interior installation method Oceanco

To simplify the installation approach and to make it more applicable for this research, the timeframe is divided into three parts and the number of collies per part is linearised. The installation approach combines the number of collies with the installation method. In the installation approach the installation method is made flexible and applicable by dividing the timeframe into three duration parts. The number of collies is divided over these three parts. This makes it possible to change the number of collies that are placed on board by each time phase. The goal of the phases is to match the external inventory of the model with the real external inventory level. This is done by changing both the time-value and the collie percentage of the three time phase. In the model the total collies per room are linear distributed over the timeframe by making use of equation 4.1. The first installation date is the start date of the timeframe.

$$For\ n = 1\ to\ Total\ number\ of\ collies\ project$$
$$Installation\ date\ collie_n = Installation\ date\ collie_{n-1} + \frac{Total\ duration\ in\ timeframe}{Total\ collies\ in\ timeframe} \quad (4.1)$$

This means that the amount of collies per timeframe influence the date that a collie is placed on board. How larger the percentage in a timeframe, the more frequently a collie is places on board. Figure 4.8 shows the three duration steps and the values of the installation approach when the installation of the collies goes according plan. The result of the installation approach value of the current model will be explained in section 4.7.

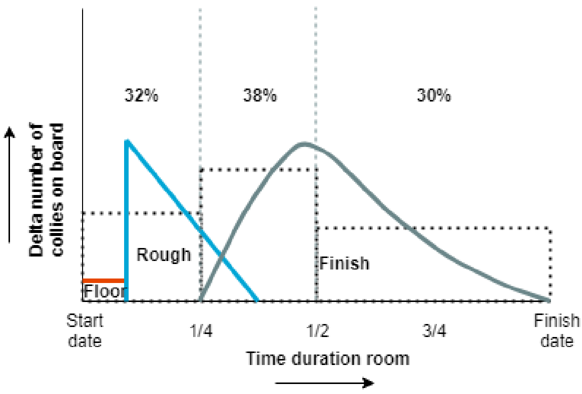


Figure 4.8: Undisturbed interior installation approach

The values of the installation approach for the co-makers must meet four requirements which are formulated based on the differences in installation for project Y718, according to the installation planning of Oceanco. The difference between the co-makers installation process is mainly formed by the different choice of the co-makers and by the circumstances created during the process, such as delays. The four requirements are:

1. Sinnex has a gap between the floor template and the rough interior where the installation stops for a certain duration. List has a smaller gap with the rough interior installation and the floor templates installation.

2. The finished interior of List starts when the rough interior is completely finished. The finished interior of Sinnex already starts when the installation of the rough interior still continues.

3. Sinnex has a longer total duration of the finished interior comparable with List.

4. The peak of the finished interior installation of List are a fraction later than Sinnex.

The model must meet these four requirements by establishing the right values for the installation approach.

4.5. Assumptions and neglected aspects

Unfortunately, it is not possible to exactly simulate reality. Therefore, in this section the assumptions and neglected aspects will be discussed.

4.5.1. Assumptions

The following assumption have been made in the model:

1. The collies are divided over the rooms by looking to the numbers of rooms that are placed in a collie. If in one collie items of three different rooms are located, each room gets one third of that collie. Another option to establish the number of collies per room is selecting the room with the first start date. The collie belongs to the room which start first with the installation. Both options are explored in the model, which gave approximately the same result. In the model the first option is applied.

2. Yacht Y718 is delivered on the 13th of February 2019. However, the yacht is not completely finished. The yacht will be finalised in 2020. The owners will use their yacht in the summer of 2019, after which the yacht will sail back to the yard of Oceanco. An estimation is made of the time that the interior builders needs to finalise the rooms. This time duration is set to two months.

3. The internal inventory capacity is assumed to be constant. In reality this level can be varied over the time, due to non-fixed storage places.

4. By the transport of the collies from the external to the internal inventory a truck lot size of five collies is assumed. These lot sizes are checked by the supervisor of Maat.

5. For both co-makers it is assumed that it takes two days to drive from the production facility in Austria to Oceanco.

6. All values are established in weeks instead of days. The last day of the week is taken as the used value.

4.5.2. Neglected aspects

Beside the assumptions, there are also aspects which are neglected in this model:

1. In reality, second time inventory storage takes place. Second time inventory are collies that need to be placed in the inventory for the second time. The collie cannot stay any longer on board, but still contains items. The model input works with the number of collies that are sent to the yard. The model is matched with a part of the real external inventory level, which can be higher due to second time inventory. So, by matching the modelled with the real external inventory, the second time inventory collies are indirectly taken into account. This leads to an overestimation in the modelled inventory level. However, there is no data available on second time inventory and thus cannot be included as variable in the model.

2. Collies arrives at the yard in different truck lot sizes. The storage place (internal or external) is determined in advance. All the collies of a truckload are stored in the external storage when there is no space available in the internal storage for all, or a part of, the collies in the batch. This is not implemented in this model. However, the temporary storage is reserved for the few collies of the truck which cannot be placed at the workshops.

4.6. Verification and validation "as is" model

Verification and validation of created models is needed to ensure the model represents reality. This section contains the verification and the validation of the “as is” model. Verification of the models is done while creating the model. However, due to the limited time and available data during this research, the model is not validated yet. This section explains how the "as is" model are verified and how the model can be validated after this research.

4.6.1. Verification

Verification is defined as: "Verification is determining that a simulation model performs as intended" (Law, 2000). This means that the model does not contain any bugs and the codes are correct (Kleijnen, 1995). The "as is" model is generated step-by-step. The step-by-step method is applied started by modelling the arrival of the collies, then modelling the interior installation date of the collies and finished with modelling the inventory time and inventory levels within the arrival and installation date. The negative values of the inventory level show that the arrival date and installation date do not match. A major mistake during this phase was the total days instead of working days, which makes a significant variation in total duration. After noticing this error, the mistake is corrected. During modelling, specific collies were followed through the process to check if the behaviour of the model was as expected. This was the case for most changes. By constantly checking the results against the current state results and adapting the model logic if the behaviour becomes non-representative, the model was verified.

4.6.2. Validation

Validation is defined as: "Validation is concerned with determining whether the conceptual simulation model (as opposed to the computer program) is an accurate representation of the system under study" (Law, 2000). Validation of the “as is” model is needed to make use of this model in the future.
The “as is” model can be validated with historical data from yachts which are already built. However, in this research it became clear that the required data of historical yacht for the model is limited. The LSP request system, which will be explained in chapter 8, ensures for more available data in the future. With these data the “as is” model can be validated. LSP request will be used for yacht Y719, which is planned to be ready in 2021. It therefore takes a while before validation is possible.
During modelling, some parts of the "as is" model of the Y718 were already validated. Parts of the final external inventory level of the “as is” model can be checked with the real external inventory level. The calculated error between the model and reality will be explained in section 4.7.1. Parts of the modelled logistic expenses can be validated with the real payments of Oceanco. The expenses validation will be described in section

4.7.5. Next to these validations with real data, the experts who have worked on the project also checked the modelled total inventory level. They were able to explain many of the peaks and troughs of the calculated inventory level with reality.
To make the total “as is” model reliable, multiple new building yachts must be implemented in the “as is” model. For this, the collie layout, the arrival date of the collies and the external stored collies is needed. The percentage of the installation method must be found again, which could correspond if the same challenges occurred as yacht Y718. The experts must check the inventory level again. If the model matches reality, the “as is” model can be interpreted as valid. This model can identify new logistics challenges from new built yachts, where new improvements can be found. Next to the interior, also other components can be modelled. However, first the different components need to be implemented in the “as is” model. The LSP request system ensures in the future for more reliable data that can be implemented in the model which eliminate the assumed installation approaches in the “as is” model.

4.7. KPI Results

In this section the results will be shown of the "as is" model. First the right values for the installation approach and the internal inventory capacity will be checked by the current external inventory. Then, the outcome of the unknown KPI values will be shown.

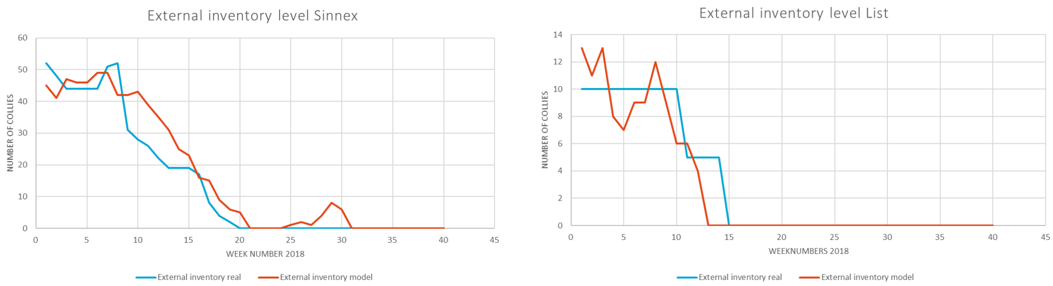
4.7.1. Model justification

The values of the installation approach and the internal storage capacity have to be determined to know the external inventory level during the process. To find the correct values of the installation approach and internal storage capacity, the external inventory level of the model is compared with the real external inventory level. Therefore, the total inventory level is needed. The total inventory level per week is calculated with equation 4.2.

$$
\begin{aligned}
&For\ n = 1\ to\ Total\ week\ numbers\ project \\
&\qquad Total\ inventory\ level\ week_n = Inventory\ level\ week_{n-1} + arrival\ collies\ week_n - \\
&\qquad\qquad installation\ collies\ week_n
\end{aligned}
\tag{4.2}
$$

The total inventory level is split up into internal inventory level and external inventory level. Hereby, the unknown internal inventory capacity needs to be estimated. Changing this capacity until the model external inventory level matches the current external inventory level will give the right value. Only the offset of the capacity changes, the shape of the external inventory stays the same.

Figure 4.9 shows the external inventory levels of the model and reality. These external inventory levels are generated by minimising the surface error between the model and reality by changing the values of the installation approach an the internal storage capacity. The aim is to get the surface error within 10% of reality. The model is minimised in a few steps. First the right duration phases are found, where the transition of the phases are located at timeframes where there is a turning point in increasing or decreasing number of collies placed on board. Thereafter, some realistic undisturbed percentages of number of collies per phase were tried. This resulted in a negative total inventory. By changing the percentage in small steps and taking the changes in inventory level into account, the minimised value for both co-makers were found.
The “as is” model of Sinnex has an average surface error of 22% (overestimation) relative to the real external inventory. This is a significant error, but if the model takes the truck lot size into account, this overestimated error will be less and expected to be within 10%. Especially the external level in the model will be lower between week eight and fifteen due to the adjusted lot size. The “as is” model of List have an average surface error of -8% (underestimation) relative to the real external inventory. The inventory level for List is relative constant, were lot size did not change the underestimated error.

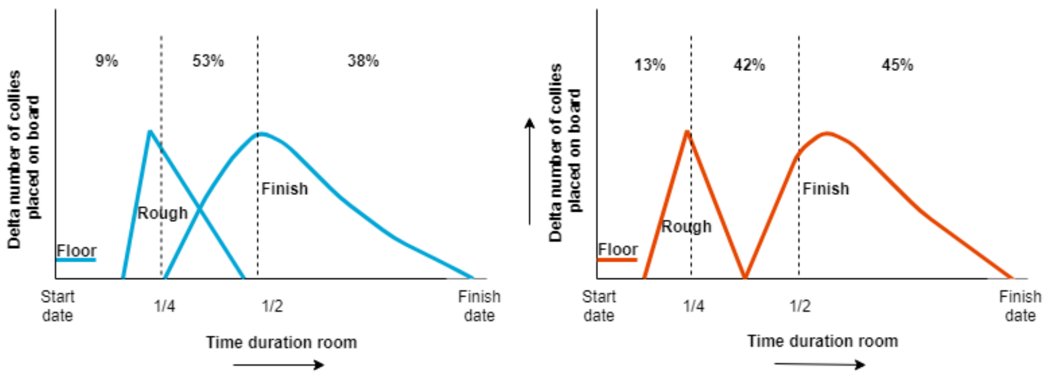


(a) Sinnex (b) List

Figure 4.9: External inventory level model and reality - Sinnex and List Y718

Figure 4.9 shows some differences between the model external inventory level and the real external inventory level. Started with co-makers Sinnex. In the model it seems that in week one the level is coming from a lower level, which is in contrast to reality. However, from the model it become clear that the beginning of 2018 is the peak period for the external inventory. The highest peak does not differ much from the peak measures by reality. During the reduction of the inventory level there is a difference due to the lot size of the truck that transport the external inventory collies to the yard. The model has a lot size of one and in reality the lot size is five.
It seems that the fit of List is better than the fit of Sinnex. The model external inventory level follows relative the same flow as the real external inventory level. The lot size of the truck mainly effects the difference in inventory level in the beginning of the process. The model reaches earlier the zero external inventory level, but this can also be a consequence of the lot size.

With the out comes of the external inventory level shown in figure 4.9 an internal inventory capacity of twenty collies is assumed for both co-makers. This is a realistic value based on the available storage space.
Figure 4.10 shows the values of the installation approach of both co-makers. The percentage in the first time-frame by both co-makers seems to be underestimated, which will be explained further in this section. Figure 4.11 shows the small difference of the installation method between the co-maker. This figure shows that the selected values of the installation approach meets the mentioned requirements in section 4.4. The difference in percentage of the number of collies that are installed on board is caused by the smaller gap between floor and rough installation, the shorter duration of the rough interior, the missing overlap between rough and finish interior and the late peak of the finished interior of co-maker List.
In appendix F the progress of the incoming collies, outgoing collies and total inventory level of both co-makers are given.



(a) Sinnex (b) List

Figure 4.10: Interior installation approach - Sinnex and List Y718

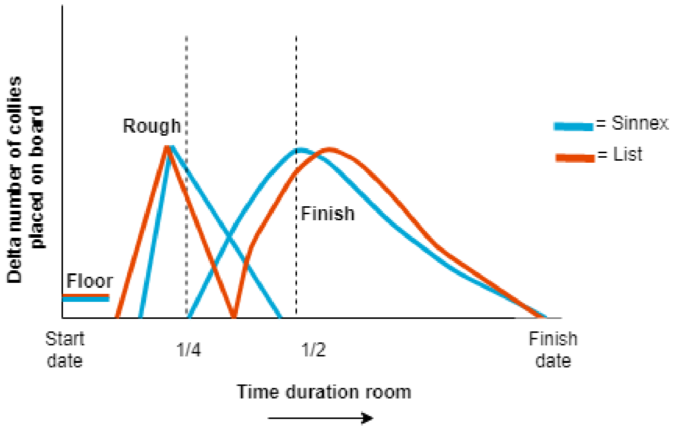


Figure 4.11: Difference in interior installation approach - Sinnex and List Y718

Since the correctness of the model has been confirmed, the effects of the different installation dates and different sending dates of both co-makers can be further investigated. Figure 4.12 shows the total inventory level of both co-makers. As mentioned above, it seems that in the first timeframe the number of collies that are placed on board are underestimated related with the standard installation method. Without this underestimation the inventory level peak located at the end of 2017 and the beginning of 2018 is less high. The major question is why this peak is originated. There are a few causes that are responsible for this first peak:

1. The installation of the interior is located at the end of the total yacht building process. Delays in earlier stages of the project result in a shorter time period for the production phase, due to the non-sliding delivery date. With non-sliding delivery date, the date is meant that the yacht will be delivered to the owners. This milestone is fixed which can only be adjusted by an unknown amount of money. The inventory level increases due to the delay in the earlier stage of the project because the non-sliding delivery date ensures that the collies cannot be delivered later than planned. In this case, the installation and production planning are not or hardly adjusted on the changed production planning.

2. The major cause of the peak is due to delays in the production phase of the interior. Technical drawings which are needed before the production of the items can start were not ready on time. The delay of these drawings is caused by the late interior decisions by the clients. The production of the interior started too late, resulting in a slow start of the installation of the interior. Due to the delays, a number of collies was delivered which collies that were late and collies that were on time. The installation of the interior takes a lot of time, mainly installing the rough interior, which makes it difficult to reduce the inventory level.

3. Mentioned by the logistics supervisor, the second time inventory take place when a lot of collies are needed on board. There is no time and space to remove all the items of the collies. Many collies are placed for the second time in the inventory during the peak period, which increases the inventory level. However, in this thesis there will be no further investigation of the second time inventory collies.

Another remarkable appearance are the small peaks at the end of the production phase. These peaks arise by the changes in orders of the interior design during production. The second time production leads to a increasing of the inventory at the end of the interior process. For the production phase, this variation in interior design is unfavourable. Communication between the co-makers and Oceanco is important due to changes in planning. Figure 4.12 shows that the total inventory level is lower for List than Sinnex. This is understandable, because Sinnex have 390 collies to install on board where List has 252 collies.
Figure 4.13 and 4.14 shows the total inventory level, where the scale of both co-makers are the same. Figure 4.13 shows the percentage of stored collies, where figure 4.14 shows the number of weeks that the inventory has collies in stock by using the installation rate calculated in section 4.4. For example, the peak of List take place in week fifty of 2017 where collies for 15 weeks of installation are placed in the inventory, which is 16% of the total number of collies.

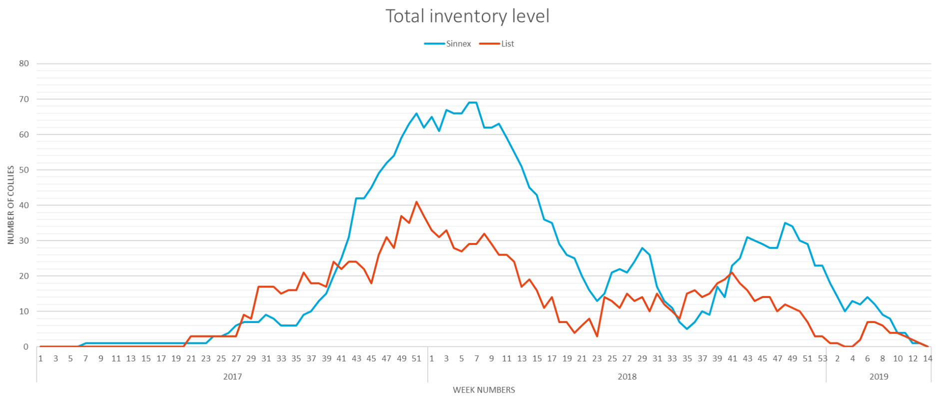


Figure 4.12: Total inventory level - Sinnex and List Y718

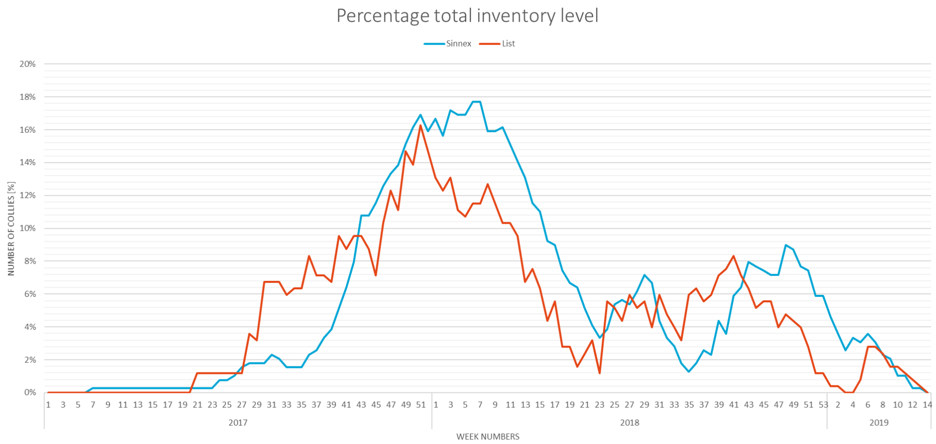


Figure 4.13: Percentage total inventory level - Sinnex and List Y718

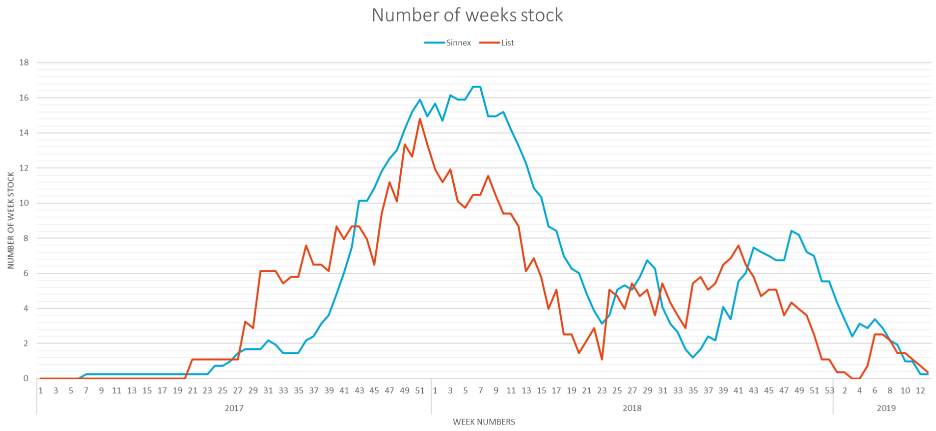


Figure 4.14: Number of weeks stock - Sinnex and List Y718

From figure 4.13 and 4.14 it can be concluded that both co-makers have to cope with the same delay aspects, because they follow the same line flow during the logistics process. By comparing both co-makers with approximately the same scale, the inventory level for List is below the inventory level of Sinnex. Two main causes can be given:

1. List controlled the start date of the production and installation better than Sinnex. The tuning with the interior production and installation is better due to frequent progress communication.

2. List could afford to fall behind schedule, because the end date of the baseline installation planning was planned on the twenty of July 2018. This end date is ahead of the delivery date of the yacht. The baseline finish date of Sinnex was planned on the fourteen of December 2018, which is close to the delivery date of the yacht. The installation duration of Sinnex took 22% longer than the planned installation time. List took 72% longer than planned, which explains the lower installation rate of List. Higher installation rate for List might have caused problems by the change orders of the client, where first a stop of installation work is followed by a peak of work due to the change orders.

It can be concluded that the communication between the co-maker and Oceanco during the process is better for List than for Sinnex, which causes the lower inventory level of List. However, the lower inventory levels are also caused due to the fact that List had more flexibility by changing the planning.

4.7.2. Inventory time

From section 4.7.1 it become clear that Sinnex makes relative more use of the external inventory space than List. The inventory time influences the duration that the collies are placed in the inventory. Higher inventory times causes higher inventory levels where more number of collies are stored in the external inventory. As already explained, this modelled inventory time deviates from the current inventory time by applying the FIFO principle. The inventory time per collie is calculated with equation 4.3.

$$\begin{aligned} &For\ n = 1\ to\ Total\ number\ of\ collies\ project \\ &Inventory\ time\ collie_n = Installation\ date\ collie_n - Arrival\ date\ collie_n \end{aligned} \tag{4.3}$$

The average value of the total area located under figure 4.14 gives also the inventory time. The inventory time of both co-makers is shown in a box-and-whisker plot for graphically depicting groups of numerical data. This box plot is shown in figure 4.15. The value of the quartile are given in table 4.8.

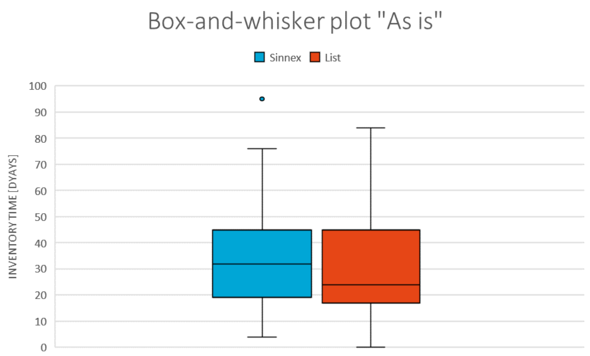


Figure 4.15: Inventory time Box-and-whisker plot - Sinnex and List Y718

	Inventory time Sinnex [working days]	**Inventory time List** [working days]
Minimum	4	0
Q1	19	17
Median	32,5	24
Q3	44,8	45
Maximum	95	84
Mean	34,6	29,1
Range	91	84

Table 4.8: Quartile inventory time - Sinnex and List Y718

It can be seen that Sinnex has a larger median than List. In the initial phase of the installation, the inventory time per collie for Sinnex is higher than List and remains high for a longer period. The range of both co-makers is more or less the same. This range is wide, which results in a wide variation in inventory time during the process.

4.7.3. Inventory stored internal and external

This section shows the inventory stored external, inventory stored internal and the number of movements external, due to the fact that the number of movements is linked to the inventory stored external. Figure 4.16 shows the total inventory stored internal and external of both co-makers. The inventory stored internal and external are calculated with equation 4.4, 4.5 and 4.6.

$$\begin{aligned}&\textbf{For } n = 1 \textit{ to Total week numbers project}\\&\textbf{If } \textit{Total inventory level week}_n > \textit{internal storage capacity}\\&\textbf{Than } \textit{Inventory level external week}_n = \textit{Total inventory level week}_n - \textit{Internal capacity}\\&\textbf{Other } \textit{Inventory level external week}_n = 0\end{aligned} \tag{4.4}$$

$$\begin{aligned}&\textbf{If } \textit{External inventory level week}_n > \textit{External inventory level week}_{n-1}\\&\textbf{Then } \textit{Delta external stored collies week}_n = \textit{Inventory level external week}_n -\\&\textit{Inventory level external week}_{n-1}\\&\textbf{Other } \textit{Delta external stored collies week}_n = 0\\&\textit{Total inventory stored external} = \sum_{n=1}^{max} \textit{Delta external stored collies week}_n\end{aligned} \tag{4.5}$$

$$\textit{Total inventory stored internal} = \textit{Total number of collies} - \textit{Total inventory stored external} \tag{4.6}$$

List placed 41 collies in the external inventory, which is 16,3% of their total number of collies. Sinnex stored 86 collies in the external inventory, which is 22,1% of their total number of collies and thus relatively higher than List.

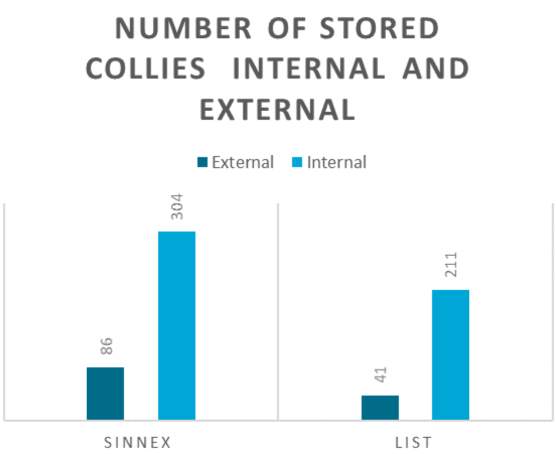


Figure 4.16: Number of internal and external movements - Sinnex and List Y718

4.7.4. Total collie weeks external

The KPI collie weeks combined the inventory time and the inventory stored external. Higher inventory times means that collies stay longer in the inventory. The total collie weeks at the external location is calculated in the model with equation 4.7.

$$\textit{Total collie weeks external} = \sum_{n=1}^{max} \textit{Inventory level external week}_n \tag{4.7}$$

Figure 4.12 in section 4.7.1 shows that the collies of Sinnex that are stored in the external inventory stays longer in the inventory. The peak periods of List are smaller due to the shorter inventory time. Next to the difference in inventory time, Sinnex stores more collies in the external inventory than list, which also affects the difference in total collie weeks. The total volume collie week for List are 220 and for Sinnex 1131. This is a significant difference, which is mainly caused by the high inventory time and high number of collies stored in the external inventory of Sinnex.

4.7.5. Logistic expenses

Next to the KPI's related to the logistics efficiency, the logistic expenses are also of high importance for Oceanco. The logistic expenses of Oceanco consist of transportation expenses of the co-makers, external storage expenses and transportation expenses from the external location to the yard of the logistic supplier Maat. In table 4.9 an overview of these logistic expenses are given. These are not all the logistic expenses of the organisation, but for this thesis the most important ones. The fixed transportation expenses of the co-makers, is determined in advance in the supplier's contract. The storage and handling expenses made by the logistic supplier will be charged afterwards. With handling expenses the expenses to place the collie in and out the storage is meant, for which Maat a total expenses of €32,96 per collie charged.
In table 4.10 the logistic expenses overview of yacht Y718 are given. These logistic expenses are calculated with equations 4.8, 4.9 and 4.10.

$$Transport\ expenses\ co-makers = Transport\ expenses * Number\ of\ drives \tag{4.8}$$

$$\begin{aligned} External\ storage\ and\ handling\ expenses = Storage\ expenses * Total\ collie\ weeks\ external \\ + Handling\ expenses * Total\ inventory\ stored\ external \end{aligned} \tag{4.9}$$

$$Transport\ expenses\ Maat = Transport\ expenses\ truck * \frac{Total\ inventory\ stored\ external}{lot\ size\ five} \tag{4.10}$$

It shows the significant impact on the expenses by the transport from Austria to Oceanco with respect to the other logistic expenses. The difference in total logistic expenses between the two co-makers is mainly caused by the difference in transport expenses, due to the variation in number of drives. Also, the storage duration in the external inventory of Sinnex are higher, resulting in higher external storage expenses. At last, due to the larger number of stored collies at the external location for Sinnex, also the transportation expenses from the external location to Oceanco are higher than List.

logistic expenses		
Transport expenses [one way]	Transport Sinnex	€ 842,10
	Transport List	€ 819,70
External inventory expenses	Storage area	€ 2,20 per m^2/per week
	Handling in and out	€ 32,96
	Small truck	€ 113,00

Table 4.9: Overview interior logistic expenses Oceanco

	Sinnex	**List**
Transport expenses	€ 192.000,00	€ 108.200,00
External storage expenses	€ 10.300,00	€ 2.803,00
Transportation expenses maat	€ 2.034,00	€ 1.017,00
Total logistic expenses	€ 204.300,00	€ 112.000,00

Table 4.10: Interior logistic expenses current situation - Sinnex and List Y718

Oceanco bought a new location in Zwijndrecht. The plans are to store all the external stored collies at this location. The advantage of this storage place is the reduction of handling expenses within the external inventory, because the handling will be arranged by Oceanco instead of Maat. The storage expenses stay the same. The new logistic expenses are still unknown. Therefore, in this thesis it is calculated with the old logistic expenses of Maat.

A rough estimation can be made to check the calculated logistic expenses of yacht Y718. Only the external storage expenses can be checked due to the available expenses overview of Maat. The data contains the external storage expenses of yacht Y718 for year 2018 and 2019. The data for year 2017 is missing in this calculation. The available expenses data makes no distinction in components as piping, interior, HVAC system, etc. This means that all components that are stored external are included in this expenses overview. The total storage expenses that Oceanco paid to Maat in 2018 and 2019 for yacht Y718 for all external handling and storage space is €19.100,00. In this thesis it is assumed that approximately 50% of the external stored goods of Y718 are interior items. This result in €9.550,00 interior external handling and storage expenses. Table 4.10 shows that the external storage expenses of both co-makers in the " as is" model are €13.100,00. This means that the external handling and storage expenses in the model have an over estimation of 30% relative to the real expenses. The total external expenses calculated in the model does take year 2017 into account. This means that the overestimation of 30% getting less. To estimate the expenses that the model makes in 2017 relative to the total duration, the number of collie weeks is used. This KPI is linked with the storage and the handling expenses. 34% of the total collie weeks takes place in 2017. The remaining 66% gives a total storage and handling expenses of €8.646,00 for the model. This result in an underestimation of 9% of the storage and handling expenses of the "as is" model relative to the real expenses. Figure 4.17 shows the difference in expenses between reality and the model.

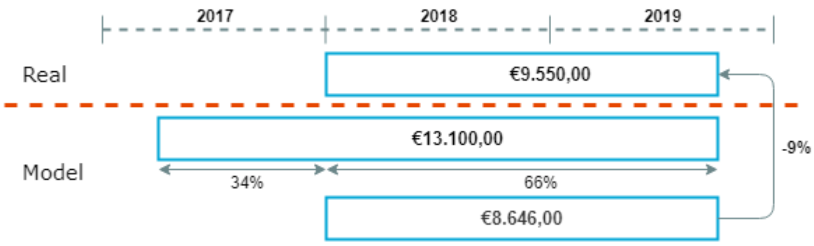


Figure 4.17: Difference in storage and handling expenses between reality and "as is" model Y718

4.7.6. Conclusion KPI's

The goal of the "as is" model is to find the KPI values which shows the main challenge of the interior logistics process where improvements are needed. Table 4.11 shows the values of the KPI's which follows from the results of the model.

KPI	Sinnex	List	Total
Inventory time	32,5 days	24 days	-
Inventory stored external	86	41	127
Inventory stored internal	304 collies	211 collies	-
Total collie weeks	1134	220	1354
Total logistic expenses	€ 204.300,00	€ 112.000,00	€ 316.300,00

Table 4.11: Overview of the KPI's for co-makers - Sinnex and List Y718

These KPI's indicates the following difference between the co-makers:

1. The total stored inventory of List is smaller than Sinnex due to the lower total number of collies.
2. Sinnex stores relatively more collies at the external inventory than List, 22,1% and 16,3% respectively.
3. The inventory time of Sinnex is 8,5 working days more than List, due to the high inventory times in the beginning of the interior installation.
4. The volume of the total collie weeks of Sinnex are much higher than List due to the higher inventory time and more stored collies external.
5. The logistic expenses for Sinnex are higher than List mainly due to the higher transport expenses caused by the number of drives to their production facility.

By investigating the current situation two main challenges are derived from the model, which have a significant impact on the number of non-value added movements:

1. The peak at the inventory level due to the delay of the production and installation of the interior.
2. Peaks at the end of the inventory level due to the changes of the interior design.

Next chapter will analyse the impact of these challenges.

4.8. Overall applicability

The "as is" model is now used for one yacht, which is for the reliability of the model not enough. To make the current model more reliable, it must by applied at more yachts. In this thesis only the way how to apply the model at different yachts will be explained due to time and data constraints.
The data that is needed to model reality for different yachts are:

1. The sending date of the collies
2. The external inventory level of the yacht in a given time duration
3. The installation planning of Oceanco
4. Number of collies per room, followed from the fixed collie planning from the co-makers
5. Finding the new installation method per unique project with the external inventory level

The current model is tested at Oceanco's facility at Marineweg 5, but it is also applicable for Marineweg 1. Only the internal inventory capacity has to be changed.
Furthermore, each project is unique and has to cope with specific project challenges which affects the logistics interior process in a different way. The variables of this model need to be adjusting accordingly.

5

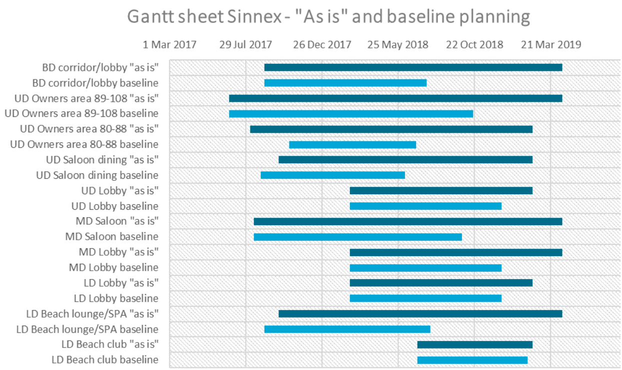
Analysis current situation

This chapter completes the analyse phase of the Deming's cycle, shown in the framework in table 2.5. This cycle focuses on the root cause of the increasing of non-value added movements. When investigating the KPI's in chapter 4, two main challenges with significant impact on the non-value added movements are derived from the model. These challenges are located at the initial phase of the interior installation where the peaks in the inventory level rises due to delays in the interior production and/or installation. The second challenge is located at the end of the interior installation where the peak in the inventory level is caused by change orders of the interior design by the client. The root cause of these challenges can be found by going into more detail, finding out the impact of the challenge and asking the question why the logistics process is as it is. Understanding the root cause gives a better insight in the possible improvements for the logistics process.

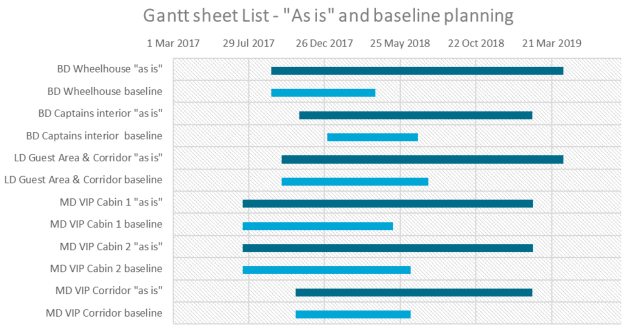
5.1. Impact of the challenges

During the delayed interior process, few actions on the inventory inflow of the collies were taken by the project team and logistic point.
Starting with some detailed information about the delays in the interior process. Figure 5.1 shows the Gantt sheets of the two co-makers, which include the current planning and the baseline planning. It can be seen that the duration of the current process takes much longer than the baseline planning. The processes started at the same time, but in the initial phase less interior was installed on board than scheduled. Thereafter, at the end of the interior process a lot of change orders were requested.

Figure 5.2 shows the inventory level of the "as is" model (dark blue) and the inventory level when the collies are delivered according to the baseline planning and installed on board according the current planning (cyan blue). This figure shows that the arrival of the collies did not go according plan. For the inventory time the median of the inventory time is taken. This means that for Sinnex an inventory time of 32 working days is applied and for List 24 working days. For the truck lot size the average values of the current lot size is taken. Sinnex has an average lot size of three collies and List four collies. For the baseline inventory level the undisturbed installation method is used, which will be explained in chapter 7. It must be noted that this baseline inventory level is including change orders. When creating the baseline planning these change orders are yet unknown. However, the change orders are included in the reported baseline inventory level, leading to a higher baseline inventory level than expected before the start of the project. The difference between the inventory levels are relatively large for both co-makers, despite the fact that less changes were made in the interior production planning during the process. Therefore, it can be concluded that next to the installation delays on board also the interior production part encountered problems.

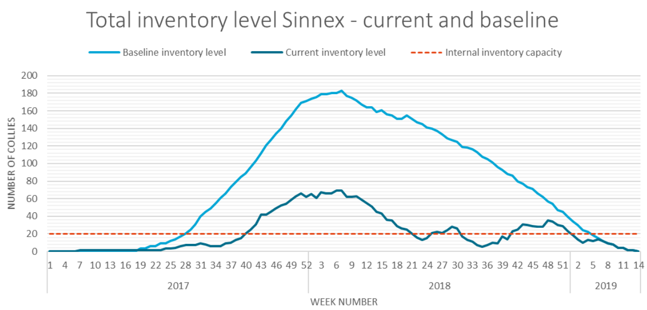


(a) Sinnex

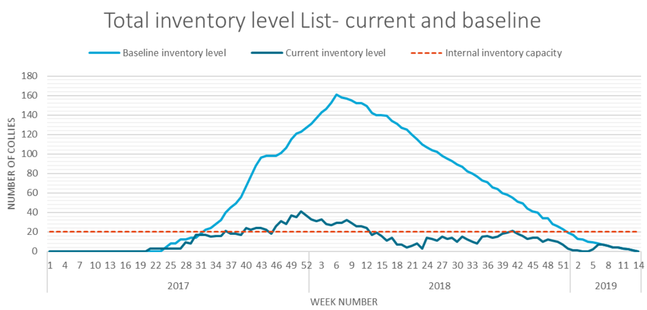


(b) List

Figure 5.1: Current and baseline gantt sheet interior installation planning - Sinnex and List Y718



(a) Sinnex



(b) List

Figure 5.2: Current total inventory level and total inventory level according to delivery baseline planning - Sinnex and List Y718

When taking a closer look to the details of the delays, the following aspects contribute to the delay of the interior process:

1. Co-makers made adjustments immediately, without actual approval. Resulting in possible rework after the approval.

2. Interior decisions came too late by the client. Y718 was the first yacht of the client where decisions generally takes longer, because the space overview must be better explained and visualised.

3. Company Alewijnse was far behind schedule. Alewijnse arranges the electrical and automation systems on board. These systems first needed to be installed on board before the interior can start.

4. Oceanco is working with a new way of planning. Sub-contractors must coordinate the planning more closely. This is new for most of the co-makers, which still needs some improvement.

5. The engineering phase took longer due to unexpected complexity, resulting in a delayed production of interior items. Late delivered collies together with collies which were delivered on time results in high inventory levels.

6. Change orders in interior were accepted until the last moment of the interior installation process.

The above aspects contribute to less control and feasibility of the interior- and logistics planning.
This thesis will focus only on the delays that arise at the initial phase of the installation process. The first inventory peak in the initial phase is more predictable than the second peak at the end of the process. Of course, it is known that change order will take place at the end of the process, but the quantity and time of these change orders are unpredictable. Also, the number of change orders depends on the experience of the client. To make this research wider applicable than just Y718, the change order delays are not taken into account.
During the beginning and mid installation phase there needs to be more control on the inventory level to minimise the impact at the end of the installation phase. So the focus of this thesis is on the delays in the earlier stage of the installation process by the interior production and previous component installation.

Despite the findings of delays during the process, no drastic changes were made to the delivering of the interior production for yacht Y718. Two reasons can be found explaining this.
Firstly, the delivery date is the most important milestone. If this milestone is not reached, some liquidation damage expenses must be paid to the owner. For yacht Y718 it was not possible to change this date anymore. It must be noted that yacht Y718 together with Y717 and Y716 were all behind schedule. By the short period between the delivery dates of these yachts, the impact on the expenses due to delays were significant. So, the processes had to speed up instead of taking a step back and taking control of each process. The project team tried to cope with the current situation and pushed their co-makers to work harder by paying some speed up bonus. All interior collies were sent to Oceanco if the production was finished, without taking the delayed planning of Oceanco into account.
Secondly, the income is an important factor in the organisation. Oceanco receives money from the client if all fixed interior is delivered at the yard. This means that Oceanco wants all the interior items as early as possible from a financial point of view. The logistic expenses are much lower compared to the income that Oceanco gets. From a financial perspective, the inefficient logistics process is more beneficial, since it generates cash faster.
From above findings it can be concluded that the efficient logistics process is affected by the financial milestone mechanism. Next section will explain the milestone mechanism.

5.2. Financial milestone mechanism

During the project several financial milestones take place where Oceanco receive their income from the client. The instalments and percentage of these milestones may vary per project, but this overview is based on the most recent yachts at Oceanco. The ten financial milestones or client instalments of project Y718 are:

1. 10% Contract signing

2. 10% Main engines ordered

3. 10% Keel has been laid
4. 10% Start construction superstructure
5. 10% Production interior woodwork started
6. 10% Hull and superstructure arriving at the yard
7. 10% Rough fairing of the superstructure (excl. mast) is finished
8. 10% All fixed interior has been delivered at the yard
9. 10% Floating of the vessel/load out
10. 10% Delivery

The scope of this thesis are the payments related to the fixed interior. These payments influence the efficiency of the logistics process. However, the start of the interior production financial milestone must be taken into account too, because this milestone determines the start of the arrival of the collies.
The fixed interior milestone is reached when all fixed interior is delivered at the yard. The interior change order items are not covered by this milestone. The change order items create a kind of "grey zone" where the income versus late delivery costs must be negotiated.
Next to the income, Oceanco also has to pay their subcontractors. The organisation works with the back-to-back agreement, which means that the subcontractors are paid when the client have paid. The subcontractors get paid when the subcontractors make enough progress to realise the client instalment. Normally, the cashflow to Oceanco is ahead of the cashflow to the subcontractors. Oceanco starts with a positive cashflow due to the payments of the client by signing the contract. The project buyers of the project team must be informed of the client instalments to align the subcontractors instalment with the client instalment.

From the findings in section 5.1, it can be concluded that the extra expenses of the inefficient logistics process is small with respect to the income generated by fulfilling the total interior milestone. So, the answer for why the project team did not take action on the increasing of the inventory level is due to financial reasons. By changing the process for the benefit of the logistics, a negative impact on income will be created. Resulting in a total negative impact on finance. Therefore, conclusion can be drawn that the mechanism of milestone related income is the main cause of increasing non-value added movements deliberately resulting in an inefficient logistics process Next section will explain the financial milestone in more detail. The position of the financial milestones is not a problem for the logistics process, if the project is on schedule. However, the yacht production of the last three yachts were behind schedule, which created a chaotic production phase where it is challenging to control all processes at the yard. Due to the close proximity of the delivery dates of the three yachts, the impact on the expenses due to the delays, process mistakes, speed up expenses, etc. were significant. Oceanco wanted to have all the interior items as soon as possible on the yard to receive the client instalment of the fixed interior. This instalment made it possible to spend money elsewhere in the project.
B. Host (supply chain specialist, May 21, 2019) mentioned that the interior milestone is a failing of the process related to the logistics efficiency. By dividing this financial milestone over the entire installation process, Oceanco already receives income of the client at the beginning of the interior process. The risk of the expenses by delays and/or rescheduling reduces due to the redistribution of the financial milestone mechanism.
V. van Vliet (Project manager production Y719, July 11, 2019) mentioned that last three yachts were an unfortunate coincidence. He believes that the focus must lie on controlling the project by detailed schedules instead of changing the financial milestones. Delays and errors in the production must be noted immediately, where the adjustments in the schedule can be communicated with the co-makers on time. This prevent unexpected expenses at the end of the project. The position of the milestones can stay the same, where mainly logistic expenses are saved by the controlled process.

Given the two different opinions of the employees at Oceanco about changing the financial milestone, two financial milestone scenarios can be drawn which focuses on the reduction of the non-value added movements in the logistics process:

1. Dividing the milestone and improving the logistics process
2. Current milestone and improving the logistics process

Both financial milestone scenarios have their pros and cons. Table 5.1 shows the advantage and disadvantage of these two financial milestone scenarios. Next chapter will focus on the selection of the improvement tools that can be implemented in the logistics process of Oceanco. The financial milestone will be neglected by selecting the improvement tools. In chapter 7 the logistic expenses reduction due to the improvement tools that reduces the movements will be calculated for both financial milestone scenarios. For the second scenario is it interesting to calculate if the logistic efficiency expense reduction outweigh the extra expenses made by the unchanged financial milestone.

	Scenario one	**Scenario two**
Pros	• No extra interest expenses due to the distribution of the financial milestone	• Deadline incentive • Extra focus on controlling the process
Cons	• No deadline incentive • Long-term process to adjust the milestones	• Extra interest expenses if milestone is not reached

Table 5.1: Advantage and disadvantage of financial milestone scenario one and two

5.3. Conclusion analysis current situation

The current situation analysis will be concluded by answering the related research subquestion.
What is the current situation of the interior logistics process?
Followed from the KPI's in the "as is" model, increasing of the non-value added movements by both co-makers is caused by two challenges. The first challenge is the delay in the interior production and the delay of the installation of the yacht. The second challenge are the change orders at the end of the interior process, this is not further discussed in this research since it is client dependent. Delays in the start of the interior process and at the last part of the process increase the inventory level, which increases the non-value added movements. Changing the process by the benefits of the logistics process, a negative impact on income will be created. Therefore, conclusion can be drawn that the mechanism of milestone related income is the main cause of increasing non-value added movements deliberately resulting in an inefficient logistics process.
By dividing this financial milestone over the entire installation process, the pressure on getting the collies on the yard as soon as possible reduces. However, this financial milestone root-cause is concluded after examining only one project, which may not be fully representative of the current situation. Because several managers within Oceanco have different opinions about this financial milestone mechanism, two financial milestone scenarios will be created that focuses both on improving the logistics process. The improvement tools must focus on controlling and coping with the delays, that follows from the challenges which increases the non-value added movements. Scenario one changes the financial milestone, while scenario two leaves the current milestone mechanism unchanged. Both financial milestone scenarios reduces the non-value added movements but variate in logistic expense reduction due to the extra expenses made by the unchanged financial milestone.

6
Improvement tools

In this chapter the fourth phase of the Deming's cycle will be discussed, which is shown in the framework in table 2.5. The improve phase select improvement tools which minimise the non-value added movements in the interior logistics process. The potential improvement tools will be explained which are based on the logistics improvement requirements and the detected challenges of yacht Y718 in the analyse phase. The improvements tools are selected from the improvement toolboxes of Lean and Lean Six Sigma which are given in table 2.1 and 2.3 in chapter 2.

6.1. Types of improvement tools

This section focuses on the improvement of the logistics interior process of Oceanco, where the financial milestones mentioned in chapter 5 are neglected. Improvement tools can be used to reduce the non-value added movements. Based on the requirement mentioned in chapter 2 and the analysis of the current situation the improvement tools must focus on the following aspects:

- Change the push flow of the collies to a pull flow.
- Standardise the transport of the co-makers and the logistics process at the yard.
- Improve the flexibility and controllability of the logistics process.
- Improve the progress communication during the logistics process.

The last two improvement aspects focus on the possible delays that can occur during the production phase. The Lean toolbox, shown and discussed in table 2.1 in chapter 2, contains two suitable improvement tools for this logistics process: JIT and 5S. The Lean Six Sigma toolbox, shown in table 2.3 in chapter 2, contains six suitable improvement tools for this logistics process: the improvement tools JIT, Lead time management, lot size, standardise work, levelled flow and 5S. It can be noticed that the toolboxes of the two methods contains the same tools. Therefore the toolbox of Lean Six Sigma will be used. Lean Six Sigma divide improvement tools into two categories; flow tools and organisation tools (Goldsby and Martichenko, 2005). Flow tools focuses on the management of the flow, while organisation tools organise the work environment to support an optimal work flow (Goldsby and Martichenko, 2005). Table 6.1 shows the improvement tools of Lean and Lean Six Sigma. These improvement tools will be explained in coming subsections, where research is done into the applicability of the improvements that should reduce the non-value added movements during project Y718.

Operational tools		
Flow concept	Just in time	JIT focus on the delivering of items only when the customer needs it. Pulling the items through the system removes inventory and has a positive influence on the seven types of waste.
	Lead time management and flexibility	Lead time management speed-ups and manage the process. These shorter lead times increases the flexibility to react on uncertainties.
	Levelled flow	Levelled flow reduces the negative effects of the fluctuations in demand. No fluctuations results in less inventory level.
	Frequency and lot size	The frequency and lot sized optimise the reduction of the external movements verses the logistic expenses.
Organisation concept	Standardise work	Standards are essential for understanding the current condition of a process, supporting continuous improvement and measuring improvement.
	5S	5S eliminate clutter and complexity in the workplace.

Table 6.1: Operational tools Lean and Lean Six Sigma (Goldsby and Martichenko, 2005)

6.1.1. Just In Time

Just in time (JIT) in logistics refers to a method that controls and manages the inventory by elimination of the inventory waste (Goldsby and Martichenko, 2005). In this case the movement and inventory waste needs to be eliminated. JIT is not just about reducing inventory, it is also about exposing problems so that people can solve them. However it is a fragile supply chain system where suppliers needs to perform constant to ensure a good connection (Liker, 2006). If the co-makers work stably the benefits of JIT are reducing inventory, increasing flexibility, high product quality and increasing productivity. A successfully JIT implementation requires efficient and reliable communication with the suppliers (Lai, 2003).
JIT uses the pull type supply chain management. Kanban is a tool that the pull system is using, which is the communication method. However, in this research the kanban tool is not implemented, due to the high complexity of the interior production and installation process. This makes it difficult to implement the kanban communication system in the logistics process of Oceanco.
At the moment Oceanco is working with their suppliers more in a push system than in a pull system. The agreement between the co-makers and Oceanco is defined based on the schedule. Collies are sent to Oceanco when the co-makers finish their production of the interior items, not when the collies are needed at the yacht. When the collies arrive at the yard, the collies are placed where there is an opening in the inventory. The location of the collies are not defined and dedicated. So, there is no way to understand what to control and how to control for the logistic point at Oceanco. Oceanco is already implementing a Logistic service provider (LSP), where deliveries of collies needs to be announced. By arrival the collies are tagged which makes it possible to track the collie during transportation. The storage place of the collies is noted. This system can control the logistic process during the entire yacht production. Implementing JIT together with LSP reduces the movement and inventory waste, by aligning the interior production process with the interior installation process.
JIT delivery at Oceanco is possible if the following information is known before the production of the interior starts:

1. Number of collies per room
2. Planning of interior installation

The number of collies per room and the installation planning together establishes the installation date per collie. If the installation date of the collies are known, the send date can be established by a given JIT value.
By the aligning of the processes the communication between Oceanco and the co-makers is especially important. Agreements are made related to the delivery plan. Of course, deviations may occurs due to delays or changes in interior. Good communication is the solution, which will be further explained in the section lead time management.
Preferable JIT value is a trade-off between a buffer for production and minimising the storage space. To reduce the waste of the non-value added movements, the inventory level at the external location must be reduced or eliminated. For List an inventory time lower than 24 working days will result in less inventory. For Sinnex, an inventory time lower than 32 working days will give a reduction of the non-value adding movements as discussed in chapter 4.

6.1.2. Lead time management and flexibility

Next to JIT, being flexible also contributes to a more efficient process. The logistics process, interior production process and installation process must be able to react on changes in the planning. Lead time management providing quick responses and represents the supply chain measure of readiness (Goldsby and Martichenko, 2005). Besides, flexibility in a supply chain copes with the uncertainties in the organisation (Chatzikontidou, 2017). The logistics process must be flexible to react on everything that comes their way. Flexibility becomes relevant when the whole supply chain is considered. In this case, many sources of uncertainty have to be handled, such as supplier lead time, product quality, information delay and production delays (Garavelli, 2003).

Being flexible is an important aspect in the interior logistics process of Oceanco. The interior process is a complex process which takes place at the end of the yacht production, where the likelihood of delays increases. Delays changes the planning of the interior. Changes in the interior design also changes the planning. All of these changes are uncertain when and whether they will take place. In order to prevent overfull inventory levels, lead time management need to be considered which replace the start and finish date of the interior process. Delays of more than two weeks, will have an impact on the inventory level. Replacing the start date of the interior installation results in a reduction of the lead time due to a more efficient and controllable installation process. Changing the schedule of interior installation means that also the interior production must adjust their schedule. If the co-makers do not change their production schedule, the inventory at their location or the inventory at Oceanco will overflow. By changing both the production and installation schedules, the following aspects are needed to take into account:

- Production time of the interior
- Extra expenses due to the financial milestones of the fixed interior

Constantly progress communication between the co-makers and Oceanco is needed to manage the changes in the planning. Figure 6.1 and 6.2 shows the lead time of the interior production and installation for List and Sinnex by yacht Y718. This figure shows the production time, the baseline installation time and the current installation time per room. The production time of the items per room can be established by measuring the difference between the start of the production and the start of the installation. However, the calculated production time would also include the driving and inventory time. Table 6.2 and 6.3 shows the production time per room.

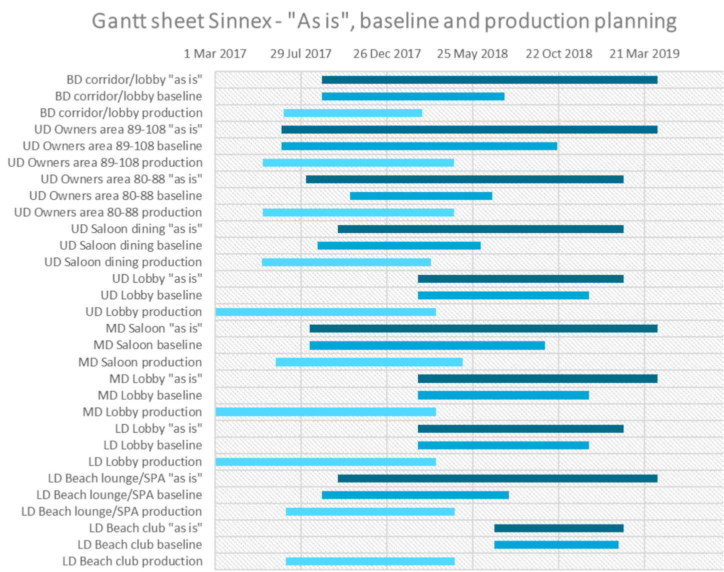


Figure 6.1: Interior production, current and baseline interior installation Gantt sheet - Sinnex Y718

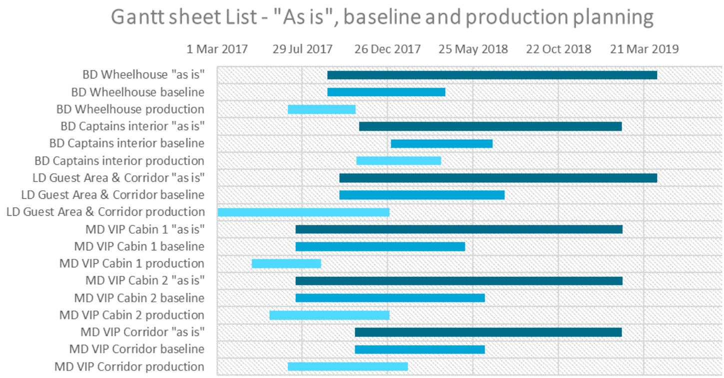


Figure 6.2: Interior production, current and baseline interior installation Gantt sheet - List Y718

Room	**Production time** [working days]
Corridor/Lobby	48
Owners area 89-108	25
Owners area 80-88	110
Saloon/Dining	71
Lobby upper deck	254
Saloon	43
Lobby main deck	254
Lobby lower deck	254
Beach lounge/SPA	46
Beach club	261
Average	90,5

Table 6.2: Interior production time - Sinnex Y718

Room	**Production time** [working days]
Wheelhouse	51
Captains interior	44
VIP Cabin 1	56
VIP Cabin 2	33
VIP Corridor	86
Guest area & corridor	154
Average	53,5

Table 6.3: Interior production time - List Y718

Implementing the lead time management tool in the interior process of Oceanco influence the response speed when changes in the process arises. Quick reaction on these changes increases the controllability of the interior process, which have a positive impact on the non-value added movements. Implementing this tool in the current model, replaced the start date due to the changes in the planning at the beginning of the process.

6.1.3. Levelled flow

In each company uncontrollable variation in demand occurs. This uncontrollable variation takes also place on process level. The logistics at Oceanco also experiences unexpected fluctuations in installation that results in a reduction and increasing of the inventory level. This level can be determined in advance by making use of the planning. However, variations in the process planning can occur due to delays. The peak in the inventory level cannot be avoided.
Levelling the flow means that you not need the capacity to cover the peaks, but rather to cover the average demand (Goldsby and Martichenko, 2005). Collaboration between Oceanco and the co-makers is important to forecast these peaks. Forecasting the peaks of the inventory level is possible if a standard number of collies are coming in the inventory and a standard number of collies leave the inventory. The following information needs to be available before the start of the interior installation:

1. Total number of collies per co-maker
2. Total duration of interior installation

This information indicates a constant number of collies placed on board each day or week. An achievable and reliable consistent level of collies arriving at the yard and a consistent level of collies what is being installed on board needs to be distracted to level the inventory. Levelling the inventory level creates more control on the yard and ensures less management during the process.

6.1.4. Frequency and lot size

Frequency and the lot size are important aspects in the logistics. Frequency and lot size influences both the inventory level and the logistic expenses of the company.
Table 6.4 shows the current transportation lot size and frequency during project Y718 from the production facilities to the yard. The lot size and frequency values are not constant during the process, but a relative constant trend can be seen if the duration is split up into three different time periods.

	Sinnex		List	
Part of the project	**Frequency**	**Lot size**	**Frequency**	**Lot size**
Start of project	Ones or twice per week	3 collies	Ones per two weeks	4 collies
Peak period of project	Ones or twice per week	6 collies	Ones per week	6 collies
End of the project	Twice per week	3 collies	Ones or twice per week	3 collies

Table 6.4: Transport frequency and lot size from production facilities to yard - Sinnex and List Y718

Table 6.4 shows that the truck drives ones or twice per week to Oceanco. One of that two drives are mostly with a small lot size of one or two collies. This could be a collie with a heavy weight or some collies which did not fit in the first batch or collies with a production delay. For project Y719 Sinnex had to drive 114 times from Austria to Oceanco and List 66 times.
In this thesis the most optimal frequency and lot size of the truck, that transports the collies from the co-makers production facilities to Oceanco needs to be determined. Smaller lot sizes and a higher frequency together with just-in-time delivering can result in a lower inventory level. But increasing the frequency and decreasing the lot size, will finally increase the transportation expenses. The optimum is a trade-off between transport expenses and the inventory level. The improvements model must show the effect and consequences on the non-value added movements and the logistic expenses by changing the lot size and frequency.

6.1.5. Standardise work

The goal of each operation is to standardise work. Standardised operation is one where the input requirements, the procedure of the process, the time duration for each step and the expected output of the operation is known (Goldsby and Martichenko, 2005). Standards are needed to understand the current process situation supporting continuous improvements (Liker, 2006). Standards makes the variance in the process feasible, which makes it possible to make corrections of this variations (Goldsby and Martichenko, 2005).
Basic standards in the logistics process of Oceanco are missing. Next to standard inventory time by the JIT tool and standard number of collies by the lot size tool, the collie dimension can be standardised at the logistics of Oceanco.

The collies of Sinnex and List are all custom made, resulting in a range of different collie dimensions. The dimension range of the interior collies are between a length of 1 to 3 meters, a width of 1 to 2 meters and a height of 1 to 2 meters. Standard collie dimension will have some positive impact on the inventory capacity. Firstly, if the standard dimension is set, custom-made scaffolds can be built where the collies can be placed at different levels. Due to these scaffolds, a constant inventory capacity can be given at the internal inventory. In addition, placing scaffold in the inventory create an organised storage space. The 5S improvement tool, explained in table 6.1, organise the working space at Oceanco by implementing scaffolds where collies get a standard and controllable place. These scaffolds reduce the complexity of the inventory space. By noting down the place were a collie is stored, the collie can be traced easily and errors can be located facile. Applying the 5S in the inventory area creates a more controllable inventory level, which supported the just in time principles.
If all the collies would have the most common collie size (2.5x1.2x1.8), the total number of collies would be approximately the same but custom scaffolding would make sure there is place for 82 collies as internal storage capacity. The most common collie size is established in collaboration with the co-makers who presented these dimensions as feasible standard collie dimensions. Due to multiple co-makers, it is important that both co-makers align all these standards. If these standards are implemented continuous improvements can take place.

6.2. Conclusion improvement tools

The selection of the improvement tools will be concluded by answering the related research subquestion.
Which improvement tools can be used at the current situation of the interior logistics process? Five improvement tools are found that can be used to improve the current situation of the logistics process at Oceanco. The fixed interior financial milestone, which affects the efficiency of the logistics process, are neglected by this selection. The selected tools focus on the reduction of the non-value added movements. The five selected improvement tools are: lead time management and flexibility, just-in-time, lot size, additional standardisation and levelled flow. Lead time management react flexible on changes and uncertainties in the installation and production planning. JIT manages and controls the inventory by implementing a standard inventory time, to expose the errors in the inventory. Lot size and frequency manage the supply of the collies, by taken both the logistic expenses and the external inventory into account. Standardisation is needed in each organisation to improve continuously. Additional standardisation of the collie dimension is needed to organise and control the inventory by making use of scaffolds. Levelled flow standardises the input and output of a constant number of collies in the inventory, by finding a reliable speed of installation. In chapter 7 the relevant combination between these tools and the relevant value will be given.

7
Improvement model

In this chapter the fifth and thus last phase of the Deming's cycle, the monitoring and controlling phase shown in the framework in table 2.5, will be explained. An improvement model is generated to be able to monitor and control the improvements of the logistics process. The improvement tools explained in the previous chapter will be implemented in this improvement model. The level in which the non-value added movement can be reduced will be calculated. This chapter starts with a framework of the improvement model. Then, the way how the improvement tools are applied in the model will be explained, followed by the verification and validation of the improvement model. Thereafter, the results that follows from the improvement model will be shown for both financial milestone scenarios discussed in chapter 5. Finally, the conclusions following from the results will be drawn.

7.1. Framework improvement model

The selected improvement tools are responsible for the reduction of the non-value added movements in the interior logistics process. Improvement tools that helps to flow, control, manage and predict the inventory level are: just in time, lot size, levelled flow and additional standardisation. To manage and control the changes in the production planning during the process, the improvement tool lead time management is needed. This improvement tool controls the planning and provides quick response on the delays by their flexibility. This tool changes the schedules of the interior production and the installation by taking the lead time of both process into account.
Within the improvement tools, lead time management gives the most impact on reducing the non-value adding movements from project Y718. Figure 7.1 shows the improvement framework for the improvement model. The core thought of this framework is standardisation. Without standards, there is no starting point from where to improve. Levelled flow improvement is missing in the framework. This tool requires adjustments to the installation, which makes that this tool is approached separately. In next section the way how the improvements are implemented in the model will be explained.

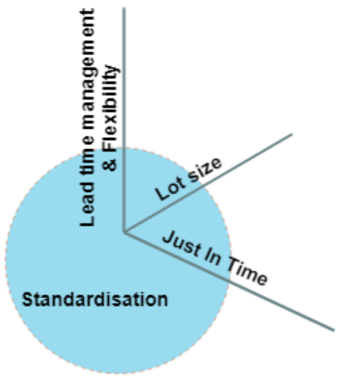


Figure 7.1: Interior logistics improvement model framework

7.2. Implementation improvement model

The improvement model uses the "as is" model as basis. The improvement tools will be implemented in the "as is" model. In this section these implementations will be explained. The values of the improvements tools including the explanation of the selected values will be given in this section.

7.2.1. Lead time management and flexibility

The lead time management and flexibility improvement tools make the logistics process more efficient by their quick and flexible response when changes in the process arises.
The interior process of the Y718 experienced changes in the interior planning. The current situation did not react on these changes in the planning. In the improvement model the lead time management tool reacts on these changes by rescheduling the start dates of both the production and the installation date to guarantee an efficient logistics process and interior installation process. The reduction of lead time of the interior installation process, through the more efficient process, reduces the inventory time resulting in a reduction of the inventory level. Constant communication between the co-makers and Oceanco about their progress is necessary to response quickly on changes in the planning. Additionally, controlling the processes is important to detect the changes in the planning on time.

Implementing this improvement tool changes the start and end date of the interior installation process, which brings the interior installation lead time back to the baseline installation lead time. In addition, changing the start date of installation changes the date that all fixed interior is delivered at the yard. Figure 7.2 shows the changes in the installation process between the current situation and the improved situation with the lead time management tool. Table 7.1 shows the current and new dates for both co-makers. The new values are calculated and implemented in the improvement model with equation 7.1, 7.2 and 7.3.

$$New\ start\ date = Current\ start\ date + constant\ delay\ in\ working\ days \tag{7.1}$$

$$New\ finish\ date = Current\ finish\ date + Constant\ delay\ in\ working\ days \tag{7.2}$$

$$New\ fixed\ interior\ at\ yard = Current\ fixed\ interior + Constant\ delay\ in\ working\ days \tag{7.3}$$

In appendix G the Gantt sheets with the start and finish date per room for both co-makers are given. Both co-makers have a delay of sixty days. The selected delay duration is based on project Y718, where the first underestimated phase in the “as is” model due to the production and installation delays will be skipped. The duration of the delay have no effect on the flow of the inventory level because lead time management brings the installation lead time back to the planned lead time. Only the start and end date will differ. The replaced start date will change the time that all fixed interior is arrived on the yard, which influence the expense due to the financial milestone mechanism. In this case it is assumed that the planned baseline installation planning is a realistic and feasible planning for the interior.

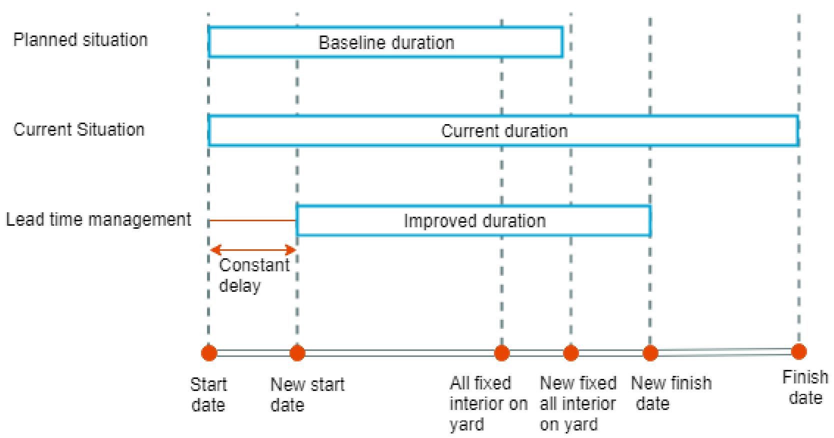
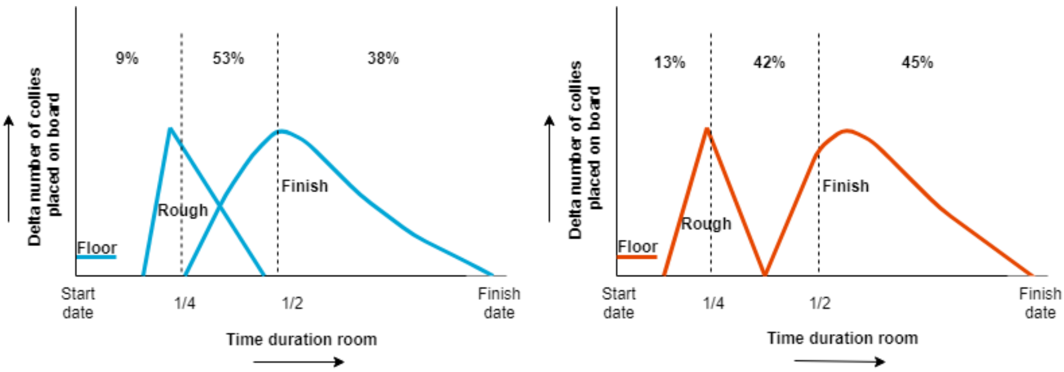


Figure 7.2: Changes in interior installation planning by lead time management Y718

	Changes in date	Current	New
Sinnex	Start date	26-06-2017	18-09-2017
	Finish date	13-04-2019	08-03-2019
	All fixed interior at yard	29-05-2018	21-08-2018
	Total installation duration [working days]	470	385
List	Start date	17-07-2017	09-10-2017
	Finish date	13-04-2019	12-10-2018
	All fixed interior at yard	31-05-2018	23-08-2018
	Total installation duration [working days]	455	265

Table 7.1: Changes in start and finish date of interior installation for both co-makers Y718

Next to the different start and finish date, also the values of the installation approach to determine the installation date will change in the improvement model by implementing lead time management. In the improvement model the undisturbed installation approach values are implemented, instead of the disturbed installation approach values that is used in the "as is" model. By disturbed installation approach, the underestimated percentage in the first timeframe of the installation approach in the "as is" model is meant. Figure 7.3 and 7.4 shows for a second time the disturbed and undisturbed installation approaches of both co-makers explained in chapter 4. In the improvement model this underestimation is solved by implementing lead time management, which cope with the changes in the planning.



(a) Sinnex (b) List

Figure 7.3: Disturbed interior installation approach - Sinnex and List Y718

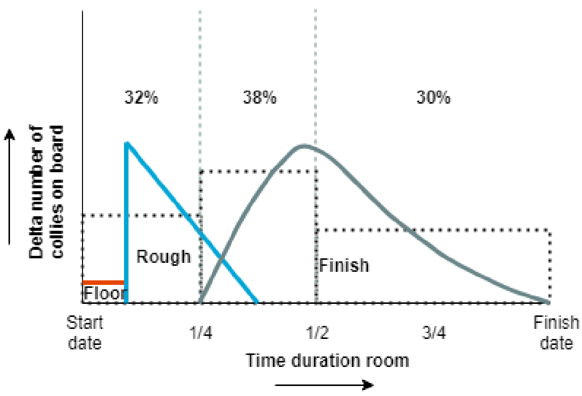


Figure 7.4: Undisturbed interior installation approach

Figure 7.2 and table 7.1 shows the difference in duration between the current and improved interior installation process. The improved situation starts later and finishes earlier. There are a number of explanations for this phenomenon. In the current situation, both the logistics- and the installation process went out of control. There was no overview of the inventory, collies were lost and actual installation status was lacking.

Resulting in an increasing lead time. The lead time management tool reduces the lead time by starting the interior installation only when both processes; interior production and previous component installation, are ready. The pre-planned control can be guaranteed in this way, which increases the efficiency of the yard. The reduction in duration between the improved duration and the current duration is larger for List than Sinnex. The finish date of installation of the interior of List was planned with a large margin until the delivery date of the yacht. Delays in the process had no major consequences for the delivery of the yacht. The finish of the interior installation of Sinnex were scheduled just before the yacht delivery, where delays were hardly possible. Sinnex had to speed up their process due to previously incurred delays. The improvement tool bring the installation process back to the planned start and finish date which makes the logistics process and interior process again controllable and flexible. This tool together with just in time delivering controls the inventory level.

This study assumes a constant delay that sustain before the interior production and installation starts. A delay during the interior process is also investigated in this research. However, this type of delay does not have any benchmark with the current situation, which makes the comparisons between the improved situation and the current situation difficult. In addition, this type of delay doubled the non-value added movements compared with a pre-determined constant delay. The investigation of this delay type will be given in appendix H, but will not be further discussed in this thesis.

A few assumptions are made by implementing the lead time management tool:

1. The improvement tool only implements constant delays.
2. The baseline lead time of the interior processes is feasible.
3. The delay is detected before the production of the interior starts.
4. The lead time management tools does not take the delivery date of the yacht into account. In this case the improved finish date take place before the current finish date, which gives no problems.
5. The current date that all fixed interior is delivered on the yard is an estimation based on the results of the "as is" model. This date can differ from the real date due to earlier assumptions in the "as is" model.
6. The delay is not applicable to rooms which the interior items are already at the yard. Besides, the installation of the room should not be dependent on other rooms. These rooms are assumed to install according the baseline planning. This is the case with for example the beach club room located on lower deck built by Sinnex shown in the Gannt sheet in appendix G.

7.2.2. Just in time

The JIT tool support both the lead time management tool as the standardisation tool by controlling a standard inventory time. The current logistics process shows that the median inventory time of Sinnex is 32,5 and List is 24 working days. The improved inventory time must be below these current inventory time values. Oceanco strives to an inventory time of ten working days before installation. Based on this information the improvement model will implement the following just in time options:

1. Five working days before installation
2. ten working days before installation
3. Fifteen working days before installation
4. Twenty working days before installation

The JIT values, which determine the time that the collie arrives at the yard, are implemented in the improvement model with equation 7.4.

$$\begin{aligned} &For\ n = 1\ to\ Total\ number\ of\ collie\ project \\ &Arrival\ date\ at\ the\ yard\ collie_n = Installation\ date\ collie_n\ -\ JIT\ value \end{aligned} \tag{7.4}$$

7.2.3. Frequency and lot size

The frequency and lot size of the truck have a large effect on both the non-value added movements as the expenses of the logistics process. The drive frequency will be determined by the lot size of the truck and the date that a collie is needed at the yard. The date that the collies are needed at the yard is not constant, which makes the frequency of delivery variable. In the current process the lot size of each truck were varied by both co-makers. The truck lot size range of the current logistics process is between the one and the thirteen collies. Both co-makers have an average truck lot size value of three or four collies. Based on these values and the truck dimensions the following three lot sizes are implemented in the improvement model:

1. Lot size seven collies
2. Lot size five collies
3. Lot size three collies

These lot sizes are implemented in the model by given the collies located in the same batch all the same send date which is the first send date in that batch.

The lot size have a significant effect on the transportation expenses, which are the highest logistic expenses mentioned already in section 4.7 table 4.10. The large lot size minimise the transportation expenses and the low lot size minimise the external inventory expenses.

It is assumed that the lot size stays constant during the process. In the current process it is noted that the lot size is smaller in the initial and end phase of the interior process than in the mid time phase. However, at the start and finish time phase, there is enough space to place the collies in the internal inventory, which makes it possible to keep the lot size constant. Applying a constant lot size requires a well planned and organised interior process.

7.2.4. Standardisation

At Oceanco the collie dimension is important to standardised to make continuous improvement possible. The standard dimensions of the collies are the basis for a standard internal inventory capacity. This standard collie dimension has a negligible small impact on the total number of collies, due to the small deviation of the collie dimensions. Due to the standard collie dimension, scaffolds can be placed to store collies collie on multiple levels. In the model the space explained in section 6.1.5 is implemented, where only the workshop and the dock inventory are used. The temporary inventory is still not taken into account, because this inventory is only intended for interior that will be placed on board immediately. The available space in the dock for each co-maker depends on the total number of collies for the project. During the production of yacht Y718 Sinnex has space for 27 collies in the internal inventory and List 23 collies.

7.2.5. Levelled flow

In the model, the levelled flow has been taken separately. This improvement is a more "outside the box" tool where more changes in the interior installation process are needed. This tool focuses on a standard input and output of the inventory resulting in a standard flow of installation. The major disadvantage of this tool is the change in the installation method, which is not sure if this change in installation is reachable for both Oceanco and the co-makers. On the other hand, this tool smooths out the inventory level which reduces the non-value added movements.

The goal when implementing this tool is not to calculate the reduction between the current process, but to show the difference in the logistics if larger measures are taken. This tool will be implemented in the model according the baseline planning. Equation 7.5 and table 7.2 shows the calculation and results of the installation method by applying levelled flow.

$$Collies\ installed\ per\ day = \frac{Total\ number\ of\ collies}{Total\ installation\ duration} \tag{7.5}$$

Placing one collie per day on board seems to be logistically feasible since there are 31 working days left when the original planning is realised. It is however less desired from an installation point of view. During installation, work is carried out in different rooms, which needs different collies. It should be avoided that a collie must wait on board for several days until the installation starts or that the installation process is waiting for a collie. The installation schedule must be well tuned to the way of working. Furthermore, in reality delays occur regularly, which has an impact on the levelled flow. If the delays occurs at the production facility, the co-maker on the yard is without work. If the delay occurs at the yacht the inventory level at the yard will increase. Therefore, levelled flow is a fragile improvement tool to implement on the yard.

Co-maker	Total installation duration [working days]	Total number of collies	Collies installed per day	Reserve [working days]
Sinnex	421	390	1	31
List	265	252	1	13

Table 7.2: Interior installation calculation levelled flow - Sinnex and List Y718

7.3. Verification and validation improvement model

Next to the "as is" model, the improvement model also needs verification and validation to ensure the improvement model represents reality. The already verified "as is" model is the base of the improvement model. This section contains the verification and the validation of the improvement model.
Verification of the improvement model follows the same steps as the "as is" model. In the improvement model the arrival dates of the collies, the installation date of the collies and the codes that measures the inventory level are used from the "as is" model. The improvement tools are added one by one to the model to check if the change of the model is as expected. Major mistakes during modelling were the selection of the wrong sending and installation date which influenced the inventory level in a negative way. By predicting and controlling each taken step, these errors are eliminated in the improvement model.
Validation of the improvement model is needed to use the model in the future. The improvement model can only be validated with future data for a yacht where the production of the yacht is not yet started. The reason that future yachts only can validate this model is due to the fact that the logistics improvements tools are not yet implemented in the interior logistics process. Similar to the "as is" model, the input date of the model gets more reliable by the LSP request system. In section 8.1 there will be explained which output data the LSP system must generate to deliver reliable data for the model. If the accurate data of the LSP request system is available and the logistics improvements are implemented in the interior process, the model can be validated. Validation is done by comparing the results for the improvement model with reality. By changing the input data of the model by data generated by LSP request, an increasingly accurate improvement model can be developed.

7.4. Results

In this section the results of the improvement model in which the improvement tools are implemented will be explained. Both financial milestone scenarios described in chapter 5 are used. The results are expressed in the reduction of non-value adding movements and logistic expense. The height of the reduction are defined by the effect of the improvement tools, but also by the efficiency level of the current logistic process. Next to the results of both financial milestone scenarios, the result of the levelled flow tool will be given, followed by the conclusion of the improvement model.

7.4.1. Scenario one

Scenario one divides the fixed interior financial milestone over the entire interior installation timeframe. This scenario focuses mainly on the efficiency of the logistics process by implementing the improvement tools in the process. Implementing the lead time management tool, which cope with the planning changes, together with a suitable JIT, lot size and standards will reduce the non-value added movements of the current logistics process.
Figures 7.5 and 7.7 shows the improvement delta of scenario one for Sinnex and figure 7.6 and 7.8 shows the improvement delta of scenario one for List. In these figures the percentage reduction of the non-value added movement and the percentage reduction of total logistic expense are given relative to the "as is" model. The difference in JIT values are represent on the x-axis. The lot size is displayed with the difference colour patterns blue and red. Appendix I shows the output of the model for scenario one including graphs of the inventory level and the improved values of the number of movements, logistic expenses, collie weeks, etc.

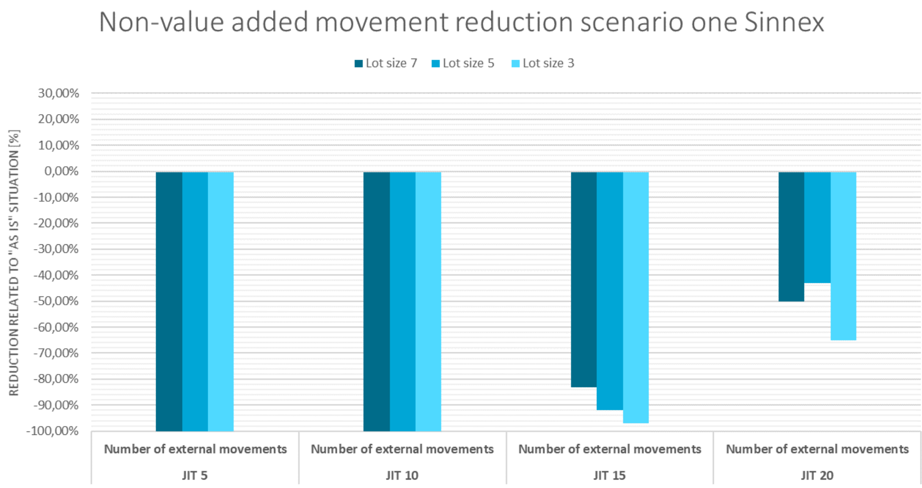


Figure 7.5: Non-value adding movements reduction - scenario one Sinnex Y718

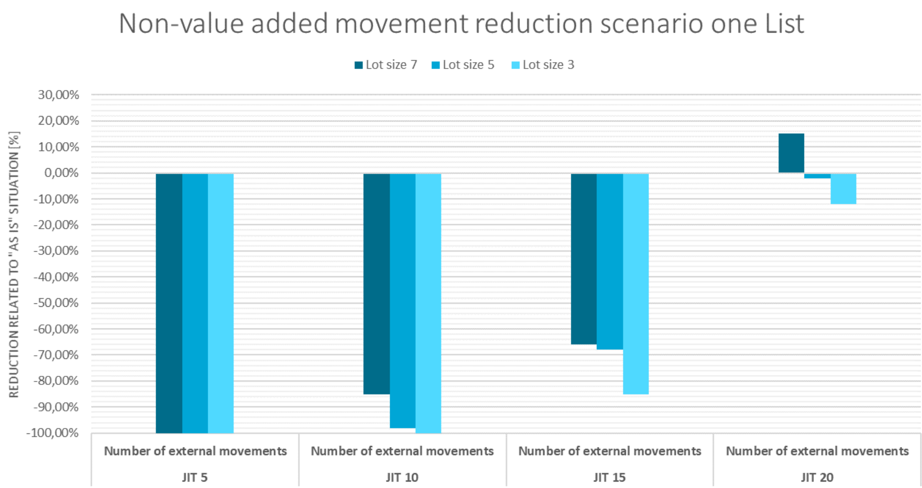


Figure 7.6: Non-value adding movements reduction - scenario one List Y718

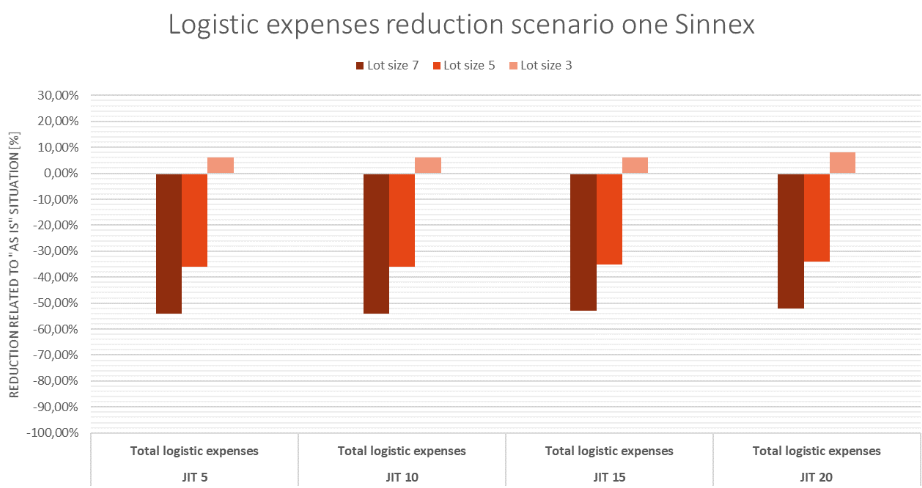


Figure 7.7: Total logistic expense reduction - scenario one Sinnex Y718

Figure 7.8: Total logistic expense reduction - scenario one List Y718

From the non-value added movements reduction in figure 7.5 and 7.6 the following findings can be drawn:

1. There is significant variation in the number of external movements by changing the JIT value. Large JIT value has less impact on the reduction in external movement than a small JIT value.
2. There is a relatively small difference in number of external movements by changing the lot size. Large lot sizes has less impact on the reduction in external movement than a small lot size.

From the non-value added movements findings it can be concluded that the external movements are influenced by the difference in both the JIT value as the lot size. By an increasing of the JIT value the number of external movements increases, due to increasing inventory times. Next to the JIT value, also the lot size affects the inventory time of the collies. The larger the lot size, the earlier the collies arrive at the yard, leading to a longer inventory time, higher the inventory level and an increased number of external movements. Figure 7.5 shows a different pattern in the lot size ranking by the movement reduction of Sinnex by a JIT value of twenty and by a lot size of five and seven. The lot size and JIT value affect the delivery date of the collies. For a JIT value of twenty the delivered collies with a lot size of seven flows better through the inventory than a lot size of five. However, the reduction in movements is small.

From the total logistic expense reduction in figure 7.7 and 7.8 the following findings can be drawn:

1. There is less variation in logistic expense reduction by changing the JIT value.
2. There are significant differences in logistic expense reduction by changing the lot size. Large lot sizes have more impact in the reduction of logistic expenses than small lot sizes.

From the total logistic expense findings it can be concluded that the logistic expenses are mainly influenced by the lot size. The lot size affects the total number of drives which have the largest impact on the total logistic expenses. The difference in number of external movements have less impact on the expenses due to the high transport expenses. A lot size of three collies for both List and Sinnex do not result in logistic expense reduction.

By comparing the movement and logistic expense reduction of List with Sinnex, two aspects stand out. The first aspect is based on the difference in movement reduction by a JIT value of fifteen and twenty days. The movements of List reduces significantly less by a JIT value of twenty days than Sinnex. The reason for this small reduction is due to the current inventory time of 24 days. The inventory time of the "as is" model for Sinnex is 32,5 days, which result in a positive movement reduction for all selected JIT values.
The second aspect is based on the difference in logistic expense reduction. The reduction ratio between the lot size for both co-makers are equal, but the logistic expense reduction are different. The reduction for List are smaller than Sinnex. The number of drives for List was already more efficient which resulted in less logistic expense reduction. This is already explained in section 4.2 table 4.4, where the truck lot size is noted of

both co-makers.

A suitable combination between the lot size and the JIT value needs to be found for this scenario. The choice of the lot size for both co-makers is relatively easy. A lot size of seven collies causes the highest logistic expense reduction and still yield a relative high reduction of the number of external movements. Additionally, a lot size of seven collies is achievable for the interior collies since the not constant current lot size consists of many batches of seven/eight collies. The most suitable just in time value for Sinnex is fifteen days. This is half of the current inventory time. For List the JIT value of ten days is most suitable. This also halves the inventory time of the "as is" model. With these halving of the current inventory times, The JIT values seems achievable for both co-makers, at least when the tool will be applied for the first time. These JIT values can change during the years when the interior installation process and the communication between the co-makers and Oceanco is improved. nevertheless, an JIT value of 5 days is not feasible due to the complex installation process where a small inventory buffer is wanted.
Table 7.3 shows the improvement delta of scenario one of the above chosen values for JIT and the lot size. The logistic expense reduction shows a significant reduction in the transport expenses, determined and paid in advance in the co-makers contract. Implementing the constant lot size of seven collies, the agreed amount of the interior co-makers contracts can be reduced with €146.800,00 in total for project Y718. The external storage, handling and transport expenses that Oceanco has to pay afterwards to Maat can be reduces with €14.500,00. The table shows that the movement and logistic expense reduction for Sinnex are higher than for List. It can be concluded that the interior process for List is already more efficient than the process of Sinnex. Table 7.4 gives the improved key performance indicators for the improved logistics process where the fixed interior financial milestone is divided over the entire interior process timeframe.

	Sinnex lot size: 7 collies JIT: 15 days	**List** lot size: 7 collies JIT: 10 days	Total
Number of drives	58 (-51%)	30 (-45%)	88 (-49%)
Number of external movements	71 (-83%)	35 (-85%)	106 (-83%)
Total collie weeks	1108 (-98%)	212 (-96%)	1320 (-97%)
Transport expenses	€ 97.680,00 (-51%)	€ 49.180,00 (-45%)	€ 146.860,00 (-49%)
External storage expenses	€ 9.653,00 (-94%)	€ 2.552,00 (-91%)	€ 12.200,00 (-93%)
Transport expenses Maat	€ 1.695,00 (-83%)	€ 791,00 (-78%)	€ 2.486,00 (-81%)
Total logistic expenses	€ 109.000,00 (-53%)	€ 52.530,00 (-47%)	€ 161.500,00 (-51%)

Table 7.3: Improvement delta - scenario one Sinnex and List Y718

KPI	**Sinnex**	**List**	**Total**
Inventory time	18 days	13 days	-
Inventory stored external	15	6	21
Inventory stored internal	375 collies	246 collies	-
Total collie weeks	26	8	34
Total logistic expenses	€ 95.320,00	€ 59.500,00	€ 154.800,00

Table 7.4: KPI for the improved interior logistics process - scenario one Sinnex and List Y718

7.4.2. Scenario two

Scenario two implement the same improvement tools as scenario one, but keeps the milestone mechanism unchanged. Resulting in the same reduction of the non-value added movement, collie weeks, transport expenses, handling expenses etc. Only the total logistic expense reduction for scenario two is different from scenario one.
The improvement tool lead time management is primarily responsible for these difference in total logistic expenses. Changing the start date of installation and production of the interior by the lead time management tool described in section 6.1.2 have effect on the revenue (client payments) and the expenses (of the co-makers). By extending the time from order to interior delivery, additional expenses are incurred in the

form of interest. The subcontractors must be paid earlier than Oceanco receives money from the client. Due to the logistics efficiency, in this exercise the start date of the production is rescheduled sixty working days later than planned. Delays of the yacht production lead to a delay in revenue. For the sake of these exercises, the delay is split in half, because the delay was also caused by the co-makers. Giving a delay in payment to the subcontractors of thirty working days. Resulting in a remaining timeframe of thirty working days where Oceanco needs to acquire a loan.

Figure 7.9 shows the changes in interior payments over the time period. It shows the time when Oceanco paid their interior co-makers and when Oceanco receives the fixed interior instalment of the client. The left graph shows the planned flow of the expenses, where the previous instalments of the client pay the co-makers. The right graph shows the flow of expenses when the improvement tools are implemented. When Oceanco plans to spend resources on other projects, Oceanco needs to acquire a loan for thirty working days due to the late revenue of the client. Figure 7.9 shows the assumed percentage of the amount to pay. This percentage might be different in reality.

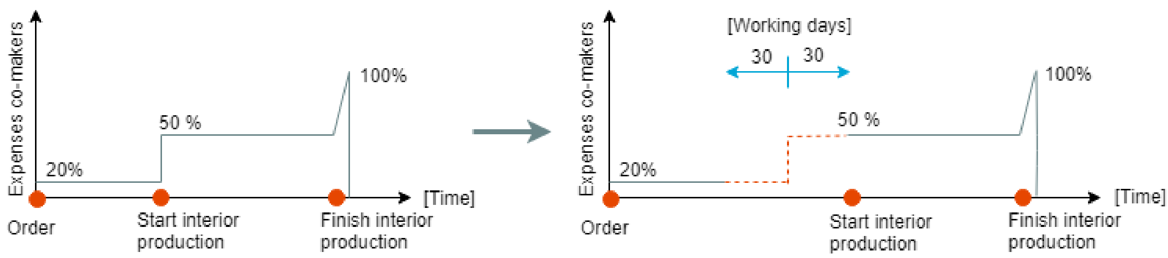


Figure 7.9: Changes in interior payments by applying lead time management, JIT and lot size

To calculate the interest payment over the loan, equation 7.6 is used. With time the total time to loan is meant.

$$Interest\ payment = \frac{1}{12} * Time\ [months] * \frac{Interest\ rate\ [\%]}{100} * Loan \tag{7.6}$$

The total interior expenses cannot be given in this paper, due to confidentiality obligations. A value can be given for the maximum height of the loan by the reduction in logistic expenses. To calculate this, the reduction in logistic expense by the applied improvements is taken equal to the interest payment from equation 7.6. The maximum loan can be deducted when the timeframe and interest rate is known, as well as the logistic expense reduction. If the real loan is below this calculated value, the result is a positive total reduction compared to the current situation. If the real loan is more than the calculated value, the improvement does not save money compared to the current process. Oceanco can estimate the maximum size of the delay where they still make positive logistic expense reduction.
Figure 7.10 shows the amount of the loan for the calculated logistic efficiency reduction of €161.500,00, found in section 7.4.1. The size of the delay due to the improvements influence the height of the loan. By thirty working days Oceanco is able to acquire a loan of €32.310.000,00 at 4% interest rate. Figure 7.10 shows also an interest rate of 2%, 3%, 5% and 6% since the interest rate might differ. It can be concluded that a loan of maximum €32.310.000,00 can be acquired with the calculated logistic expense efficiency reduction. This calculation seems reasonable. If the real loan, checked by Oceanco, is below this value, the result is a positive total reduction in logistic expense compared to the current situation.
It can be concluded that the improvements delta shown in table 7.3 by scenario one are the same for scenario two, except the total logistic expense reduction. The expense reduction for Oceanco on the co-makers contracts and Maat are the same. Only the total logistic expense reduction are less for scenario two due to the extra interest payments that Oceanco must pay by implementing the improvement tools. The logistic expense reduction for scenario two can not be expressed due to the confidentially total interior expenses.

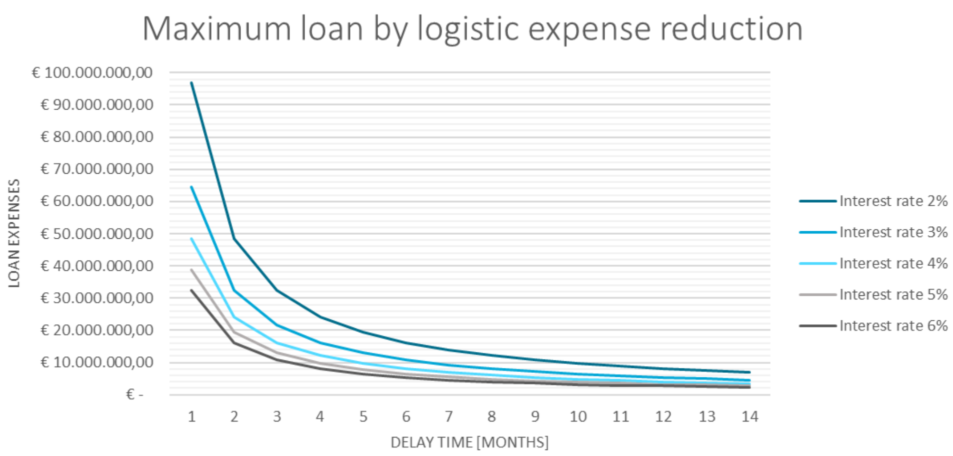


Figure 7.10: Minimum loan by logistic expense reduction Y718

7.4.3. Levelled flow

Figure 7.11 and 7.12 shows the results of implementing the levelled flow tool. The levelled flow tool influences the installation method. The figures show the total inventory level based on the undisturbed installation approach and the inventory level based on the levelled flow installation method. For this implementation the baseline duration of yacht Y718 is taken. The levelled flow tool uses the same lot size and JIT value as scenario one and two. The levelled flow indicates a relative constant inventory level based on the JIT value and lot size. The production of co-makers ends sooner with levelled flow than the undisturbed installation approach. The reason for this difference is the reserve days of 31 for Sinnex and thirteen days for List.

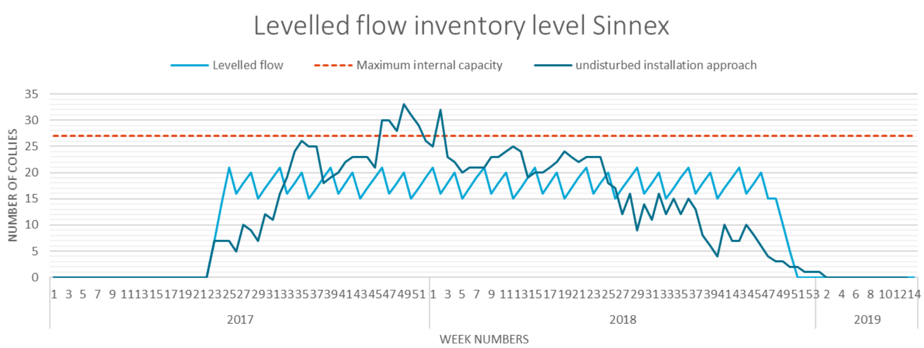


Figure 7.11: Levelled flow inventory level - Sinnex Y718

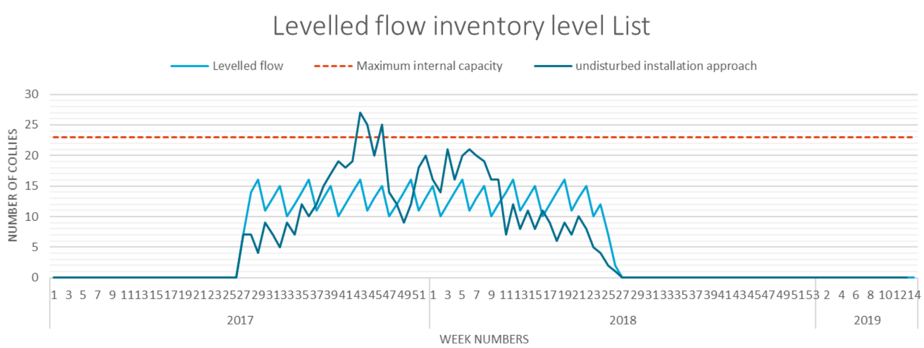


Figure 7.12: Levelled flow inventory level - List Y718

From above figures it can be concluded that the number of external movements is reduced to zero, which improve the efficiency at the yard significantly. The truck lot size stays the same which causes negligible changes in the logistic expenses. The only logistic expenses are the transport expenses, which are the same as scenario one and two. Table 7.5 shows the improved KPI's by implementing the levelled flow, JIT, lot size and additional standardisation tool. The main advantage of this tool is the constant inventory level. This makes it easier to control the logistics process. The disadvantage is the change of the installation method, where the applicability of the levelled flow installation is unknown.

KPI	**Sinnex**	**List**	**Total**
Inventory time	18 days	13 days	-
Inventory stored external	0	0	0
Inventory stored internal	390 collies	252 collies	-
Total collie weeks external	0	0	0
Total logistic expenses	€79.680,00	€49.180,00	€128.900,00

Table 7.5: KPI for the improved interior logistics process by levelled flow - Sinnex and List Y718

7.5. Conclusion improvement model

From above findings, it can be concluded that the selected improvement tools lead time management and flexibility, JIT, lot size, levelled flow and additional standardisation can significantly reduce the non-value added movement at project Y718. All these improvement tools can be applied on the logistics process at Oceanco, which improve the efficiency on the yard. The lead time management tool is most significant in reducing the non-value adding movements of project Y718. In this research two financial milestone scenarios are presented which both improves the logistics process but differ in milestone mechanism. In addition, the levelled flow improvement tool has been taken separately.

Scenario one implements the logistics improvement tools and divides the financial milestone mechanism over the total interior process timeframe, the values used within this scenario are explained below. The lead time management tool moves the start date of the collies sixty days forward in time. The lot size of the truck will be seven collies for both co-makers, which gives the lowest transportation expenses. The JIT value is chosen by taking the current inventory time into account. List will have a JIT value of ten days, as for Sinnex the JIT value is fifteen days. Additional standardisation is implemented in the collie dimension which gives a maximum capacity that can be stored in the internal inventory at Oceanco; with 27 collie places for Sinnex and 23 for List. Implementing these tools with the above explained values reduces the number of external movements of the current model with 71 movements for Sinnex and 35 movements for List at the yard of Oceanco. The logistic expense reduction for Oceanco is € 109.000,00 on the collies of Sinnex and € 52.530,00 on the collies of List. The logistic expense reduction on List are lower than Sinnex because the current logistics process of List is already more efficient.
The improvements result in a total reduction of 106 (-83%) number of external movements and a total logistic expense reduction of € 161.500,00 (-51%) for Oceanco. This means that the current non-value added movements could be reduced to 21 movements involving the total logistic expenses of € 154.800,00.
Scenario two implement the same improvement tool values as scenario one, but keeps the milestone mechanism unchanged. Resulting in the same reduction of the non-value added movement. Only the total logistic expense reduction for scenario two are different than scenario one. The lead time management tool extends the time from order to interior delivery, where addition expenses are incurred in the form of interest. Oceanco needs to acquire a loan for thirty days due to the late revenue of the client. The maximum amount of the loan for the logistics efficiency reduction of € 161.500,00 is € 32.310.000,00 at 4% interest rate. If the real loan, checked by Oceanco, is below this value, the result is a positive total logistic expense reduction compared to the current situation.

Implementing the levelled flow of items by the chosen lot size and JIT value from scenario one and two at yacht Y718 reduces the external movements to zero. The logistic expenses of Oceanco will only consist of transport expenses, which remains the same in scenario one and two. However, before implementing this tool further research needs to be done into the accessibility of the method of installation within the complexity of the interior installation process.

The improvement model will be concluded by answering the related research subquestion.
Which combination of the chosen improvement tools can be implemented which improves the movements at the yard?
A significant improvement of the movements can be generated by implementing the improvement tools; JIT, lead time management and flexibility, lot size, levelled flow and additional standardisation. By dividing the fixed interior milestone mechanism, a JIT value of ten or fifteen working days, a lot size of seven collies, lead time management for the quick response on changes and standard collie sizes gives the largest reduction of 106 non-value added movements with the greatest logistic expense reduction of €161.500,00 for Oceanco.

8

Implementation roadmap

In this chapter the implementation road that Oceanco should follow to actually achieve the results of the proposed improvements will be explained. The order in which certain actions must be take place will be discussed in detail. Figure 8.1 shows the implementation roadmap. In appendix J the enlarged implementation roadmap is displayed. The roadmap is divided into five categories: LSP application, financial milestone, communication/ team training, the interior logistics improvement model and the total logistics process improvement model. The road is sketched for an unlimited duration, because it is impossible to define the duration to change the financial milestone and to implement the improvements in the logistics process. The figure shows the two financial milestone scenarios. The first scenario, financial milestone scenario one (orange line), describes the road were first the financial milestone must be changed before implementing the improvements. The second scenario, financial milestone scenario two (blue line), describes the road were the improvements can already be implemented without changing the financial milestones. Oceanco management must make a strategic choice which road they want to go. The following sections will explained the five categories where the activities within the categories will be described.

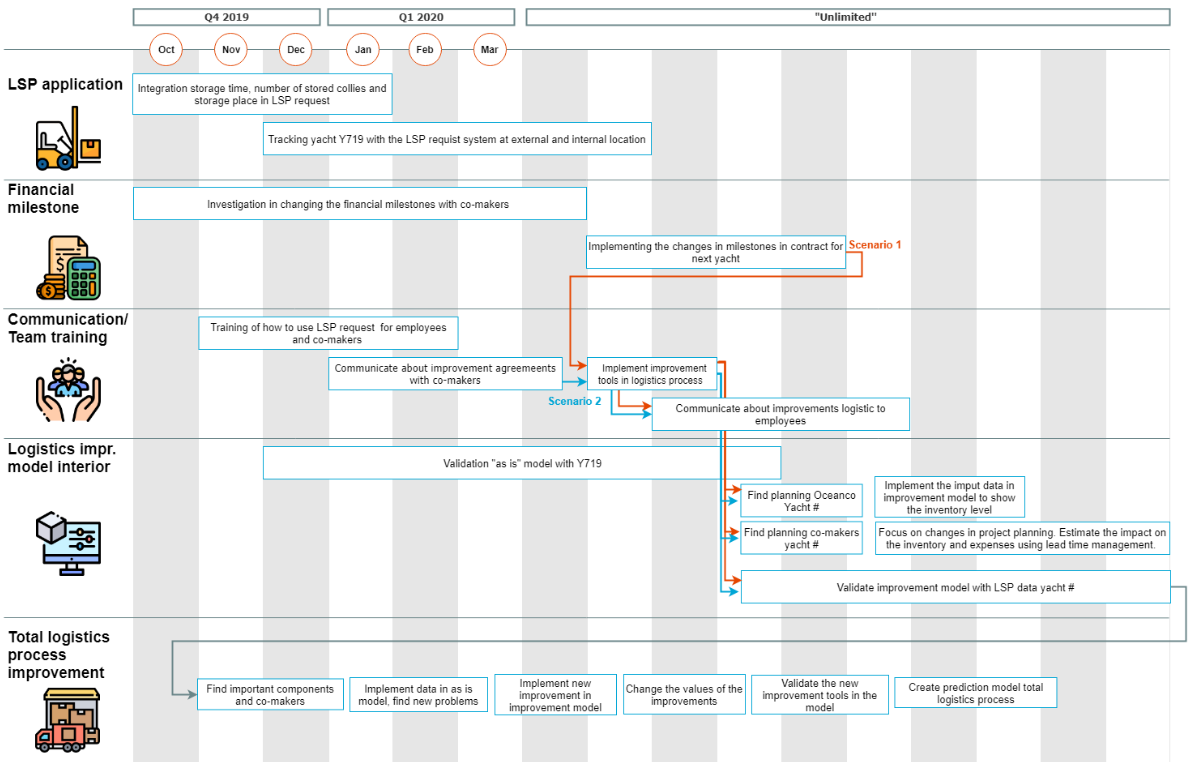


Figure 8.1: Implementation roadmap Oceanco

8.1. LSP application

The implementation road starts by the Logistics Service Portal (LSP). At this moment the data that LSP request provides is limited, partly through the recent development of the system. However, the LSP system is able to collect the required data during the logistics process. The values of both models can be validated with this LSP request system. When the model is validated on multiple yacht simulations, the improvement model can be used as a logistics prediction model where the logistics process can be managed beforehand. To make it possible to validate the models with reality, it is important that LSP request implement the following aspects in the LSP System:

1. The time that a collie is stored in the inventory - This means that the date a collie is placed in the inventory and the time the collie is placed on board must be noted.

2. Allocating the storage location of a collie - The specific storage location of the collies that are stored internal must be noted. Additionally, the exact collies which will be stored external must be noted. However, the specific storage place of these external stored collies is not necessary to known.

3. Implementing a maximum internal storage capacity – This will make it possible to know if the internal storage place is full.

4. Generating an overview sheet which shows the status of all collies in the inventory.

After implementing these four aspects in the LSP request system, the needed data to validate the "as is" model can be tracked for project Y719. The casco of yacht Y719 will arrive in July at Alblasserdam in Marineweg 5 to start with the exterior painting and installation of electricity, piping, interior etc. The improvement model can use the LSP data only when the improvements are implemented in the logistics process.

8.2. Financial milestone

The financial milestone category focuses on scenario one where the fixed financial milestone needs to be changed in order to maximise the logistic expense reduction. If Oceanco chooses scenario one, the improvements can already be implemented when the current financial milestone remains at the end of the fixed interior. However, the maximum logistic expense reduction cannot be achieved with these fixed financial milestone. The maximum logistic expense reduction is only collected when the milestone is changed. Changing the milestone can be a challenging process where multiple parties are involved. Consultation between the owner, the co-makers and Oceanco must take place in order to conclude a contract.
First some investigation is needed to find out whether owners and co-makers are willing to make changes. Besides, the contract where the financial milestones are recorded for the coming three yachts are already signed. Some investigation is needed if the milestone mechanism in this contract can still be changed.
If all parties agree the specific shift of the milestones, the already implemented improvement tools gives the greatest reduction in the non-value added movements and logistic expenses. Giving a specific timeframe to this process in the roadmap is challenging.

8.3. Communication/team training

The communication and team training category contains the activities about the communication between the different involved parties before and after the implementation of the improvement tools. Communication between the co-makers and Oceanco about the improvement agreements are necessary. Examples of issues to be discussed during these conversations; Are the tools achievable for all parties? how do we coordinate the schedules to achieve the desired lot size and JIT delivery? At what moment of time must the delivery date be fixed? When the improvements are agreed by all parties the improvement tools can be implemented in the logistics process of Oceanco. This is the start sign for the improvement model.
Beside the agreements between the co-makers and Oceanco, each employee must be able to work with the LSP request system. Training's are required for the employees to learn how and when to use the LSP request system. If each employee of Oceanco and the co-makers knows how to use the LSP request the data what is generated by the system is reliable.
Communication about the improvement from the logistics department to the employees is important. It is important to get support within the company by sharing the aimed logistics improvements and the targets.

8.4. Logistics improvement model

The logistics improvement model can be used in the future as a prediction model that shows the inventory level, the number of external movements, the number of drives, the collie weeks and the logistic expenses before the process starts. Additionally, the model can estimate the impact on the inventory and the expenses by changes/delays in the production of installation process using the improvement tool lead time management. To be able to calculate accurate impact estimations, the installation approach must be reliable. So, the improvement model and in the future the prediction model can only be used when the improvement has been applied in the organisation and when both models are validated.
Until the improvement tools are fully implemented in the logistics process, the "as is" model without improvements can already be validated with data from yacht Y719. During the interior production phase, the available data can be implemented in the model and validated is directly possible during this collection of data.
If the improvement tools are implemented in the process the collie planning of the co-makers and the installation planning of Oceanco needs to be implemented in the model. Thereafter, the agreed JIT and lot size values must be selected in the model which will show the inventory level during the logistics process. During the process, delays must be monitored to be able to change the start of the installation process on time if needed. The first yacht where this model will be applied on is unknown. The first yacht will validate the model by comparing reality with the model output. After validating the models, both models can be used for Marineweg 1 and 5 by only changing the available space to store the collies. The available space at Marineweg 1 still needs to be determined after creating standards of the inventory spaces. Once validated the model can be used as a prediction model. This is useful for prediction inventory level and logistic expenses and assessing impact when a project is delayed.

8.5. Total logistics process

This thesis focuses on the interior logistics process. But the goal of Oceanco is to generate an overview of the total logistics process and be able to predict the entire logistics process for each component that arrives at the yard. The following steps are needed to be able to predict the entire logistics process:

1. Find the important logistics components and the associated co-makers.
2. Implement the required data in the "as is" model to check the current logistics process for each component and find the challenges that needs improvements. Important data which are needed are the installation planning of the components and the planning of the items which are sent to Oceanco by the co-makers.
3. If new improvements next to JIT, lot size, lead time management, additional standardisation and levelled flow are needed, implement these new improvements in the improvement model for the specific components.
4. Change the values of the improvement tools to the achievable value of the various components. This means that the JIT, lot size or standards values can change for different components and co-makers.
5. Validate the improvement model if new improvement tools are implemented in the model.
6. Create a improvement model where all components have been merged. This creates a logistics overview of what the logistics point can expected during a project.

This can only take place if the interior improvement model is validated.

8.6. Conclusion implementation roadmap

The implementation roadmap will be concluded by answering the related research subquestion.
What should Oceanco do to implement the interior logistics improvements?
Oceanco has to take multiple steps before the non-value added movements in the logistics process will be reduced. First the LSP request system need to be updated to generate accurate data from the logistics process. Second, communication between the co-makers and Oceanco is needed to discuss and agree upon the implementation of the improvements that have been examined in this research. Third, If Oceanco chooses for scenario one, the financial milestone mechanism must be changed in order to achieve the maximum logistic expense reduction. If these three steps have been taken the improvements can be implemented in the

logistics process after which the validation of the improvement model can take place. If the improvement model has been completely optimised with regard to the interior logistics flow, the improvement model can be expanded for different components, such as piping and HVAC systems. The ultimate goal is to predict the entire logistics process of a shipyard.

9

Conclusion & recommendation

In this chapter conclusions are drawn on this research. Furthermore, recommendations for Oceanco and for further research will be given. Finally, the limitations of this research will be discussed.

9.1. Conclusion

This section will focus on answering the main research question of this thesis:
To what level can the non-value added movements in the interior logistics process be reduced by combining multiple improvement methods?
At the yard of Oceanco the logistics process is inefficient. Oceanco preferably wants to use their floorspace for yacht building. Therefore, not all the installation items can be stored at the shipyard itself. Therefore, Oceanco has an external storage location. This external saved inventory however creates unnecessary movements, which can be seen as waste in the logistics process. If the logistics department wants to keep up with the company growth and speed in the yacht building process, Oceanco's management needs to work on a more efficient process where the non-value added movements are reduced. Improvements in the progress communication, the flow of items and the co-makers process standard can help to reduce or even eliminate the non-value added movements.
The logistics process of Oceanco can be improved by applying a set of combined improvement methods. The improvement methods Lean and Lean Six Sigma matches best with the requirements, partly due to their focus on high controllability of the flow of items and the flexibility during the process. This answers the first sub research question. Both methods also uses the five stage Deming's improvement cycle DMAIC. This cycle improves the challenges in the logistics interior processes of Oceanco by going through five different phases: *define, measure, analyse, improve and control*.

The *define* phase takes the boundary conditions and process mapping into account. There are two major logistics process flows at Oceanco, due to the limited space at the yard; the internal logistics inventory flow and the external logistics inventory flow. This thesis focuses on process type two: the external inventory flow, because this has the only impact on the total waste caused by many non-value added movements. List and Sinnex are the two interior co-makers which make the most use of the external inventory due to their production facilities are located in Austria. Both co-makers hardly take the prescribed inventory level and the storage time of Oceanco into account. Recognisable as a push flow from the production facilities towards the shipyard. Which ultimately results in an increasing inventory level when there are changes in the installation schedule.

The *measure* phase estimates the Key Performance Indicators (KPI's) which indicate the performance of the interior logistics process. By using the collaboration-oriented performance model the following five KPI's are defined; the inventory time of the collies, inventory stored internal, inventory stored external (linked to the external movements), the total collie weeks external and the total logistic expenses. An "as is" model is created for yacht Y718 where, for the two important interior co-makers Sinnex and List, the current logistics process is drawn. The "as is" model calculates a total of 127 non-value added movements, resulting in a total logistic expenses of €316.300,00 for Oceanco. The logistics process for List is already more efficient than

Sinnex. Sinnex stores relatively more collies at the external inventory than List, 22,1% and 16,3% respectively. The number of stored collies external are higher due to the higher inventory times of Sinnex at the beginning of the process. This causes the higher number of collie weeks for Sinnex which increases the logistic expenses.

The *analyse* phase analyses the key performance indicators to find the causes that increase the non-value added movements. The main reason that the non-value added movements are increasing are the interior production and previous installations delays at the beginning of the interior installation.
Oceanco receives money from her client when the complete fixed interior is delivered at the yard; this is one of the ten financial milestones during the total project. Which means that the inefficient logistics process generates cash faster, this is more beneficial from a financial perspective of Oceanco. Therefore, conclusion can be drawn that the mechanism of milestone related income is the main cause of increasing non-value added movements deliberately resulting in an inefficient logistics process. This answers the second sub research question.
From the logistics point of view, the most important reason to change this specific financial milestone is to reduce the push flow of the interior item to the inventory. By dividing this financial milestone over the entire installation process, the pressure on getting the collies on the yard as soon as possible reduces. The collies will then follow the most optimised logistics flow resulting in a reduction of the non-value added movements. However, this financial milestone root-cause is concluded after examining only one project, which may be not fully representative of the current situation. Because several managers within Oceanco have different opinions about this financial milestone mechanism, two financial milestone scenarios will be created that focuses both on improving the logistics process. Scenario one changes the financial milestone, while scenario two leaves the current milestone mechanism unchanged.

The *improve* phase of the Deming's cycle discusses the improvement tools based on the selected set of methods Lean and Lean Six Sigma. The improvement tools suggest to improve the flow of items, the progress communication, the controllability and flexibility of the process, to cope with possible process changes. The following five improvement tools are selected; Just in time, lead time management & flexibility, levelled flow, frequency & lot size and additional standardisation. This selection of improvement tools give answers on the third sub research question.

The *control* phase, which is the last phase of the Deming's cycle, monitors and controls the improvements by implementing the improvement tools in the improvement model. The improvement framework applied on both financial milestone scenarios consists of lead time management, JIT value and the lot size. The core thought of this framework is standardisation. Levelled flow improvement is missing in the framework. This tool requires adjustments to the installation, which makes that this tool is approached separately. Within the improvement tools, lead time management gives the most impact on reducing the non-value adding movements from project Y718.
Scenario one implements the logistics improvement tools and divides the financial milestone mechanism over the total interior process timeframe, the values used within this scenario are explained in this section. The lead time management tool moves the start date of the collies sixty days forward in time. The lot size of the truck will be seven collies for both co-makers, which gives the lowest transportation expenses. The JIT value is chosen by taking the current inventory time into account. List will have a JIT value of ten days, as for Sinnex the JIT value is fifteen days. Additional standardisation is implemented in the collie dimension which gives a maximum capacity that can be stored in the internal inventory at Oceanco; with 27 collie places for Sinnex and 23 for List. Implementing these tools with the above explained values result in a total reduction of 106 (-83%) number of external movements and a total logistic expense reduction of € 161.500,00 (-51%) for Oceanco. This means that the current non-value added movements could be reduced to 21 movements involving the total logistic expenses of € 154.800,00.
Scenario two implement the same improvement tools as scenario one, but keeps the milestone mechanism unchanged. Resulting in the same reduction of the non-value added movements. Only the total logistic expense reduction for scenario two is different from scenario one. The lead time management improvements extend the time from order to interior delivery. This means the financial milestone is reached later in time. To bridge the gap Oceanco needs to acquire a loan. Oceanco needs to acquire a loan for thirty days by implementing scenario two. The maximum amount of the loan for the logistics efficiency reduction of € 161.500,00 is € 32.310.000,00 at 4% interest rate. If the real loan, checked by Oceanco, is below this value, the result is a positive total logistic expense reduction compared to the current situation. This answers the fourth sub

research question.
Implementing the levelled flow of items by the chosen lot size and JIT value from scenario one and two at yacht Y718 reduces the external movements to zero. The logistic expenses of Oceanco will only consist of transport expenses, which remains the same in scenario one and two.However, before implementing this tool further research needs to be done into the accessibility of the method of installation within the complexity of the interior installation process.
Oceanco has to take a number of steps if it really wants to use of the improvement model effectively. First the LSP request system needs to be updated to be able to generate accurate data from the logistics process. Communication between the co-makers and Oceanco is needed to discuss and agree upon the implementation of the improvements that have been examined in this research. Thereafter, Oceanco should change the financial milestone by choosing scenario one. If these three steps have been taken the improvements can be implemented in the logistics process after which the validation of the improvement model can take place. If the improvement model has been completely optimised with regard to the interior logistics flow, the improvement model can be expanded for different components, such as piping and HVAC systems. Besides, the model can be made applicable for Marineweg 1 by only changing the available internal storage space. The ultimate goal is to predict the entire logistics process of a shipyard before the project starts. With this prediction model the impact on the expenses and the non-value added movements can be calculated when unexpected changes in the planning occur. This give answer on the fifth sub research question.

The answer on the main research question is: By combining the improvement methods Lean and Lean Six Sigma, the non-value added movements in the interior logistics process can reach a reduction in the order of 80%, which result in a new level in the order of magnitude of twenty non-value added movements per project. This movement reduction results in a logistic expenses reduction in the order of 50%. These maximum reductions in non-value added movements and the logistic expenses can be reached by applying scenario one, where the financial milestone mechanism is divided over the timeframe.

9.2. Recommendation

In this section recommendations are made for further internal research at Oceanco. Furthermore, recommendations for further scientific research are given.

9.2.1. Recommendation for Oceanco

The following recommendation for Oceanco can be defined:

- In case of financial milestone scenario one, it is necessary to change the financial milestones before the desired non-value added movement reduction and logistic expense reduction can be achieved in the logistics process.
- Validation of the "as is" model is needed with data from new building yachts. The result of the "as is" model become more reliable, when the updated LSP data is used in the "as is" model.
- Validation of the improvement model is needed before the model can be used as a prediction model and expanded for other component flows in the logistic. The base of the model is already validated by the validation of the "as is" model, but the implemented improvements tools must be tested for reliability. The improvement tools can already be implemented in the logistics process.
- Improvement of the LSP request system is necessary to generate more reliable data which both models can use to make an accurate prediction of the logistics process. Next to the reliable data for the models, this optimised LSP request data creates a more structured logistics planning and overview of the logistics process.
- Investigation of the impact of the lost items. Items from the collies get lost at the yard of Oceanco when the items are placed outside the collies. Only the collie has a tag which can be traced due to the LSP request system. Tracing individual items also needs to be taken into account.
- Beside the fact that some items get lost in the inventory, another common problem by the storage are the half-full collies which get lost too. The LSP request system must register that the collie is removed and after a short duration is places back in the inventory. This half-full box must get a new code in LSP request with their new storage location.

- Oceanco has plans to arrange the external movements at the new location in Zwijndrecht itself instead of Maat, resulting in a reduction of the external storage expenses. The new external storage expenses must be changed in the models when the exact values are known.
- Research is needed related to the second time inventory collies. In this thesis this problem is neglected, but in reality it is expected that a lot of collies are placed half-full for the second time in the inventory. The root cause needs to be found of this problem and the impact of the problem must be determined. Some scaffolds next to the yacht above the water will be a solution if the main problem is the limited place on board.
- The explained improvement tool levelled flow needs further investigation in the installation method that the tool applies. Is it possible to change the installation method of the interior by a standard inventory inflow and outflow which increases the efficiency at the logistics process?
- Automate the model, sending of notifications, assessing an impact, etc. can be of high value within the logistics process. In a wider context, machine learning can be applied in the prediction model (Durga, 2006).

9.2.2. Recommendation for further research

Beside the recommendation for Oceanco, the following recommendation for further research can be given:

- This case study combined a set of improvement methods that improves the logistics process at Oceanco. Further research can also be done by different yachtbuilders and/or organisations which make use of comparable processes. By combining different improvement methods and following the improvement cycle, different improvement tools can be used to improve their logistics process.
- The improvement theories Lean and Lean Six Sigma fitted the requirements of this research best. However, when looking to figure 2.3 a simplification has been made on the process type. The way of work with collies can be seen as a line flow process type. This is true for the logistics process, but not for the installation process. Since the content of each collie is different, the installation process is better categorised as process type 'Flow Shop' or 'Job Shop'. However figure 2.3 does not show an improvement method for high-volume, non-standard products. Further research into this would be beneficial for better assessing the source of delays further downstream in the installation process. When these delays can be prevented, managing the logistics process becomes more predictable and can be made more efficient.

9.3. Discussion

This section discusses the results and limitations of this thesis. The results that follows from the improvement model are only validated by checking the order size and the correctness probability. The result must be checked by another yacht which will be built in the future. Two important results are found from this thesis; the reduction of the non-value added movements and the logistic expense reduction. The result of the non-value added movements reduction is less than expected. After modelling the "as is" situation it become clear that the delays in the interior installation and production causes the high non-value added movements, where the improvement tool lead time management could make major improvements. The target was a complete elimination of the non-value added movements. However, this result is a good start. The logistic expense reduction were difficult to estimate beforehand due to the unknown height of these logistic expenses. After analysing the root cause that increases the non-value added movements, the expectation, that the logistic expenses due to improvements can be saved by at least 33%, were right. The main goal of this thesis is to reduce the non-value added movements, which has been succeeded with a reduction in the order of 80% including significant logistic expense reduction.

It is important to discuss the limitations of this research. Oceanco's specific limitation are discussed below.
The first limitation is the cooperation of the co-makers during the research. Data about the way of work of the co-makers is difficult to receive from these parties. Oceanco has most of the co-makers information, but the correct planning of the production and the transportation costs are missing. This makes the correctness of the collie planning and the transportation expenses doubtful.
The second limitation is based on the number of yachts. This research focuses on yacht Y718. However, each

yacht is unique and contains various innovative features. The appropriate approaches, the results and the challenges can be variate per yacht.
The last shortcoming is the fast-changing logistics process. Aspects within the logistics process changes due to the new location. The location of storage and the expenses will change. This affects the results determined in this thesis. These new logistics plans are not taken into account in the model, because the information is still limited.

A more general limitation of this research is the applicability of the logistics improvement model. Only Oceanco is able to use the results and model after validating the results of this thesis. During this research it was not possible to extend the applicability of the model over multiple shipyards. Main reason for this limitation is the uniqueness of the projects. The model must be tested by different shipyard due to their unique project, before the model can be applied. Additionally, the yacht building process takes five year, which takes too long for this research. Data of the logistics process of yacht which were build in the past are not tracked. When this research is applied to different yachtbuilders, different sets of improvement methods will be constructed. If the model in this research can be extended with the most common improvement tools and these tools can be turned on/off, this research can be wider applicable. However, due to data limitations and long process times, this was not feasible for this thesis.

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A

Overview interior installation process

The red blocks shows the processes after which inspection of the installed items must take place. This figure does not take the mounting, testing and inspection of the cables and pipes into account.

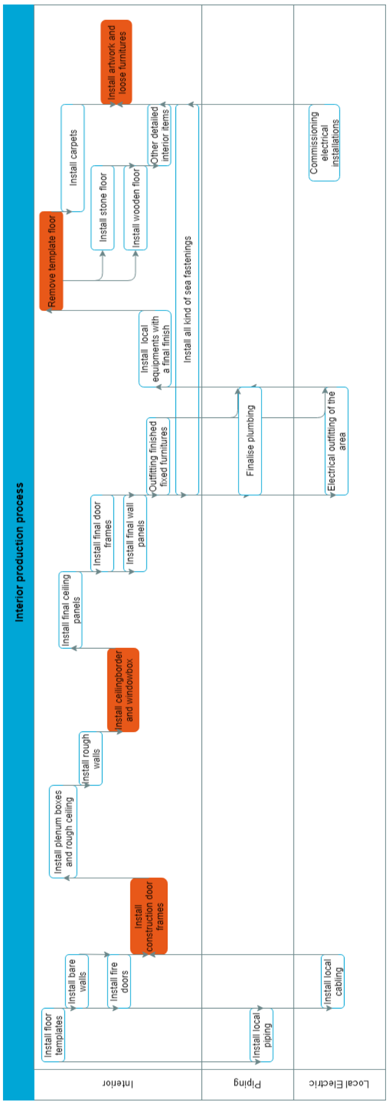

Figure A.1: Overview interior installation process at Oceanco

B

Lean Six Sigma tools

Strategy and planning tools	
Voice of business and customer	Input of the organisation and customer gives inside in the needs of the organisation
Value Steam Mapping (VSM)	A value stream map uses flowchart techniques to capture visually the sum of activities performed in the sourcing, making, and delivery of the specific items.
Pareto Analysis	Priority technique - can serve as a way to highlight the root causes of problems that are most important.
ABC classification	Priority technique - is used to distinguish low- and high- value inventory
XY Matrix	Priority technique - drives priorities according to the voice of the costumer and voice of the business considerations

Table B.1: Strategy and planning tools Lean Six Sigma(Goldsby and Martichenko, 2005)

Problem solving tools	
DMAIC	The outcome of this method should recognise the opportunities for improvement
Brainstorm	Brainstorming sessions are likely to occur throughout the DMAIC process as a way to not only gather ideas but also get team members involved in problem recognition.
Cause-and-effect Diagrams	The cause-and-effect diagram often provides structure to causal analysis brainstorming and serve as a good starting point for deeper analysis.
Five-Why	An technique which is used to ascertain root cause of problem. Focusing on the key problem can lead to the core by asking questions "why".

Table B.2: Problem solving tools Lean Six Sigma(Goldsby and Martichenko, 2005)

Operational tools		
Flow concept	Just in time	JIT focus on the delivering of items only when the customer needs it. Pulling the items through the system removes inventory and has a positive influence on the seven types of waste.
	Lead time management and flexibility	Lead time management speed-ups and manage the process. These shorter lead times increases the flexibility to react on uncertainties.
	Levelled flow	Levelled flow reduces the negative effects of the fluctuations in demand. No fluctuations results in less inventory level.
	Frequency and lot size	The frequency and lot sized optimise the reduction of the external movements verses the logistic expenses.
Organisation concept	Standardise work	Standards are essential for understanding the current condition of a process, supporting continuous improvement and measuring improvement.
	5S	5S eliminate clutter and complexity in the workplace.

Table B.3: Operational tools Lean Six Sigma(Goldsby and Martichenko, 2005)

C

Systematic overview VSM

VSM - Internal inventory						
	Steps	Flow	Cycle time [min]	Chart Symbol □	Chart Symbol △	Chart Symbol ⇨
1	Register Collie in LSP	□	5			
2	Remove collie out of the truck	□	6			
3	Move collie to inventory by lift (3th floor)	⇨	8			
4	Intern inventory collie	△	min 4800 max 67200			
5	Pick up collie for yacht	□	3			
6	Move collie from inventory to yacht	⇨	10			
7	Place collie on yacht by crane	□	8			
8	Remove items of collie	□	min 10 max 4800			
	Total	8 steps	Cycle time	5 times	1 time	3 times
	Minimum		4850min	32min	4800min	18min
	Maximum		72040min	4822min	67200min	18min

Table C.1: Systematic overview value stream map internal inventory

VSM - External inventory						
	Steps	Flow	Cycle time [min]	Chart Symbol □	Chart Symbol △	Chart Symbol ⇨
1	Register Collie in LSP	□	5			
2	Remove collie out of the truck	□	6			
3	Move collie to inventory	⇨	8			
4	Extern inventory collie	△	min 4800 max 67200			
5	Pick up collie for yacht	□	3			
6	Move collie to truck	⇨	8			
7	Place collie in truck	□	6			
8	Move collie from extern inventory to Oceanco	⇨	10			
9	Remove collie out of the truck	□	6			
10	Move collie to temporary inventory	⇨	5			
11	Storage collie in temporary inventory	△	min 10 max 4800			
12	Pick up collie for yacht	□	3			
13	Move collie from inventory to yacht	⇨	8			
14	Place collie on yacht by crane	□	8			
15	Remove items of collie	□	min 10 max 4800			
	TOTAL	15 steps	Cycle time	8 times	2 time	6 times
	Minimum		4896min	47min	4810min	39min
	Maximum		76876min	4837min	72000min	39min

Table C.2: Systematic overview value stream map external inventory

D

Send date collies by the co-makers

Sinnex collies sending date					
Nr.	Collie	Deck	Area	Description	Sended date
1	2017-109	-	All	-	10/02/2017
2	2017-398	-	All	-	09/06/2017
3	2017-402	UD	Lobby	Floor templates	09/06/2017
3	2017-402	UD	Owners Area fr 80-88	Floor templates	09/06/2017
3	2017-402	UD	Owners Area fr 89-108	Floor templates	09/06/2017
4	2017-417	-	-	-	23/06/2017
5	2017-419	-	-	-	23/06/2017
6	2017-432	UD	Saloon&Dining	Floor templates	30/06/2017
7	2017-436	-	-	-	30/06/2017
8	2017-454	-	-	-	07/07/2017
9	2017-458	MD	Lobby	Floor templates	14/07/2017
9	2017-458	MD	Main Saloon	Floor templates	14/07/2017
10	2017-483	LD	Beach L/SPA/Hspt/Corridor	Floor templates	28/07/2017
10	2017-483	BD	Corridor/Lobby	Floor templates	28/07/2017
11	2017-494	-	-	-	28/07/2017
12	2017-536	MD	Main Saloon	Rough ceiling + ventilation	01/09/2017
13	2017-537	-	-	Montage material	01/09/2017
14	2017-543	MD	Lobby	Rough ceiling + ventilation	01/09/2017
15	2017-548	MD	Main Saloon	Rough ceiling + ventilation	08/09/2017
16	2017-549	UD	Owners Area fr 89-108	Rough ceiling	01/09/2017
17	2017-571	MD	Main Saloon	Rough ceiling	08/09/2017
18	2017-573	MD	Main Saloon	Ventilation	08/09/2017
18	2017-573	UD	Owners Area fr 89-108	Rough ceiling	08/09/2017
19	2017-584	UD	Owners Area fr 89-108	Ventilation	15/09/2017
20	2017-585	LD	Beach L/SPA/Hspt/Corridor	Rough ceiling + ventilation	15/09/2017
20	2017-585	LD	Lobby	Rough ceiling + ventilation	15/09/2017
21	2017-596	UD	Lobby	Rough ceiling + ventilation	21/09/2017
22	2017-599	-	-	stencil ceiling heights	15/09/2017
23	2017-603	-	-	stencil ceiling heights	21/09/2017
24	2017-621	UD	Owners Area fr 89-108	Rough walls	06/10/2017
25	2017-622	LD	Lobby	Rough ceiling + ventilation	29/09/2017
26	2017-623	BD	Corridor/Lobby	Rough ceiling + ventilation	29/09/2017
27	2017-624	MD	Lobby	Rough ceiling + ventilation	29/09/2017
28	2017-627	UD	Owners Area fr 80-88	Rough ceiling + ventilation	29/09/2017
29	2017-628	LD	Beach L/SPA/Hspt/Corridor	Rough ceiling + ventilation	29/09/2017
30	2017-632	LD	Beach L/SPA/Hspt/Corridor	E-Cabinet	29/09/2017
30	2017-632	MD	Lobby	E-Cabinet	29/09/2017
30	2017-632	MD	Main Saloon	E-Cabinet	29/09/2017
30	2017-632	UD	Owners Area fr 89-108	E-Cabinet	29/09/2017
30	2017-632	UD	Saloon&Dining	E-Cabinet	29/09/2017
31	2017-639	UD	Saloon&Dining	Rough ceiling	29/09/2017
32	2017-642	MD	Main Saloon	Ceiling panel	13/10/2017
33	2017-648	UD	Lobby	Rough ceiling	06/10/2017
33	2017-648	UD	Owners Area fr 80-88	Rough ceiling	06/10/2017
34	2017-651	BD	Corridor/Lobby	Rough ceiling + ventilation	06/10/2017
35	2017-653	LD	Beach L/SPA/Hspt/Corridor	Rough ceiling	06/10/2017
35	2017-653	LD	Beachclub / Corridor	Rough ceiling + ventilation	06/10/2017
36	2017-654	UD	Saloon&Dining	Rough ceiling	06/10/2017
37	2017-655	UD	Saloon&Dining	Rough ceiling	06/10/2017
38	2017-656	-	-	-	06/10/2017
39	2017-673	LD	Beach L/SPA/Hspt/Corridor	Ceiling panel	13/10/2017
40	2017-674	LD	Lobby	Ceiling panel	13/10/2017
41	2017-675	MD	Lobby	Ceiling panel	13/10/2017
42	2017-678	MD	Lobby	Rough walls	13/10/2017
43	2017-679	LD	Beach L/SPA/Hspt/Corridor	Rough ceiling + ventilation	20/10/2017
44	2017-680	BD	Corridor/Lobby	Rough ceiling + ventilation	13/10/2017
45	2017-681	MD	Lobby	Rough ceiling	13/10/2017
46	2017-682	UD	Saloon&Dining	Rough walls	20/10/2017
47	2017-683	LD	Beach L/SPA/Hspt/Corridor	Rough ceiling + ventilation + Allu sheet	20/10/2017
48	2017-686	UD	Lobby	Sliding basket	13/10/2017
48	2017-686	UD	Owners Area fr 80-88	Sliding basket	13/10/2017
48	2017-686	UD	Owners Area fr 89-108	Sliding basket	13/10/2017
49	2017-700	LD	Beach L/SPA/Hspt/Corridor	Ventilation	20/10/2017
50	2017-704	UD	Lobby	Rough walls	20/10/2017
51	2017-705	UD	Owners Area fr 89-108	Rough ceiling + ventilation	20/10/2017
52	2017-706	MD	Lobby	Rough walls	25/10/2017
53	2017-708	UD	Lobby	Sliding basket	20/10/2017
53	2017-708	UD	Owners Area fr 89-108	Sliding basket	20/10/2017
53	2017-708	UD	Saloon&Dining	Sliding basket	20/10/2017

Sinnex collies sending date					
Nr.	Collie	Deck	Area	Description	Sended date
54	2017-714	UD	Lobby	Rough walls	23/10/2017
55	2017-716	LD	Beach L/SPA/Hspt/Corridor	Door	20/10/2017
56	2017-723	LD	Beach L/SPA/Hspt/Corridor	Rough ceiling stairs	03/01/2018
57	2017-748	-	-	-	25/10/2017
58	2017-758	UD	Lobby	Groove base +finish ceiling	10/11/2017
59	2017-759	BD	Corridor/Lobby	Groove base +finish ceiling	03/11/2017
60	2017-760	LD	Beach L/SPA/Hspt/Corridor	Groove base +finish ceiling	03/11/2017
61	2017-764	MD	Main Saloon	Sliding basket	03/11/2017
62	2017-778	UD	Owners Area fr 89-108	Rough ceiling + ventilation	03/11/2017
63	2017-780	LD	Beach L/SPA/Hspt/Corridor	Bare walls	03/11/2017
63	2017-780	MD	Lobby	Bare walls	03/11/2017
63	2017-780	MD	Main Saloon	Bare walls	03/11/2017
63	2017-780	UD	Owners Area fr 80-88	Bare walls	03/11/2017
63	2017-780	UD	Owners Area fr 89-108	Bare walls	03/11/2017
64	2017-781	-	-	-	03/11/2017
65	2017-783	LD	Beach L/SPA/Hspt/Corridor	Sliding basket	10/11/2017
65	2017-783	LD	Beachclub / Corridor	Sliding basket	10/11/2017
65	2017-783	UD	Saloon&Dining	Sliding basket	10/11/2017
66	2017-786	BD	Corridor/Lobby	Lift vermomming	10/11/2017
67	2017-787	LD	Beach L/SPA/Hspt/Corridor	Rough ceiling + ventilation	10/11/2017
68	2017-788	MD	Main Saloon	Rough walls	10/11/2017
69	2017-797	UD	Owners Area fr 89-108	Groove base	09/11/2017
70	2017-798	UD	Owners Area fr 80-88	Rough walls	17/11/2017
71	2017-804	LD	Beach L/SPA/Hspt/Corridor	Rough ceiling+ Groove base	24/11/2017
72	2017-810	UD	Owners Area fr 89-108	Rough walls	30/11/2017
73	2017-812	MD	Main Saloon	Wough walls	17/11/2017
74	2017-813	LD	Lobby	Sliding basket	17/11/2017
75	2017-841	UD	Owners Area fr 80-88	Rough ceiling+ Groove base	24/11/2017
76	2017-842	UD	Lobby	Rough ceiling+ Groove base	24/11/2017
77	2017-844	UD	Lobby	Rough ceiling+ Groove base	07/12/2017
78	2017-864	UD	Saloon&Dining	Groove base	04/12/2017
79	2017-865	LD	Lobby	Rohteile??	01/12/2017
80	2017-867	MD	Main Saloon	Rough ceiling+ Groove base	01/12/2017
81	2017-868	MD	Main Saloon	Groove base	01/12/2017
82	2017-880	UD	Lobby	Rough walls	05/12/2017
82	2017-880	UD	Owners Area fr 89-108	Rough walls	05/12/2017
83	2017-889	-	-	-	01/12/2017
84	2017-892	UD	Owners Area fr 89-108	Ceiling panel	26/02/2018
85	2017-893	MD	Lobby	Ceiling panel + groove base	15/12/2017
86	2017-896	BD	Corridor/Lobby	Rohteile??	07/12/2017
86	2017-896	MD	Lobby	Rohteile??	07/12/2017
87	2017-897	LD	Lobby	Ceiling panel + groove base	07/12/2017
88	2017-898	BD	Corridor/Lobby	Ceiling panel + groove base	07/12/2017
89	2017-900	UD	Lobby	Ceiling panel + groove base	07/12/2017
90	2017-902	-	-	-	07/12/2017
91	2017-917	UD	Saloon&Dining	Groove base	15/12/2017
92	2017-928	UD	Owners Area fr 80-88	Ceiling panel + groove base	15/12/2017
93	2017-930	BD	Corridor/Lobby	Ceiling panel + groove base	15/12/2017
93	2017-930	UD	Owners Area fr 89-108	Alluminium angle frame	15/12/2017
94	2017-934	LD	Lobby	Rohteile	15/12/2017
95	2017-941	LD	Beach L/SPA/Hspt/Corridor	door	25/05/2018
95	2017-941	MD	Main Saloon	Furniture	25/05/2018
95	2017-941	UD	Owners Area fr 80-88	Furniture	25/05/2018
95	2017-941	Ud	Owners Area fr 89-108	Finished ceiling	25/05/2018
96	2017-967	UD	Owners Area fr 89-108	Ceiling panel + groove base	16/01/2018
97	2017-968	UD	Owners Area fr 89-108	Ceiling panel	16/01/2018
98	2017-969	UD	Saloon&Dining	Groove base	03/01/2018
99	2017-979	LD	Beach L/SPA/Hspt/Corridor	Rough walls	19/01/2018
100	2017-981	MD	Main Saloon	Rough walls	03/01/2018
101	2017-982	MD	Main Saloon	Ceiling panels	17/01/2018
102	2017-983	LD	Beachclub / Corridor	Floor templates	03/01/2018
103	2017-986	-	-	-	03/01/2018
104	2018-001	UD	Lobby	Door	03/01/2018
104	2018-001	UD	Owners Area fr 80-88	Door	03/01/2018
104	2018-001	UD	Owners Area fr 89-108	Door	03/01/2018
104	2018-001	UD	Saloon&Dining	Door	03/01/2018
105	2018-003	LD	Beach L/SPA/Hspt/Corridor	Ceiling panel + groove base	12/01/2018
106	2018-031	UD	Owners Area fr 80-88	Rough walls	11/01/2018
107	2018-032	UD	Owners Area fr 80-88	LED milky edge	12/01/2018

Sinnex collies sending date					
Nr.	Collie	Deck	Area	Description	Sended date
107	2018-032	UD	Owners Area fr 89-108	LED milky edge	12/01/2018
108	2018-034	LD	Beachclub / Corridor	Groove plate +Allu plate	19/01/2018
109	2018-035	UD	Owners Area fr 89-108	Groove base	12/01/2018
110	2018-036	LD	Beach L/SPA/Hspt/Corridor	Rough walls	12/01/2018
111	2018-037	BD	Corridor/Lobby	ruw bouw	12/01/2018
112	2018-049	LD	Beach L/SPA/Hspt/Corridor	Ceiling panel + groove base	19/01/2018
112	2018-047	MD	Lobby	Rough ceiling	12/01/2018
113	2018-050	LD	Beach L/SPA/Hspt/Corridor	Ceiling panel + groove base	19/01/2018
113	2018-048	UD	Lobby	Rough walls	12/01/2018
114	2018-052	LD	Beachclub / Corridor	Ceiling panel + groove base	19/01/2018
115	2018-084	UD	Saloon&Dining	Finished ceiling	05/02/2018
116	2018-091	LD	Beach L/SPA/Hspt/Corridor	Door	26/01/2018
116	2018-091	LD	Beachclub / Corridor	Door	26/01/2018
116	2018-091	LD	Lobby	Door	26/01/2018
116	2018-091	UD	Owners Area fr 89-108	LED milky edge	26/01/2018
117	2018-1004	MD	Lobby	Metal ground	09/10/2018
117	2018-1004	MD	Main Saloon	Metal ground	09/10/2018
118	2018-1007	LD	Beach L/SPA/Hspt/Corridor	Door	31/08/2018
118	2018-1007	LD	Beachclub / Corridor	Door	31/08/2018
118	2018-1007	LD	Lobby	Door	31/08/2018
118	2018-1007	MD	Main Saloon	Door	31/08/2018
119	2018-1008	UD	Lobby	E-Cabinet	31/08/2018
120	2018-1011	LD	Beach L/SPA/Hspt/Corridor	Door	31/08/2018
121	2018-1017	UD	Owners Area fr 89-108	Door	07/09/2018
122	2018-1018	LD	Beach L/SPA/Hspt/Corridor	Door	07/09/2018
123	2018-1027	UD	Owners Area fr 89-108	Rough ceiling?	07/09/2018
124	2018-1028	LD	Lobby	Rough ceiling?	07/09/2018
125	2018-1034	LD	Beach L/SPA/Hspt/Corridor	Other	17/09/2018
125	2018-1034	LD	Beachclub / Corridor	Other	17/09/2018
125	2018-1034	MD	Lobby	Other	17/09/2018
125	2018-1034	MD	Main Saloon	Other	17/09/2018
125	2018-1034	UD	Owners Area fr 89-108	Other	17/09/2018
125	2018-1034	UD	Saloon&Dining	Other	17/09/2018
126	2018-104	UD	Saloon&Dining	Finished ceiling	26/01/2018
127	2018-1040	UD	Owners Area fr 89-108	Furniture	12/09/2018
128	2018-1041	MD	Main Saloon	Furniture	17/09/2018
128	2018-1041	UD	Owners Area fr 80-88	Furniture	17/09/2018
129	2018-1043	UD	Owners Area fr 89-108	Furniture	12/09/2018
130	2018-1044	UD	Owners Area fr 89-108	Furniture	12/09/2018
131	2018-1058	LD	Beach L/SPA/Hspt/Corridor	Furniture	17/09/2018
132	2018-1092	UD	Owners Area fr 89-108	Finish walls	31/10/2018
133	2018-1093	MD	Main Saloon	Furniture	31/10/2018
134	2018-1095	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	31/10/2018
134	2018-1095	LD	Beachclub / Corridor	Fixed restpoints	31/10/2018
134	2018-1095	MD	Main Saloon	Furniture	31/10/2018
134	2018-1095	UD	Owners Area fr 80-88	Furniture	31/10/2018
134	2018-1095	UD	Owners Area fr 89-108	Furniture	31/10/2018
135	2018-1096	LD	Beach L/SPA/Hspt/Corridor	Door	31/10/2018
136	2018-1097	LD	Beach L/SPA/Hspt/Corridor	Furniture	01/02/2019
136	2018-1097	LD	Beachclub / Corridor	Finish walls	01/02/2019
137	2018-1098	LD	Beachclub / Corridor	Finish walls	01/02/2019
139	2018-1100	UD	Owners Area fr 89-108	Fixed restpoints	09/11/2018
140	2018-1106	UD	Owners Area fr 89-108	Finish walls	09/11/2018
141	2018-135	UD	Saloon&Dining	Furniture	05/02/2018
142	2018-138	UD	Owners Area fr 89-108	Rough walls	05/02/2018
143	2018-139	UD	Owners Area fr 89-108	Ceiling panel + groove base	05/02/2018
144	2018-140	MD	Main Saloon	Ceiling panel	05/02/2018
145	2018-141	MD	Lobby	Ceiling panel	05/02/2018
146	2018-163	MD	Lobby	LED milky edge	05/02/2018
146	2018-163	UD	Lobby	LED milky edge	05/02/2018
146	2018-163	MD	Main Saloon	LED milky edge	05/02/2018
146	2018-163	UD	Owners Area fr 89-108	LED milky edge	05/02/2018
146	2018-163	UD	Saloon&Dining	LED milky edge	05/02/2018
147	2018-164	MD	Main Saloon	Rough walls	09/02/2018
148	2018-165	MD	Main Saloon	Rough walls	26/02/2018
149	2018-170	UD	Lobby	rough ceiling	05/02/2018
150	2018-172	LD	Beach L/SPA/Hspt/Corridor	Door	05/02/2018
150	2018-172	LD	Lobby	Door	05/02/2018
150	2018-172	UD	Owners Area fr 80-88	Door	05/02/2018

Sinnex collies sending date					
Nr.	Collie	Deck	Area	Description	Sended date
150	2018-172	UD	Owners Area fr 89-108	Door	05/02/2018
151	2018-177	LD	Beach L/SPA/Hspt/Corridor	Ceiling panel + groove base	09/02/2018
152	2018-182	MD	Lobby	Rough walls	09/02/2018
153	2018-183	MD	Lobby	Rough walls	09/02/2018
154	2018-184	LD	Beach L/SPA/Hspt/Corridor	Furniture	09/02/2018
154	2018-184	MD	Lobby	Rough walls	09/02/2018
154	2018-184	UD	Owners Area fr 80-88	Furniture	09/02/2018
155	2018-193	LD	Beach L/SPA/Hspt/Corridor	Door	09/02/2018
155	2018-193	UD	Owners Area fr 89-108	Door	09/02/2018
156	2018-216	MD	Main Saloon	Finish ceiling	16/02/2018
157	2018-217	MD	Main Saloon	Finish ceiling	16/02/2018
158	2018-224	UD	Owners Area fr 80-88	Finish walls	23/02/2018
159	2018-239	MD	Main Saloon	Finish walls	26/02/2018
160	2018-242	MD	Lobby	Groove base	16/02/2018
161	2018-244	MD	Main Saloon	Furnitures	16/02/2018
161	2018-244	UD	Owners Area fr 89-108	Furnitures	16/02/2018
162	2018-245	UD	Owners Area fr 80-88	Furnitures	16/02/2018
162	2018-245	UD	Owners Area fr 89-108	Furnitures	16/02/2018
163	2018-256	MD	Main Saloon	Rough walls	22/02/2018
164	2018-259	MD	Lobby	Finish floor	05/03/2018
165	2018-260	MD	Lobby	Finish floor	26/02/2018
166	2018-268	MD	Main Saloon	Door	26/02/2018
167	2018-289	LD	Beach L/SPA/Hspt/Corridor	Floor templates	26/02/2018
168	2018-292	UD	Owners Area fr 89-108	Finish walls	06/03/2018
169	2018-293	UD	Lobby	Finish walls	27/03/2018
170	2018-294	UD	Lobby	Rough walls	23/03/2018
171	2018-297	UD	Owners Area fr 89-108	Rough walls	06/03/2018
172	2018-300	UD	Owners Area fr 80-88	Rough walls	05/03/2018
173	2018-306	UD	Owners Area fr 89-108	Finish walls	05/03/2018
174	2018-307	LD	Beach L/SPA/Hspt/Corridor	Furniture	05/03/2018
175	2018-313	LD	Beach L/SPA/Hspt/Corridor	Rough walls	06/03/2018
176	2018-314	LD	Beachclub / Corridor	Rough walls	06/03/2018
177	2018-315	LD	Beachclub / Corridor	Rough walls	06/03/2018
178	2018-329	UD	Owners Area fr 89-108	Groove base wall	05/03/2018
179	2018-333	LD	Beach L/SPA/Hspt/Corridor	Rough walls	09/03/2018
180	2018-350	UD	Owners Area fr 80-88	Fixed restpoints	09/03/2018
181	2018-354	LD	Beach L/SPA/Hspt/Corridor	Rough walls	09/03/2018
182	2018-355	UD	Saloon&Dining	Fixed restpoints	16/03/2018
183	2018-356	LD	Beach L/SPA/Hspt/Corridor	Furniture	19/07/2018
184	2018-357	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	09/03/2018
184	2018-357	LD	Lobby	Fixed restpoints	09/03/2018
184	2018-357	UD	Lobby	Fixed restpoints	09/03/2018
184	2018-357	MD	Main Saloon	Fixed restpoints	09/03/2018
184	2018-357	UD	Owners Area fr 80-88	Fixed restpoints	09/03/2018
184	2018-357	UD	Owners Area fr 89-108	Fixed restpoints	09/03/2018
184	2018-357	UD	Saloon&Dining	Fixed restpoints	09/03/2018
185	2018-359	UD	Saloon&Dining	finished walls	23/03/2018
186	2018-363	UD	Owners Area fr 89-108	Rough walls	20/03/2018
187	2018-365	UD	Lobby	Finished walls	16/03/2018
188	2018-382	BD	Corridor/Lobby	Furniture	16/03/2018
189	2018-393	-	-	-	16/03/2018
190	2018-399	BD	Corridor/Lobby	Fixed restpoints	06/04/2018
190	2018-399	LD	Lobby	Fixed restpoints	06/04/2018
191	2018-416	BD	Corridor/Lobby	Furniture	23/03/2018
192	2018-419	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	23/03/2018
193	2018-439	UD	Owners Area fr 89-108	Finish walls	04/04/2018
194	2018-440	LD	Beach L/SPA/Hspt/Corridor	furniture	10/04/2018
194	2018-440	BD	Corridor/Lobby	Furniture	10/04/2018
195	2018-450	LD	Lobby	Finish ceiling	06/04/2018
196	2018-451	UD	Lobby	Rough walls	03/04/2018
197	2018-453	LD	Lobby	Door	13/04/2018
198	2018-454	-	-	-	03/04/2018
199	2018-457	-	-	-	03/04/2018
200	2018-458	MD	Main Saloon	Fixed restpoints	03/04/2018
201	2018-485	UD	Saloon&Dining	Groove base + finish ceiling	06/04/2018
202	2018-486	UD	Saloon&Dining	Finish walls	06/04/2018
203	2018-509	LD	Beach L/SPA/Hspt/Corridor	Finish floor	20/04/2018
204	2018-510	LD	Beach L/SPA/Hspt/Corridor	Finish floor	20/04/2018
205	2018-522	UD	Owners Area fr 89-108	Fixed restpoints	13/04/2018

Sinnex collies sending date					
Nr.	Collie	Deck	Area	Description	Sended date
206	2018-524	UD	Owners Area fr 80-88	Finish walls	18/04/2018
207	2018-547	UD	Owners Area fr 80-88	Furniture	18/04/2018
208	2018-550	All	All	Smoke detector	20/04/2018
209	2018-562	BD	Corridor/Lobby	Rough ceiling	20/04/2018
210	2018-566	LD	Beach L/SPA/Hspt/Corridor	Door	20/04/2018
210	2018-566	LD	Beachclub / Corridor	Door	20/04/2018
210	2018-566	BD	Corridor/Lobby	Door	20/04/2018
210	2018-566	LD	Lobby	Door	20/04/2018
210	2018-566	MD	Lobby	Door	20/04/2018
210	2018-566	UD	Lobby	Door	20/04/2018
210	2018-566	MD	Main Saloon	Door	20/04/2018
210	2018-566	UD	Owners Area fr 80-88	Door	20/04/2018
211	2018-573	LD	Beach L/SPA/Hspt/Corridor	Rough ceiling	20/04/2018
212	2018-578	UD	Saloon&Dining	Finish ceiling	02/05/2018
213	2018-595	BD	Corridor/Lobby	furniture	26/04/2018
213	2018-595	LD	Lobby	furniture	26/04/2018
213	2018-595	MD	Lobby	furniture	26/04/2018
213	2018-595	UD	Lobby	furniture	26/04/2018
214	2018-600	MD	Lobby	Door	02/05/2018
214	2018-600	MD	Main Saloon	Door	02/05/2018
215	2018-601	LD	Lobby	Furniture	16/05/2018
216	2018-602	LD	Beach L/SPA/Hspt/Corridor	Furniture	26/04/2018
216	2018-602	LD	Beachclub / Corridor	Furniture	26/04/2018
216	2018-602	UD	Lobby	Furniture	26/04/2018
216	2018-602	UD	Saloon&Dining	Furniture	26/04/2018
217	2018-644	UD	Owners Area fr 89-108	Finish walls	04/05/2018
218	2018-647	UD	Owners Area fr 80-88	Finish ceiling	09/05/2018
219	2018-664	-	-	-	09/05/2018
220	2018-672	UD	Owners Area fr 80-88	Furniture	08/06/2018
221	2018-673	UD	Lobby	Rough ceiling	22/05/2018
222	2018-677	MD	Lobby	Fixed restpoints	16/05/2018
223	2018-679	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	16/05/2018
223	2018-679	UD	Lobby	Fixed restpoints	16/05/2018
223	2018-679	MD	Main Saloon	Fixed restpoints	16/05/2018
224	2018-682	MD	Lobby	Floor templates nieuw	16/05/2018
224	2018-682	UD	Lobby	Floor templates nieuw	16/05/2018
225	2018-693	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	18/05/2018
225	2018-693	MD	Lobby	Fixed restpoints	18/05/2018
225	2018-693	UD	Lobby	Fixed restpoints	18/05/2018
225	2018-693	UD	Owners Area fr 89-108	Fixed restpoints	18/05/2018
226	2018-720	-	-	-	25/05/2018
227	2018-723	-	-	-	25/05/2018
228	2018-729	MD	Main Saloon	Rough walls	08/06/2018
229	2018-736	MD	Main Saloon	Furniture	04/06/2018
230	2018-737	MD	Main Saloon	rough walls	04/06/2018
231	2018-738	MD	Main Saloon	rough walls	04/06/2018
232	2018-739	MD	Main Saloon	rough walls	04/06/2018
233	2018-740	MD	Main Saloon	Milky edge	04/06/2018
234	2018-741	-	-	-	08/06/2018
235	2018-744	LD	Beach L/SPA/Hspt/Corridor	Door	08/06/2018
236	2018-745	LD	Lobby	Fixed restpoints	15/06/2018
236	2018-745	UD	Lobby	Fixed restpoints	15/06/2018
236	2018-745	UD	Saloon&Dining	Fixed restpoints	15/06/2018
237	2018-749	UD	Lobby	Furniture	07/06/2018
238	2018-756	LD	Beach L/SPA/Hspt/Corridor	ceiling panel	08/06/2018
238	2018-756	LD	Lobby	ceiling panel	08/06/2018
238	2018-756	UD	Lobby	Finish ceiling	08/06/2018
239	2018-757	MD	Lobby	Rough wall new	08/06/2018
240	2018-758	LD	Beach L/SPA/Hspt/Corridor	furniture	08/06/2018
241	2018-760	BD	Corridor/Lobby	Floor templates	08/06/2018
242	2018-767	BD	Corridor/Lobby	Rough walls	15/06/2018
243	2018-774	LD	Beach L/SPA/Hspt/Corridor	Rough walls	15/06/2018
244	2018-775	LD	Beach L/SPA/Hspt/Corridor	Rough ceiling	15/06/2018
245	2018-776	LD	Beach L/SPA/Hspt/Corridor	Rough walls	15/06/2018
246	2018-777	LD	Beach L/SPA/Hspt/Corridor	Rough walls	15/06/2018
247	2018-780	UD	Saloon&Dining	Door	06/07/2018
248	2018-781	BD	Corridor/Lobby	Finish ceiling	22/06/2018
249	2018-785	-	-	-	15/06/2018
250	2018-786	LD	Beach L/SPA/Hspt/Corridor	Finish walls	15/06/2018

Sinnex collies sending date					
Nr.	Collie	Deck	Area	Description	Sended date
251	2018-787	LD	Beach L/SPA/Hspt/Corridor	Rough walls	15/06/2018
252	2018-799	LD	Beach L/SPA/Hspt/Corridor	Rough ceiling +groove base	26/06/2018
253	2018-803	BD	Corridor/Lobby	Furniture	22/06/2018
253	2018-803	UD	Owners Area fr 80-88	Furniture	22/06/2018
254	2018-808	BD	Corridor/Lobby	Finish walls	22/06/2018
255	2018-810	UD	Owners Area fr 89-108	Rough Ceiling	21/06/2018
256	2018-813	all	all	door	22/06/2018
257	2018-818	UD	Owners Area fr 89-108	Rough walls	22/06/2018
258	2018-826	MD	Main Saloon	Finish walls	06/07/2018
259	2018-827	MD	Main Saloon	Finish walls	29/06/2018
260	2018-828	MD	Main Saloon	Finish walls	29/06/2018
261	2018-829	MD	Main Saloon	Furniture	29/06/2018
262	2018-830	MD	Main Saloon	Furniture	06/07/2018
263	2018-840	LD	Beach L/SPA/Hspt/Corridor	Rough walls	13/07/2018
264	2018-841	LD	Beach L/SPA/Hspt/Corridor	Rough ceiling + groove base	06/07/2018
265	2018-842	LD	Beach L/SPA/Hspt/Corridor	Rough walls	19/10/2018
265	2018-842	MD	Lobby	Rough walls	19/10/2018
265	2018-842	UD	Lobby	Rough walls	19/10/2018
266	2018-843	BD	Corridor/Lobby	Fixed restpoints	29/06/2018
266	2018-843	MD	Lobby	Fixed restpoints	29/06/2018
266	2018-843	UD	Owners Area fr 80-88	Fixed restpoints	29/06/2018
267	2018-848	MD	Main Saloon	Fixed restpoints	29/06/2018
267	2018-848	UD	Owners Area fr 80-88	Fixed restpoints	29/06/2018
268	2018-850	BD	Corridor/Lobby	Rough wall mirror	29/06/2018
268	2018-850	LD	Lobby	Rough wall mirror	29/06/2018
268	2018-850	MD	Lobby	Rough wall mirror	29/06/2018
268	2018-850	UD	Lobby	Rough wall mirror	29/06/2018
269	2018-853	-	-	-	06/07/2018
270	2018-857	UD	Lobby	Fixed restpoints	06/07/2018
270	2018-857	UD	Owners Area fr 80-88	Fixed restpoints	06/07/2018
270	2018-857	UD	Owners Area fr 89-108	Fixed restpoints	06/07/2018
271	2018-858	UD	Saloon&Dining	Finish ceiling	13/07/2018
272	2018-686	-	-	-	13/07/2018
273	2018-871	-	-	-	06/07/2018
274	2018-878	LD	Beach L/SPA/Hspt/Corridor	Groove base	06/07/2018
274	2018-878	BD	Corridor/Lobby	furniture	06/07/2018
274	2018-878	MD	Main Saloon	furniture	06/07/2018
274	2018-878	UD	Owners Area fr 80-88	furniture	06/07/2018
275	2018-879	UD	Lobby	furniture	11/07/2018
276	2018-882	LD	Beach L/SPA/Hspt/Corridor	Rough ceiling + groove base	13/07/2018
277	2018-885	UD	Owners Area fr 89-108	Rough ceiling	11/07/2018
278	2018-888	UD	Saloon&Dining	Door	13/07/2018
279	2018-896	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	20/07/2018
279	2018-896	UD	Saloon&Dining	Furniture	20/07/2018
280	2018-897	LD	Beach L/SPA/Hspt/Corridor	Door	13/07/2018
281	2018-898	LD	Beach L/SPA/Hspt/Corridor	Furniture	13/07/2018
281	2018-898	BD	Corridor/Lobby	Furniture	13/07/2018
281	2018-898	LD	Lobby	Furniture	13/07/2018
281	2018-898	MD	Lobby	Furniture	13/07/2018
281	2018-898	UD	Lobby	Furniture	13/07/2018
281	2018-898	MD	Main Saloon	Furniture	13/07/2018
281	2018-898	UD	Owners Area fr 80-88	Furniture	13/07/2018
281	2018-898	UD	Owners Area fr 89-108	Furniture	13/07/2018
282	2018-899	MD	Lobby	Rough ceiling	13/07/2018
283	2018-901	UD	Owners Area fr 89-108	Finish walls	16/07/2018
284	2018-912	LD	Beach L/SPA/Hspt/Corridor	Door	20/07/2018
284	2018-912	LD	Lobby	Door	20/07/2018
284	2018-912	MD	Lobby	Rough ceiling + door	20/07/2018
284	2018-912	UD	Lobby	Rough ceiling + door	20/07/2018
285	2018-916	MD	Main Saloon	Finish walls	20/07/2018
286	2018-918	UD	Saloon&Dining	Furniture	20/07/2018
287	2018-919	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	20/07/2018
287	2018-919	MD	Lobby	Fixed restpoints	20/07/2018
287	2018-919	UD	Saloon&Dining	Fixed restpoints	20/07/2018
288	2018-925	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	07/09/2018
288	2018-925	LD	Lobby	Fixed restpoints	07/09/2018
289	2018-929	LD	Beach L/SPA/Hspt/Corridor	Floor templates	27/01/2018
290	2018-931	UD	Lobby	Fixed restpoints	17/08/2018
291	2018-934	UD	Owners Area fr 89-108	Fixed restpoints	27/01/2018

Sinnex collies sending date					
Nr.	Collie	Deck	Area	Description	Sended date
292	2018-938	UD	Saloon&Dining	Fixed restpoints	27/01/2018
293	2018-941	UD	Lobby	Door	24/08/2018
293	2018-941	UD	Saloon&Dining	Door	24/08/2018
294	2018-943	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	17/08/2018
294	2018-943	BD	Corridor/Lobby	Fixed restpoints	17/08/2018
294	2018-943	LD	Lobby	Fixed restpoints	17/08/2018
294	2018-943	MD	Lobby	Fixed restpoints	17/08/2018
294	2018-943	UD	Lobby	Fixed restpoints	17/08/2018
295	2018-945	LD	Beach L/SPA/Hspt/Corridor	Door	17/06/2018
296	2018-952	UD	Lobby	Finish walls	03/09/2018
296	2018-952	UD	Owners Area fr 89-108	Finish walls	03/09/2018
297	2018-953	MD	Main Saloon	Furniture	07/09/2018
298	2018-954	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	07/09/2018
299	2018-960	LD	Beach L/SPA/Hspt/Corridor	Furniture	19/10/2018
300	2018-973	-	-	-	24/08/2018
301	2018-974	UD	Owners Area fr 89-108	Furniture	24/08/2018
302	2018-975	UD	Lobby	Finish walls	24/08/2018
303	2018-976	UD	Lobby	Finish walls	24/08/2018
304	2018-978	LD	Beachclub / Corridor	Finish floor	31/08/2018
305	2018-992	-	-	-	26/09/2018
306	2018-993	LD	Beach L/SPA/Hspt/Corridor	Furniture	28/08/2018
306	2018-993	MD	Main Saloon	Furniture	28/08/2018
306	2018-993	UD	Owners Area fr 80-88	Furniture	28/08/2018
306	2018-993	UD	Owners Area fr 89-108	Furniture	28/08/2018
307	2018-997	LD	Beach L/SPA/Hspt/Corridor	Furniture	17/09/2018
308	2019-003	LD	Beach L/SPA/Hspt/Corridor	Finish walls	11/01/2019
309	2019-009	-	-	-	11/01/2019
310	2019-028	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	18/01/2019
310	2019-028	LD	Beachclub / Corridor	Fixed restpoints	18/01/2019
310	2019-028	MD	Lobby	Fixed restpoints	18/01/2019
310	2019-028	MD	Main Saloon	Fixed restpoints	18/01/2019
310	2019-028	UD	Owners Area fr 89-108	Fixed restpoints	18/01/2019
311	2019-029	LD	Beach L/SPA/Hspt/Corridor	Finish walls	18/01/2019
312	2019-030	UD	Owners Area fr 89-108	Fixed restpoints	18/01/2019
313	2019-041	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	23/01/2019
313	2019-041	LD	Beachclub / Corridor	Fixed restpoints	23/01/2019
313	2019-041	MD	Lobby	Fixed restpoints	23/01/2019
313	2019-041	UD	Owners Area fr 89-108	Fixed restpoints	23/01/2019
314	2019-051	LD	Beach L/SPA/Hspt/Corridor	Milky edge	23/01/2019
315	2019-056	UD	Owners Area fr 80-88	Fixed restpoints	28/01/2019
316	2019-057	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	28/01/2019
316	2019-057	MD	Lobby	Fixed restpoints	28/01/2019
316	2019-057	UD	Owners Area fr 89-108	Fixed restpoints	28/01/2019
316	2019-057	UD	Saloon&Dining	Fixed restpoints	28/01/2019
317	2019-061	UD	Owners Area fr 80-88	Fixed restpoints	28/01/2019
318	2019-071	MD	Lobby	Fixed restpoints	05/02/2019
318	2019-071	UD	Owners Area fr 89-108	Fixed restpoints	05/02/2019
319	2019-082	LD	Beach L/SPA/Hspt/Corridor	furniture	12/02/2019
319	2019-082	LD	Beachclub / Corridor	furniture	12/02/2019
320	2018-1111	LD	Beach L/SPA/Hspt/Corridor	Furniture	09/11/2018
320	2018-1111	BD	Corridor/Lobby	Furniture	09/11/2018
320	2018-1111	MD	Lobby	Furniture	09/11/2018
320	2018-1111	UD	Lobby	Furniture	09/11/2018
320	2018-1111	MD	Main Saloon	Furniture	09/11/2018
320	2018-1111	UD	Owners Area fr 80-88	Furniture	09/11/2018
320	2018-1111	UD	Owners Area fr 89-108	Furniture	09/11/2018
321	2018-1115	UD	Owners Area fr 89-108	Furniture	21/09/2018
322	2018-1117	UD	Saloon&Dining	Finish ceiling	26/09/2018
323	2018-1121	LD	Beach L/SPA/Hspt/Corridor	Rough walls	24/09/2018
324	2018-1123	UD	Saloon&Dining	Rough walls	21/09/2018
325	2018-1125	MD	Main Saloon	Fixed restpoints	21/09/2018
325	2018-1125	UD	Owners Area fr 89-108	Fixed restpoints	21/09/2018
326	2018-1126	-	-	-	21/09/2018
327	2018-1130	-	-	-	21/09/2018
328	2018-1133	LD	Beach L/SPA/Hspt/Corridor	Door	24/09/2018
329	2018-1134	BD	Corridor/Lobby	Furniture	26/09/2018
329	2018-1134	UD	Lobby	Furniture	26/09/2018
330	2018-1135	LD	Beach L/SPA/Hspt/Corridor	Rough walls	26/09/2018
330	2018-1135	LD	Beachclub / Corridor	Rough walls	26/09/2018

Sinnex collies sending date					
Nr.	Collie	Deck	Area	Description	Sended date
331	2018-1136	LD	Beach L/SPA/Hspt/Corridor	Finish walls	26/09/2018
331	2018-1136	LD	Beachclub / Corridor	Finish walls	26/09/2018
332	2018-1139	MD	Main Saloon	Furniture	26/09/2018
332	2018-1139	UD	Owners Area fr 80-88	Furniture	26/09/2018
332	2018-1139	UD	Owners Area fr 89-108	Furniture	26/09/2018
333	2018-1140	MD	Main Saloon	Furniture	26/09/2018
334	2018-1148	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	02/10/2018
335	2018-1150	LD	Beach L/SPA/Hspt/Corridor	Furniture	05/10/2018
335	2018-1150	MD	Main Saloon	Furniture	05/10/2018
335	2018-1150	UD	Owners Area fr 89-108	Furniture	05/10/2018
336	2018-1151	LD	Beach L/SPA/Hspt/Corridor	Finish walls	02/10/2018
337	2018-1152	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	05/10/2018
337	2018-1152	LD	Beachclub / Corridor	Finish walls	05/10/2018
338	2018-1154	-	-	-	05/10/2018
339	2018-1155	MD	Main Saloon	Fixed restpoints	05/10/2018
340	2018-1158	BD	Corridor/Lobby	Finish walls	05/10/2018
341	2018-1159	MD	Main Saloon	Finish walls	05/10/2018
342	2018-1160	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	05/10/2018
342	2018-1160	LD	Beachclub / Corridor	Fixed restpoints	05/10/2018
342	2018-1160	MD	Lobby	Fixed restpoints	05/10/2018
342	2018-1160	UD	Lobby	Fixed restpoints	05/10/2018
343	2018-1161	UD	Lobby	Finish walls	05/10/2018
344	2018-1162	UD	Lobby	Fixed restpoints	05/10/2018
345	2018-1163	UD	Saloon&Dining	Fixed restpoints	05/10/2018
346	2018-1164	LD	Beachclub / Corridor	Fixed restpoints	05/10/2018
347	2018-1166	-	-	-	05/10/2018
348	2018-1172	MD	Main Saloon	Fixed restpoints	05/10/2018
348	2018-1172	UD	Saloon&Dining	Fixed restpoints	05/10/2018
349	2018-1174	MD	Main Saloon	Finish walls	12/10/2018
350	2018-1176	MD	Main Saloon	Finish walls	11/10/2018
351	2018-1177	UD	Lobby	furniture	12/10/2018
351	2018-1177	MD	Main Saloon	furniture	12/10/2018
351	2018-1177	UD	Owners Area fr 80-88	furniture	12/10/2018
351	2018-1177	UD	Owners Area fr 89-108	Floor templates	12/10/2018
352	2018-1184	LD	Beach L/SPA/Hspt/Corridor	Door	12/10/2018
352	2018-1182	UD	Owners Area fr 89-108	Fixed restpoints	12/10/2018
353	2018-1186	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	12/10/2018
353	2018-1186	LD	Beachclub / Corridor	Fixed restpoints	12/10/2018
353	2018-1186	BD	Corridor/Lobby	Fixed restpoints	12/10/2018
353	2018-1186	MD	Lobby	Fixed restpoints	12/10/2018
353	2018-1186	UD	Lobby	Fixed restpoints	12/10/2018
353	2018-1186	MD	Main Saloon	Fixed restpoints	12/10/2018
353	2018-1186	UD	Saloon&Dining	Fixed restpoints	12/10/2018
354	2018-1191	UD	Owners Area fr 89-108	Finish walls	06/11/2018
355	2018-1192	LD	Lobby	furniture	19/10/2018
355	2018-1192	MD	Main Saloon	furniture	19/10/2018
355	2018-1192	UD	Saloon&Dining	furniture	19/10/2018
356	2018-1193	UD	Saloon&Dining	furniture	12/10/2018
357	2018-1196	MD	Lobby	Fixed restpoints	12/10/2018
357	2018-1196	UD	Lobby	Fixed restpoints	12/10/2018
358	2018-1197	MD	Main Saloon	Finish floor	12/10/2018
358	2018-1197	UD	Owners Area fr 80-88	Finish floor	12/10/2018
358	2018-1197	UD	Owners Area fr 89-108	Finish floor	12/10/2018
358	2018-1197	UD	Saloon&Dining	Finish floor	12/10/2018
359	2018-1199	MD	Lobby	Finish walls	19/10/2018
360	2018-1202	LD	Beach L/SPA/Hspt/Corridor	Finish walls	19/10/2018
361	2018-1203	LD	Beachclub / Corridor	Finish walls	19/10/2018
362	2018-1204	MD	Lobby	furniture	19/10/2018
362	2018-1204	MD	Main Saloon	furniture	19/10/2018
363	2018-1205	LD	Beach L/SPA/Hspt/Corridor	Door	19/10/2018
364	2018-1208	UD	Owners Area fr 89-108	Finish walls	19/10/2018
365	2018-1209	MD	Main Saloon	Fixed restpoints	25/10/2018
366	2018-1215	LD	Beach L/SPA/Hspt/Corridor	Door	25/10/2018
367	2018-1220	UD	Lobby	Furniture	09/11/2018
367	2018-1220	UD	Owners Area fr 80-88	Furniture	09/11/2018
367	2018-1220	UD	Owners Area fr 89-108	Furniture	09/11/2018
368	2018-1222	UD	Owners Area fr 89-108	Finish walls	26/11/2018
369	2018-1225	LD	Beachclub / Corridor	Finish walls	01/02/2019
370	2018-1226	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	01/02/2019

Sinnex collies sending date					
Nr.	Collie	Deck	Area	Description	Sended date
370	2018-1226	MD	Lobby	Fixed restpoints	01/02/2019
370	2018-1226	MD	Main Saloon	Fixed restpoints	01/02/2019
370	2018-1226	UD	Owners Area fr 80-88	Fixed restpoints	01/02/2019
370	2018-1226	UD	Owners Area fr 89-108	Fixed restpoints	01/02/2019
371	2018-1228	UD	Owners Area fr 89-108	Finish walls	16/11/2018
372	2018-1229	UD	Owners Area fr 89-108	Finish walls + floor	16/11/2018
373	2018-1234	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	19/11/2018
373	2018-1234	LD	Beachclub / Corridor	Fixed restpoints	19/11/2018
373	2018-1234	LD	Lobby	Fixed restpoints	19/11/2018
373	2018-1234	MD	Lobby	Fixed restpoints	19/11/2018
373	2018-1234	MD	Main Saloon	Fixed restpoints	19/11/2018
374	2018-1239	UD	Owners Area fr 89-108	Finish walls	22/11/2018
375	2018-1241	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	19/11/2018
376	2018-1244	UD	Lobby	Furniture	22/11/2018
377	2018-1245	LD	Beach L/SPA/Hspt/Corridor	Fixed restpoints	22/11/2018
377	2018-1245	MD	Lobby	Fixed restpoints	22/11/2018
378	2018-1252	UD	Owners Area fr 89-108	Furniture	23/11/2018
379	2018-1253	UD	Owners Area fr 89-108	Finish walls	23/11/2018
380	2018-1254	UD	Owners Area fr 89-108	Finish walls	23/11/2018
381	2018-1257	UD	Owners Area fr 89-108	Finish walls	23/11/2018
382	2018-1258	UD	Owners Area fr 89-108	Furniture	26/11/2018
383	2018-1260	UD	Owners Area fr 89-108	Fixed restpoints	28/11/2018
384	2018-1261	UD	Owners Area fr 89-108	Furniture	28/11/2018
385	2018-1262	LD	Beach L/SPA/Hspt/Corridor	ceiling panel	28/11/2018
385	2018-1262	MD	Lobby	Finish walls	28/11/2018
385	2018-1262	MD	Main Saloon	Finish walls	28/11/2018
385	2018-1262	UD	Owners Area fr 89-108	Finish walls	28/11/2018
386	2018-1272	UD	Saloon&Dining	Fixed restpoints	03/12/2018
387	2018-1273	LD	Beachclub / Corridor	Fixed restpoints	03/12/2018
387	2018-1273	UD	Lobby	Fixed restpoints	03/12/2018
387	2018-1273	MD	Main Saloon	Fixed restpoints	03/12/2018
388	2018-1288	UD	Owners Area fr 89-108	Furniture	07/12/2018
389	2018-1290	MD	Lobby	Furniture	07/12/2018
389	2018-1290	MD	Main Saloon	Furniture	07/12/2018
390	2018-1291	UD	Owners Area fr 89-108	Furniture	07/12/2018
391	2018-1301	MD	Main Saloon	Finish walls	14/12/2018

List collies sending date				
Room number	Item	Mass [kg]	Sended date	Description
36004	Unterkonstruktion Lower Deck Teil 2+3	714	22/05/2017	Unterkonstruktion-Wand Holz
36004	Unterkonstruktion Lower Deck 1 +Corridor	551	22/05/2017	Unterkonstruktion-Wand Holz
36004	Unterkonstruktion Main Deck	627	22/05/2017	Unterkonstruktion-Wand Holz
36004	UK Wand 3-513 und 3-514	314	29/09/2017	Unterkonstruktion-Wand Holz
36004	UK Wand 3-513 und 3-514	487	29/09/2017	Unterkonstruktion-Wand Holz
5-315	UK Wand	454	29/09/2017	Unterkonstruktion-Wand Holz
5-315	UK Wand	303	29/09/2017	Unterkonstruktion-Wand Holz
36004	6 Stk.Sperrholzplatten schwarz lackiert	92	15/11/2017	Unterkonstruktion-Wand Holz
5-401	Wand UK Captians Cabin 2500x1040x470mm	265	15/11/2017	Unterkonstruktion-Wand Holz
5-404	Wand und Decken Uk,Lüftungsboxen 2290x1290x920mm	419	22/11/2017	Unterkonstruktion-Wand Holz
5-403	Wand und Decken UK Bathroom und Shower 2290x1290x720mm	416	22/11/2017	Unterkonstruktion-Wand Holz
5-784	784 Day Head UK Wand und Decke, LÜ Box	215	01/12/2017	Unterkonstruktion-Wand Holz
5-329	Pantry / UK Wand und Decke, LÜ Box	217	01/12/2017	Unterkonstruktion-Wand Holz
5-315	Wheelhouse Pultunterkonstuktion	215	01/12/2017	Unterkonstruktion-Wand Holz
5-001	Wand und Decken UK +Randleisten	202	05/12/2017	Unterkonstruktion-Wand Holz
3-743	Wand Uk	517	05/12/2017	Unterkonstruktion-Wand Holz
3-744	Wand UK	442	05/12/2017	Unterkonstruktion-Wand Holz
5-492	Wand und Decken UK,Lüftungsboxen	400	05/12/2017	Unterkonstruktion-Wand Holz
36004	50 lfm Montageleisten 40x30	28	15/12/2017	Unterkonstruktion-Wand Holz
36004	50 lfm Montageleisten 40x40	49	15/12/2017	Unterkonstruktion-Wand Holz
36004	8 Bullaugenschablonen	38	15/12/2017	Unterkonstruktion-Wand Holz
36004	Sperrholzstreifen weiß lackiert Wand Uk, Leisten für Ropelights ,Sanitär UK	350	07/02/2018	Unterkonstruktion-Wand Holz
36004	1 Sanitär UK Platte mit Unterputzteil	22	07/03/2018	Unterkonstruktion-Wand Holz
	Einbaurahmen Captains Cabin Door	10	14/03/2018	Unterkonstruktion-Wand Holz
36004	30 lfm UK Leisten in Tulip Massivholz Ral 9010 40x40mm	25	13/06/2018	Unterkonstruktion-Wand Holz
36004	30 lfm Uk Leisten Tulip Massivholz ral 9010 30x30	15	13/06/2018	Unterkonstruktion-Wand Holz
36004	Sperrholzplatten weiß lackiert	35	10/10/2018	Unterkonstruktion-Wand Holz
36004	schwarze Platten,Speigel,TGH Sanitärteile,Relinge 2.0,Turnstyle Griffe	168	17/10/2018	Unterkonstruktion-Wand Holz
36004	350 lfm HPl Streifen weiß	31	31/01/2019	Unterkonstruktion-Wand Holz
36004	1482lfm Winkel 60x20,40x20,30x25 3000mm	953	25/07/2017	Unterkonstruktion-Wand Metall
36004	MBM Wände	900	25/07/2017	Unterkonstruktion-Wand Metall
36004	MBM Wände	900	25/07/2017	Unterkonstruktion-Wand Metall
36004	MBM Wände	900	25/07/2017	Unterkonstruktion-Wand Metall
36004	MBM Wände	1.800,00	25/07/2017	Unterkonstruktion-Wand Metall
36004	MBM Wände	600	25/07/2017	Unterkonstruktion-Wand Metall
36004	Profile für MBM Wände	1.022,00	25/07/2017	Unterkonstruktion-Wand Metall
36004	B 15 door Alu Rahmen weiß lackiert	118	29/09/2017	Unterkonstruktion-Wand Metall
36004	6 Alu Core Platten Vip Corridor und Vip Cabin	59	29/09/2017	Unterkonstruktion-Wand Metall
36004	Wand UK Metall Wheelhouse AFT, Alu Profile	200	13/10/2017	Unterkonstruktion-Wand Metall
36004	5 Stk.Alucoreplatten	120	17/10/2017	Unterkonstruktion-Wand Metall
36004	Uk Metall schwarz lackiert	134	15/11/2017	Unterkonstruktion-Wand Metall
36004	Alu Corre Platten	128	15/11/2017	Unterkonstruktion-Wand Metall
36004	6 Stk Einbaurahmen Weiß	410	01/12/2017	Unterkonstruktion-Wand Metall
5-315	Wheelhouse Alu Core gefräst	201	01/12/2017	Unterkonstruktion-Wand Metall
36004	30 Formrohre 40x20x3000mm	60	05/12/2017	Unterkonstruktion-Wand Metall
36004	40 Formrohre 40x20,80x20 3000mm,20 Winkel 30x20x3000mm	104	15/12/2017	Unterkonstruktion-Wand Metall
36004	1 Duschsitz UK	14	03/04/2018	Unterkonstruktion-Wand Metall
36004	2 UK schwarz lackiert	34	25/09/2018	Unterkonstruktion-Wand Metall
36004	Sub Woofer Befestigungen	10	01/10/2018	Unterkonstruktion-Wand Metall
36004	UK Decke 3-515,3-516	532	25/07/2017	Unterkonstruktion-Decke Holz
3-515	3-515 VIP Cabin 1 STB / 3-516 VIP Bathroom 1 STB	260	06/09/2017	Unterkonstruktion-Decke Holz
3-515	3-515 VIP Cabin 1 STB / 3-516 VIP Bathroom 1 STB	495	06/09/2017	Unterkonstruktion-Decke Holz
5-315	Bridge Wheelhouse Lüftungsbox	473	06/09/2017	Unterkonstruktion-Decke Holz
5-315	Bridge Wheelhouse Lüftungsbox	722	06/09/2017	Unterkonstruktion-Decke Holz
36004	UK Decke 3-513,3-514	512	29/09/2017	Unterkonstruktion-Decke Holz
2-510	Decken Uk 2200x1050x650mm	232	15/11/2017	Unterkonstruktion-Decke Holz
2-512	Decken Uk 2200x1050x650mm	232	15/11/2017	Unterkonstruktion-Decke Holz
2-742	Decken Uk 2500x1250x1150mm	460	15/11/2017	Unterkonstruktion-Decke Holz
5-401	UK Decke Captains Cabin,Lüftungsboxen Captains Cabin und Captains Bath 2340x1040x920mm	275	15/11/2017	Unterkonstruktion-Decke Holz
3-743	Decken Uk 2540x940x1350mm	334	22/11/2017	Unterkonstruktion-Decke Holz
36004	Decken Uk 3-744 und 3-781 2540x940x1450mm	333	22/11/2017	Unterkonstruktion-Decke Holz
36004	Fancoil Boxen PS1/S+B 1 1940x840x820mm	150	01/12/2017	Unterkonstruktion-Decke Holz
36004	Lüftungsboxen	100	07/02/2018	Unterkonstruktion-Decke Holz
36004	Einhängleisten 3000mm,Einhängleisten 150mm	782	15/12/2017	Unterkonstruktion-Decke Metall
36004	Alu Winkel und Flachstangen	84	07/02/2018	Unterkonstruktion-Decke Metall
36004	Alu Formrohre	25	07/02/2018	Unterkonstruktion-Decke Metall
36004	Decken Einhängleisten 135mm	43	27/02/2018	Unterkonstruktion-Decke Metall
36004	20 Alu Formrohre 40x20 3000mm	35	27/02/2018	Unterkonstruktion-Decke Metall
36004	Alu Winkel,Einhängleisten	180	21/03/2018	Unterkonstruktion-Decke Metall
36004	Formrohre und Winkel 3000mm	150	03/04/2018	Unterkonstruktion-Decke Metall
5-315	Wand Sofafront rechts und links 2340x1200x970mm	230	07/03/2018	Wand
5-315	FWD Lederpaneele,Sofateile	488	03/04/2018	Wand
3-515	1 Blende Pos.3 für Wände	17	23/04/2018	Wand
3-515	Gebogene Wände	217	23/04/2018	Wand
36004	Schwarze Laminatplatten	352	07/05/2018	Wand
36004	Swarovski Paneele	176	15/05/2018	Wand

List collies sending date				
Room number	Item	Mass [kg]	Sended date	Description
36004	Wheelhouse Pult Deko Teile,Verkleidungen,Schlagleisten,Stufenprofile,Schablonen,Kleinteile	599	15/05/2018	Wand
3-513	Wände	509	29/05/2018	Wand
2-742	3 Kisten mit Artwork Wandpaneele Helen Amy LD Corridor	281	29/05/2018	Wand
5-401	Decorative wall	249	07/06/2018	Wand
5-404	Dekorative Wand, und Möbel	425	07/06/2018	Wand
36004	Stair & Lobby + Aluwinkel	570	20/06/2018	Wand
5-329	Küche PS,Unterschrank,Oberschrank,Hochschrank,Wandverkleidung	364	04/07/2018	Wand
36004	2x Lederteile Crew Office / 2x Lederteile Pantry	124	29/08/2018	Wand
36004	14 Ladenfronten PL, 8 Stk Friese PL, 2Stk Gläser BRD	160	03/09/2018	Wand
36004	Leder Wandpaneele Stitching 3-743,3-744 Corridor	450	29/01/2019	Wand
5-315	Wheelhouse Sichtdecke Kranz	482	15/12/2017	Decke
5-315	Wheelhouse Sichtdecke Dom	322	15/12/2017	Decke
5-315	Decke 2600x880x460mm	142	12/01/2018	Decke
36004	Sichtdecke 3-513 und 3-514	408	12/01/2018	Decke
36004	Sichtdecke 3-515, 3-516, 3-781	428	12/01/2018	Decke
36004	Sichtdecke tapezierungen 3-515,3-513 Vip Cabin	212	07/02/2018	Decke
36004	Sichtdecke 3-743 und 3-744 Vip Corridor AFT/FWD	436	07/02/2018	Decke
5-001	Sichtdecke 1740x940x530mm	100	20/02/2018	Decke
5-329	Sictdecke 1290x1240x420mm	88	20/02/2018	Decke
36004	Sichtdecke Crew Office,Captains office,Cabtains Cabin, 2240x1240x1520mm	614	20/02/2018	Decke
5-784	UK Decke 1640x740x420mm	69	20/02/2018	Decke
5-403	Sichtdecke 1190x1240x520mm	96	20/02/2018	Decke
36004	Sichtdecke tapezierungen neu 3-515 und 3-513	212	27/02/2018	Decke
5-401	Decke Deko	219	23/04/2018	Decke
5-315	Alcantara Decke Wheelhouse	99	17/05/2018	Decke
5-001	Decke BD Stair Case	98	02/08/2018	Decke
5-001	Decke BD Stair Case	432	02/08/2018	Decke
36004	3 Metallschränke, Regal für Baustelleneinrichtung z.Hd.hr.Miklautz	630	07/07/2017	Möblierung
36004	Mustertafeln	345	25/07/2017	Möblierung
36004	100lfm Montageleisten	10	22/11/2017	Möblierung
5-315	Schrank 2 und 3	290	13/02/2018	Möblierung
5-315	Schrank 4	238	13/02/2018	Möblierung
36004	Unterputzteile,Randleiste,Aufkantungen,Einbauringe	35	07/03/2018	Möblierung
	Bahthroom Vanities und Spiegelrückwände für 3-516 / 3-514	456	14/03/2018	Möblierung
36004	2 Bathroom Schränke 3-516,3-514	102	21/03/2018	Möblierung
36004	18 schwarze Laminatplatten 20mm	227	21/03/2018	Möblierung
5-315	Charttable,lederpaneele Fenster,Sofa,Wall+Sofafront	536	03/04/2018	Möblierung
5-315	Lederpaneele Fenster,Wall+Sofafront,Sofa li+re	542	03/04/2018	Möblierung
3-515	Wardrobe Schränke inkl.Wände	594	23/04/2018	Möblierung
36004	Wardrobe Schränke inklWände Vip Cabin 1,Deckenteile Vip Corridor,Ladenfronten Vip Bath 1+2	471	23/04/2018	Möblierung
36004	Schrank+Lederaufsatz Charttable	411	23/04/2018	Möblierung
36004	1 Charttabe Platte	39	07/05/2018	Möblierung
36004	Spiegelober und Unterschränke,Fächer,Kabelübergänge VIP Bathroom 1+2	231	07/05/2018	Möblierung
5-315	Wheelhouse Pult	152	17/05/2018	Möblierung
5-315	Wheelhouse Lederpaneele, Bedienfeld	228	23/05/2018	Möblierung
5-784	Deyhead Bath WC	264	23/05/2018	Möblierung
5-403	Wände,Möbel Dekorativ Captains Bathroom	343	23/05/2018	Möblierung
36004	Bettwand Rahmen 3-513,3-515,Wönde W 1 3-744,Fensterwinke und Blind Liesten 3-743	351	23/05/2018	Möblierung
3-513	Schrank für TV List inkl.UK.1 TV Lift	318	29/05/2018	Möblierung
5-401	Captians Cabin Möbel 2140x1240x1320 mm	439	29/05/2018	Möblierung
5-401	Captains Cabin Möbel 2140x660x1400mm	221	29/05/2018	Möblierung
5-784	1 washing table	60	07/06/2018	Möblierung
5-315	Wheelhousesofa Tischfuß,Carbon Säulen	87	07/06/2018	Möblierung
5-315	Wheelhouse Sofa Teile	167	07/06/2018	Möblierung
36004	Fitlock,Magnete,Leder für Samo Fiddle Rails,Capt.Office Rest,Wheelhouse Flag,Schrank 3,Sofa Lehne,Chartable Lederfront	467	13/06/2018	Möblierung
36004	Captains Cabin Rest,Spiegel captains bath,Türstöcke	242	13/06/2018	Möblierung
5-315	Wheelhouse Fronten	931	06/07/2018	Möblierung
5-401	Captains Cabin Bett	439	18/07/2018	Möblierung
36004	1 Design und Comfort mock Up in Weißpolster	190	27/07/2018	Möblierung
36004	Captains Bett Fronten,Wardrobe Fronten,Handläufe,PL Paneel,MMM Teile,Sanitärteile,Beschläge	485	27/07/2018	Möblierung
36004	Fensteranschlüsse VIP cabin 1 und Aft Corridor,Sockel rep.FWD Corridor	354	27/07/2018	Möblierung
5-329	Pantry fehlende Teile	154	20/08/2018	Möblierung
3-513	2 STk Nachkästchen 3-513 VIP Cabin 2 / 2 Stk Nachtkästchen 3-515 VIP Cabin 1	173	24/08/2018	Möblierung
3-513	Bettelement mit Tapezierungen und UK 3-515 VIP Cabin 1 und 3-513 VIP Cabin 2	582,5	24/08/2018	Möblierung
	10 Stk Innenladen 3-515 u 3-313 / 12 Stk Türl tapez L67 , 2 Stk Bl. tapez. L67 u. Beschlägek. 3-743	188	24/08/2018	Möblierung
5-492	Crew office Möblierung 2640x1440x1440mm	677	24/08/2018	Möblierung

List collies sending date				
Room number	Item	Mass [kg]	Sended date	Description
36004	Türaufdopplungen,Pushbutton,Türen,Sichtdecke Lederpaneelke,Steintür,Cable Tray,Türdrücker	265	14/09/2018	Möblierung
36004	1 Bettrahmen,1 Niesche SF B16 Lower Deck Guest Cabin	210	14/09/2018	Möblierung
36004	4 Matratzen	840	25/09/2018	Möblierung
36004	3 Matratzen,PTop PAD,Bed Bridges	590	25/09/2018	Möblierung
36004	Facettenspiegel 3-781,Waschbecken 3-781,Sockelblenden 3-743,Schubladen,Schiebetür,Spiegeltür bathroom alles 3-515	395	25/09/2018	Möblierung
5-401	Rahmen	310	25/09/2018	Möblierung
36004	Türstock Ca.office+Riegel Ahor,2 Glastüren WH,Pantry Tür Waschbecken,2 Capt.Office Türen,Dayhead Tür	309	03/10/2018	Möblierung
5-315	2 Fensterrahmen für Wheelhouse Tür	32	03/10/2018	Möblierung
36004	1 Lederpaneel,Kleinteile,Muster,1 Spiegel mit Spiegelheizung	209	25/10/2018	Möblierung
36004	5 Rollen Vlies,1 Reading light ,1 Tursülle,36 Fensteraussteifungen	110	29/10/2018	Möblierung
36004	2 Matratzen	274	07/11/2018	Möblierung
36004	Oberflächen Muster freigabe,2 Handläufe,Klebebänder,Griffe nachtkästen,Ladenkeile	241	07/11/2018	Möblierung
36004	2 TV Möbel Guest Cabin 3+6,3 Blenden in W01 bei Fenster 3-743 AFT Corridor	273	07/11/2018	Möblierung
36004	Paneele,Beschläge,Sanitärteile,	241	12/11/2018	Möblierung
36004	Nachträge,blenden,Deckenpanel	70	28/11/2018	Möblierung
36004	Metallleisten,Leiste	2	03/12/2018	Möblierung
36004	Wandverkleidungen,Night Stand Einlagen,	47	03/12/2018	Möblierung
36004	3 TV Lift Fronten,6 Ausgleichsbeschläge Plano	130	03/12/2018	Möblierung
3-743	2 A Tür Klappen umgebaut in W01	8	03/12/2018	Möblierung
36004	Night Srand Einlagen,Duschtürbänder,Deckenfeld,A Türen Klappen,Lüftungsgitter,Seafastening	219	10/12/2018	Möblierung
36004	Schränke,Wand und Decke,Spiegel,Glasfächer für Storage 4-839	710	08/01/2019	Möblierung
36004	4 Spiegel,Paneele,Montagematerial,Beschläge	500	08/01/2019	Möblierung
3-513	Sichtwände in W20,3 Rollen Vlies,1 Paket	510	09/01/2019	Möblierung
36004	Deckenfeld,GMDSS Paneel,Zedernleisten,	83	18/01/2019	Möblierung
36004	Stockverkleidung,reserve Material ,schwarze Leisten,Lackdose,Metallleisten	83	18/01/2019	Möblierung
36004	3 Wheelhouse AFT Stege,BodenführungmDrechstangenabdeckungen,Metallwinkel,2Spiegel	150	29/01/2019	Möblierung
36004	Blenden,Reisingerverklesiung,Pultverkleidung,Sofaplatten,Bodenführungen,Carbonsockel Beschläge	211	29/01/2019	Möblierung
36004	Laden für Wardrobeschränke,6 Streifen Birds Eye zwischen blinds	222	06/02/2019	Möblierung
36004	Lederteile für Wardrobe Cip Cabin 2	92	06/02/2019	Möblierung
36004	Laden für Wardrobeschränke,Techniktür,Leisten Schiebetür,kleine Laden,Fugelleisten Wardrobe	246	06/02/2019	Möblierung
36004	Div.Kleinteile für Y 718 LUX,716 LUX/716 Crew	155	06/02/2019	Möblierung
36004	Türstock, Musterplatten ,Leder, div.Kleinteile,Beschläge	136	08/02/2019	Möblierung
36004	4 Duschwannen	152	07/03/2018	Möblierung Metall
36004	3 Duschtassen	135	15/05/2018	Möblierung Metall
36004	Niro leisten MD Vip Bath 1+2	30	04/07/2018	Möblierung Metall
36004	Lautsprechergitter	63	18/07/2018	Möblierung Metall
36004	Metallleisten bathrooms	15	10/10/2018	Möblierung Metall
36004	Diverse Nachträge	234	26/11/2018	Lose Möblierung
36004	LED	2	12/09/2018	Beleuchtung
36004	Sanitärteile	109	21/03/2018	Sanitär
36004	2 Badewannen,10 Duschtassenklappen	251	03/04/2018	Sanitär
36004	HansGrohe Sanitärteile	49	13/06/2018	Sanitär
36004	Sherley Wagner Sanitär Deko,Bidet,Lautsprecher james QX1010,Push Buttons	155	04/07/2018	Sanitär
36004	Dornbracht Sanitär Acces.	10	10/10/2018	Sanitär
36004	3 Karton Sherley Wagner Sanitätteile	74	19/11/2018	Sanitär
36004	8 Safe	139	20/06/2018	Safe
	Siebdruckplatten zum Auslegen	152	14/03/2018	Boden Holz
36004	Fußboden Nuss 5-404,5-492,5-329,5-001 Montagematerial	640	10/10/2018	Boden Holz
36004	Fußboden Nuß,Reserveteile ud Monatgematerial	819	10/10/2018	Boden Holz
36004	Bodenschablonen BD,Lacke,Härter	280	19/07/2017	Boden Sperrholz
36004	Bodenschablonen Wheelhouse	383	18/08/2017	Boden Sperrholz
36004	Schwarzes und weißes Laminat,Sperrhiolzplatten beidseitig lackiert	242	03/04/2018	Boden Sperrholz
36004	200lfm Sperrholzstreifen,UK Sperrholzplatten weiß lackiert,Glaseinfassungen Lower Deck	304	07/06/2018	Boden Sperrholz
36004	Duschtürdichtungen	2	25/09/2018	Boden Gummi
36004	Türen,Türaufdopplungen gesamt 6 Edelstahlleisten	760	24/08/2018	Türen
36004	1 Stk Tür Pos. E254-316 und Beschläge für alle Türen	180	29/08/2018	Türen
36004	2 Innentüren 3-515,3-513,4 Ladenfronten f.Nachtkästen 3-513	385	14/09/2018	Türen
	Aeroflex 1 Rolle	15	06/09/2017	Lüftung
36004	500m Kunst.Montageprofile für Ropelights	25	15/12/2017	Beschläge
36004	Devimat ,Deviflex,Deviclip,Flexschlauch,Fühlerhülsen	59	21/03/2018	Beschläge
36004	Fitlock,Absturzsicherungen	35	23/04/2018	Beschläge
36004	10 Mink Standardbürsten	12	23/04/2018	Beschläge
36004	5 Devimat,Flexschlauch, Fühlerhülsen	8	13/06/2018	Beschläge
36004	Hot Water Tap,Guest bath 4 Duschtassen,1GT Gasdruckdämpfer,Fußbodenheizung,Elekrto Muster,1 Speedlog,1 Echosonder	102	04/07/2018	Beschläge

List collies sending date				
Room number	Item	Mass [kg]	Sended date	Description
36004	Metallplatten	3	24/08/2018	Beschläge
36004	Montgematerial z.Hd.Herrn Miklautz	8	24/08/2018	Beschläge
36004	1 Satz Drückerstifte 150mm	2	03/09/2018	Beschläge
36004	Spiegelheizung	7	12/09/2018	Beschläge
36004	Geschirr retour	2	12/09/2018	Beschläge
36004	Montagematerial lt.Liste,Schrauben,Kleber,u.sw.	659	07/07/2017	Schrauben
36004	Schrauben,Klebstoff,Montageböcke,Markierungsspray	112	29/09/2017	Schrauben
36004	Schrauben, Sicherungen ,Schleifpapier,Klebstoff,Bekleidung	46	17/10/2017	Schrauben
36004	Schrauben Klebstoff,Sicherungen,Reinigungsmittel ,Bekleidung	85	22/11/2017	Schrauben
36004	Schrauben,Klebstoff,Klebebänder,Reinigungsmittel ,Filzstreifen,Handschuhe	80	12/01/2018	Schrauben
36004	Schrauben,Klebebänder,Bekleidung	208	20/02/2018	Schrauben
36004	Schrauben Klebebänder,Reinigungsmittel	91	14/03/2018	Schrauben
36004	Schrauben,Holzklötze,Reinigungsmittel,Klebebänder,Monitore,Fußgestell Badewanne	106	07/05/2018	Schrauben
36004	Schrauben,Klebstoff,Sprühlack,Klebebänder,Distanzplatten	73	29/05/2018	Schrauben
36004	Montagematerial Schrauben u.s.w.	100	04/07/2018	Schrauben
36004	Schrauben,Holzklötze,Speigelkleber,klebebänder,Sofadis,Reinigungsmittel,Einhängeleisten	135	27/07/2018	Schrauben
36004	Schrauben,Klebstoffe,Sprühlack,Klebebänder,Reinigungsmittel	85	08/01/2019	Schrauben
36004	1 Kübel Leim	12	07/07/2017	Montagekleber
36004	Div. Montagematerial	5	01/12/2017	Montagekleber
36004	1 Paket Sikaflex	30	13/02/2018	Montagekleber
36004	120 Kartuschen Pur Klebstoff,Danfoss Fühler und Flexschlauch	55	03/04/2018	Montagekleber
36004	diverse Montagematerialien	60	03/09/2018	Montagekleber
36004	Kantenschutzwinkel,Schutzfolie,Baufolie,Gewindestangen	271	07/07/2017	Verpackungsmaterial
36004	1 Rolle Luftpolsterfolie	10	20/02/2018	Verpackungsmaterial
36004	1 Role Flexroll 300	36	20/02/2018	Verpackungsmaterial
36004	MDF und Ti Board Platten,Sofadis ,Badewannengestell ,Abfluss,Deckenfelder,UK Streifen WH,Laminatstreifen,Tischgestelle WH	539	11/04/2018	Verpackungsmaterial
36004	1 Rolle Flies	11	04/07/2018	Verpackungsmaterial
36004	1 Rolle Noppenflies	12	04/07/2018	Verpackungsmaterial
36004	1 Rolle Luftpolsterfolie	9	27/07/2018	Verpackungsmaterial
36004	1 Rolle Kartonvlies	35	27/07/2018	Verpackungsmaterial
36004	1 Hubwagen kurz	65	07/07/2017	Werkzeug
36004	1 Hubwagen lang	80	07/07/2017	Werkzeug
36004	1 Kreissäge	540	23/05/2018	Werkzeug
36004	Werkeug Firma Miedl	110	25/09/2018	Werkzeug
36004	Muster Furnier z.Hd,.Herrn Miklautz	7	29/05/2018	Montagepläne
36004	LED Mirror Zodiac	12	13/06/2018	Glas und Spiegel
36004	LED Mirror Zodiac	12	13/06/2018	Glas und Spiegel
36004	5 Spiegel	49	04/07/2018	Glas und Spiegel
36004	Duschtüren,Glaseinfassungen,Kleinteile	568	18/07/2018	Glas und Spiegel
36004	Glas Duschtüren,Drehstangenabdeckungen,Stollen 13.2.3/9.2.3,Sperrholzstreifen weiß lackiert	1.217,00	27/07/2018	Glas und Spiegel
	MD Magic Mirrors Teil1	206	29/08/2018	Glas und Spiegel
	MD Magic Mirrors Teil2	169	29/08/2018	Glas und Spiegel
36004	2 LED Mirror	5	07/11/2018	Glas und Spiegel
36004	4 Spiegel	70	19/11/2018	Glas und Spiegel
36004	3 Spiegel,Kleinteile,Ladeneinlagen	91	05/12/2018	Glas und Spiegel
36004	Spiegel	100	31/01/2019	Glas und Spiegel

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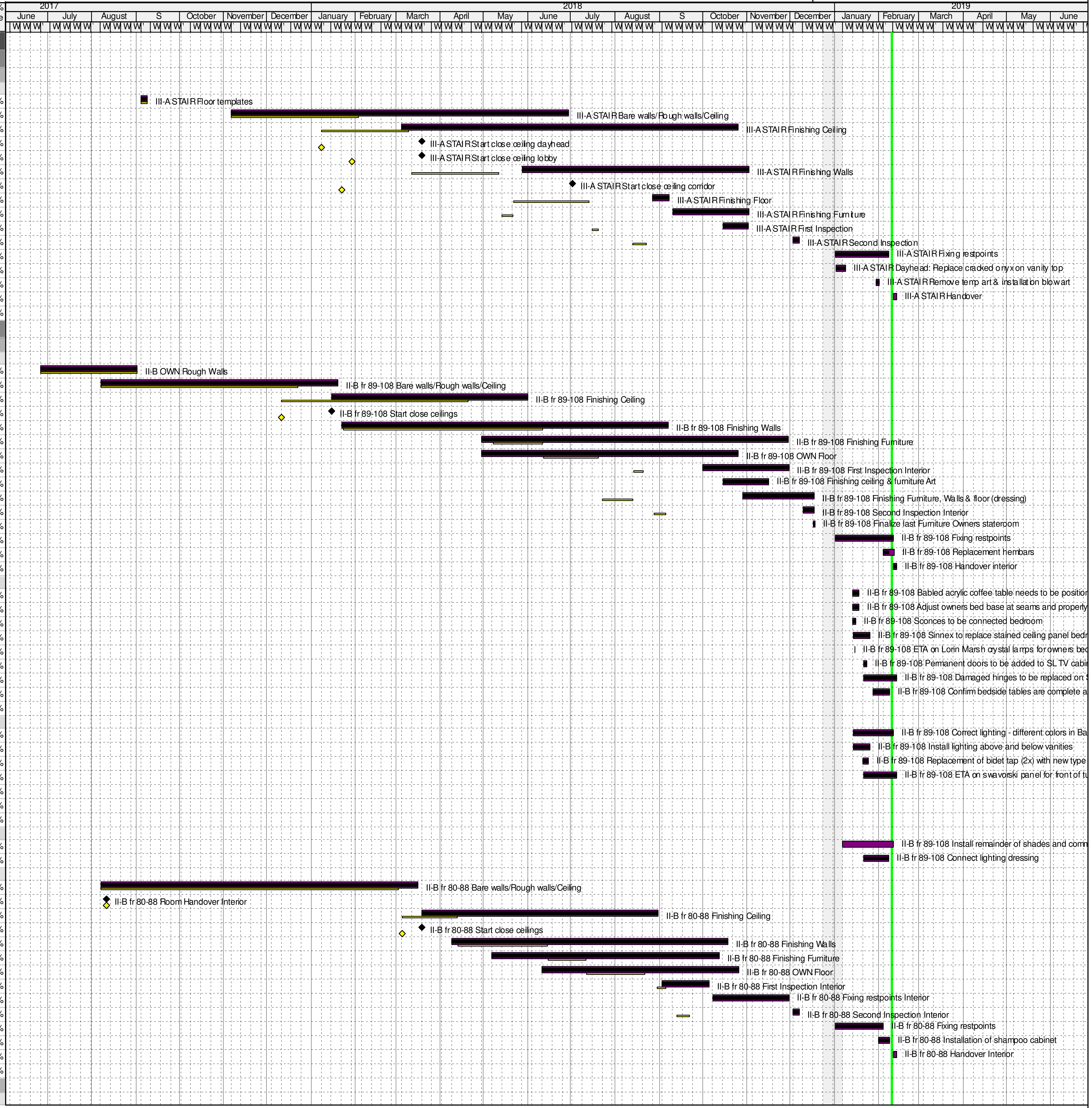
Detail interior installation planning Oceanco

Y718 Interior SINNEX

Activity ID	Supplier	Activity Name	Start	Finish	Remaining Duration	Physical % Complete
Interior Area			19-06-17 A	28-02-20	275d	
Bridge Deck			04-09-17 A	27-12-19	230d	
Block III-A			04-09-17 A	27-12-19	230d	
Corridor/Lobby			04-09-17 A	27-12-19	230d	
	SINNEX	III-A STAIR Floor templates	04-09-17 A	08-09-17 A	0d	100%
	SINNEX	III-A STAIR Bare walls/Rough walls/Ceiling	06-11-17 A	29-06-18 A	0d	100%
	SINNEX	III-A STAIR Finishing Ceiling	05-03-18 A	26-10-18 A	0d	100%
		III-A STAIR Start close ceiling dayhead	19-03-18 A		0d	0%
		III-A STAIR Start close ceiling lobby	19-03-18 A		0d	0%
	SINNEX	III-A STAIR Finishing Walls	28-05-18 A	02-11-18 A	0d	100%
		III-A STAIR Start close ceiling corridor	02-07-18 A		0d	0%
	SINNEX	III-A STAIR Finishing Floor	27-08-18 A	07-09-18 A	0d	100%
	SINNEX	III-A STAIR Finishing Furniture	10-09-18 A	02-11-18 A	0d	100%
	AYB	III-A STAIR First Inspection	15-10-18 A	02-11-18 A	0d	100%
	AYB	III-A STAIR Second Inspection	03-12-18 A	07-12-18 A	0d	100%
	SINNEX	III-A STAIR Fixing restpoints	02-01-19 A	08-02-19 A	0d	100%
	SINNEX	III-A STAIR Dayhead: Replace cracked onyx on vanity top	02-01-19 A	08-01-19 A	0d	100%
	SINNEX	III-A STAIR Remove temp art & installation blowart	30-01-19 A	01-02-19 A	0d	100%
	AYB	III-A STAIR Handover	11-02-19	13-02-19	3d	0%
	SINNEX	III-A STAIR Dayhead: Remove black "switch" inside niche - PL panel will h	23-12-19*	27-12-19	5d	0%
Upper Deck			19-06-17 A	31-12-19	232d	
Block II-B			26-06-17 A	31-12-19	232d	
Owners Area fr 89-108			26-06-17 A	31-12-19	232d	
	SINNEX	II-B OWN Rough Walls	26-06-17 A	01-09-17 A	0d	100%
	SINNEX	II-B fr 89-108 Bare walls/Rough walls/Ceiling	07-08-17 A	19-01-18 A	0d	100%
	SINNEX	II-B fr 89-108 Finishing Ceiling	15-01-18 A	01-06-18 A	0d	100%
		II-B fr 89-108 Start close ceilings	15-01-18 A		0d	0%
	SINNEX	II-B fr 89-108 Finishing Walls	22-01-18 A	07-09-18 A	0d	100%
	SINNEX	II-B fr 89-108 Finishing Furniture	30-04-18 A	30-11-18 A	0d	100%
	SINNEX	II-B fr 89-108 OWN Floor	30-04-18 A	26-10-18 A	0d	100%
	AYB	II-B fr 89-108 First Inspection Interior	01-10-18 A	30-11-18 A	0d	100%
	SINNEX	II-B fr 89-108 Finishing ceiling & furniture Art	15-10-18 A	16-11-18 A	0d	100%
	SINNEX	II-B fr 89-108 Finishing Furniture, Walls & floor (dressing)	29-10-18 A	18-12-18 A	0d	100%
	AYB	II-B fr 89-108 Second Inspection Interior	10-12-18 A	18-12-18 A	0d	100%
	SINNEX	II-B fr 89-108 Finalize last Furniture Owners stateroom	17-12-18 A	18-12-18 A	0d	100%
	SINNEX	II-B fr 89-108 Fixing restpoints	02-01-19 A	11-02-19 A	0d	100%
	SINNEX	II-B fr 89-108 Replacement hembars	04-02-19 A	11-02-19	1d	50%
	AYB	II-B fr 89-108 Handover interior	11-02-19 A	13-02-19 A	0d	100%
Owners Stateroom			14-01-19 A	23-12-19	1d	
	SINNEX	II-B fr 89-108 Babled acrylic coffee table needs to be positioned and sea	14-01-19 A	18-01-19 A	0d	100%
	SINNEX	II-B fr 89-108 Adjust owners bed base at seams and properly repair lacqu	14-01-19 A	18-01-19 A	0d	100%
	SINNEX	II-B fr 89-108 Sconces to be connected bedroom	14-01-19 A	16-01-19 A	0d	100%
	SINNEX	II-B fr 89-108 Sinnex to replace stained ceiling panel bedroom	14-01-19 A	25-01-19 A	0d	100%
	SINNEX	II-B fr 89-108 ETA on Lorin Marsh crystal lamps for owners bedside tables	15-01-19 A	15-01-19 A	0d	100%
	SINNEX	II-B fr 89-108 Permanent doors to be added to SL TV cabinet bedroom	21-01-19 A	23-01-19 A	0d	100%
	SINNEX	II-B fr 89-108 Damaged hinges to be replaced on SL TV cabinet at pop u	21-01-19 A	13-02-19 A	0d	100%
	SINNEX	II-B fr 89-108 Confirm bedside tables are complete and electronics on the	28-01-19 A	08-02-19 A	0d	100%
	SINNEX	II-B fr 89-108 ETA Replace breakfast chairs with out Bentley logo TBD	23-12-19*	23-12-19	1d	0%
Owners Bathroom			14-01-19 A	31-12-19	7d	
	SINNEX	II-B fr 89-108 Correct lighting - different colors in Bathroom	14-01-19 A	11-02-19 A	0d	100%
	SINNEX	II-B fr 89-108 Install lighting above and below vanities	14-01-19 A	25-01-19 A	0d	100%
	SINNEX	II-B fr 89-108 Replacement of bidet tap (2x) with new type	21-01-19 A	25-01-19 A	0d	100%
	SINNEX	II-B fr 89-108 ETA on swavorski panel for front of tub	21-01-19 A	13-02-19 A	0d	100%
	SINNEX	II-B fr 89-108 Replacement of back plate thermostat	23-12-19 A	23-12-19 A	0d	100%
	SINNEX	II-B fr 89-108 Install towel bars in water closet TBD	23-12-19*	31-12-19	7d	0%
	SINNEX	II-B fr 89-108 ETA owners vanity Silverlining TBD	23-12-19*	23-12-19	1d	0%
Owners Dressing			07-01-19 A	11-02-19	0d	
	SINNEX	II-B fr 89-108 Install remainder of shades and commission dressing	07-01-19 A	11-02-19	0d	0%
	SINNEX	II-B fr 89-108 Connect lighting dressing	21-01-19 A	08-02-19 A	0d	100%
Owners Area fr 80-88			07-08-17 A	27-12-19	230d	
	SINNEX	II-B fr 80-88 Bare walls/Rough walls/Ceiling	07-08-17 A	16-03-18 A	0d	100%
		II-B fr 80-88 Room Handover Interior	11-08-17 A		0d	0%
	SINNEX	II-B fr 80-88 Finishing Ceiling	19-03-18 A	31-08-18 A	0d	100%
		II-B fr 80-88 Start close ceilings	19-03-18 A		0d	0%
	SINNEX	II-B fr 80-88 Finishing Walls	09-04-18 A	19-10-18 A	0d	100%
	SINNEX	II-B fr 80-88 Finishing Furniture	07-05-18 A	12-10-18 A	0d	100%
	SINNEX	II-B fr 80-88 OWN Floor	11-06-18 A	26-10-18 A	0d	100%
	AYB	II-B fr 80-88 First Inspection Interior	03-09-18 A	05-10-18 A	0d	100%
	AYB	II-B fr 80-88 Fixing restpoints Interior	08-10-18 A	30-11-18 A	0d	100%
	AYB	II-B fr 80-88 Second Inspection Interior	03-12-18 A	07-12-18 A	0d	100%
	SINNEX	II-B fr 80-88 Fixing restpoints	02-01-19 A	04-02-19 A	0d	100%
	SINNEX	II-B fr 80-88 Installation of shampoo cabinet	01-02-19 A	08-02-19 A	0d	100%
	AYB	II-B fr 80-88 Handover Interior	11-02-19	13-02-19	3d	0%
	SINNEX	II-B fr 80-88 Replacement hembars TBD	23-12-19*	27-12-19	5d	0%
Block II-A			19-06-17 A	13-02-19 A	0d	
Saloon & Dining			02-10-17 A	13-02-19 A	0d	



Y718 Bravo L2 planning

Y718 Interior SINNEX

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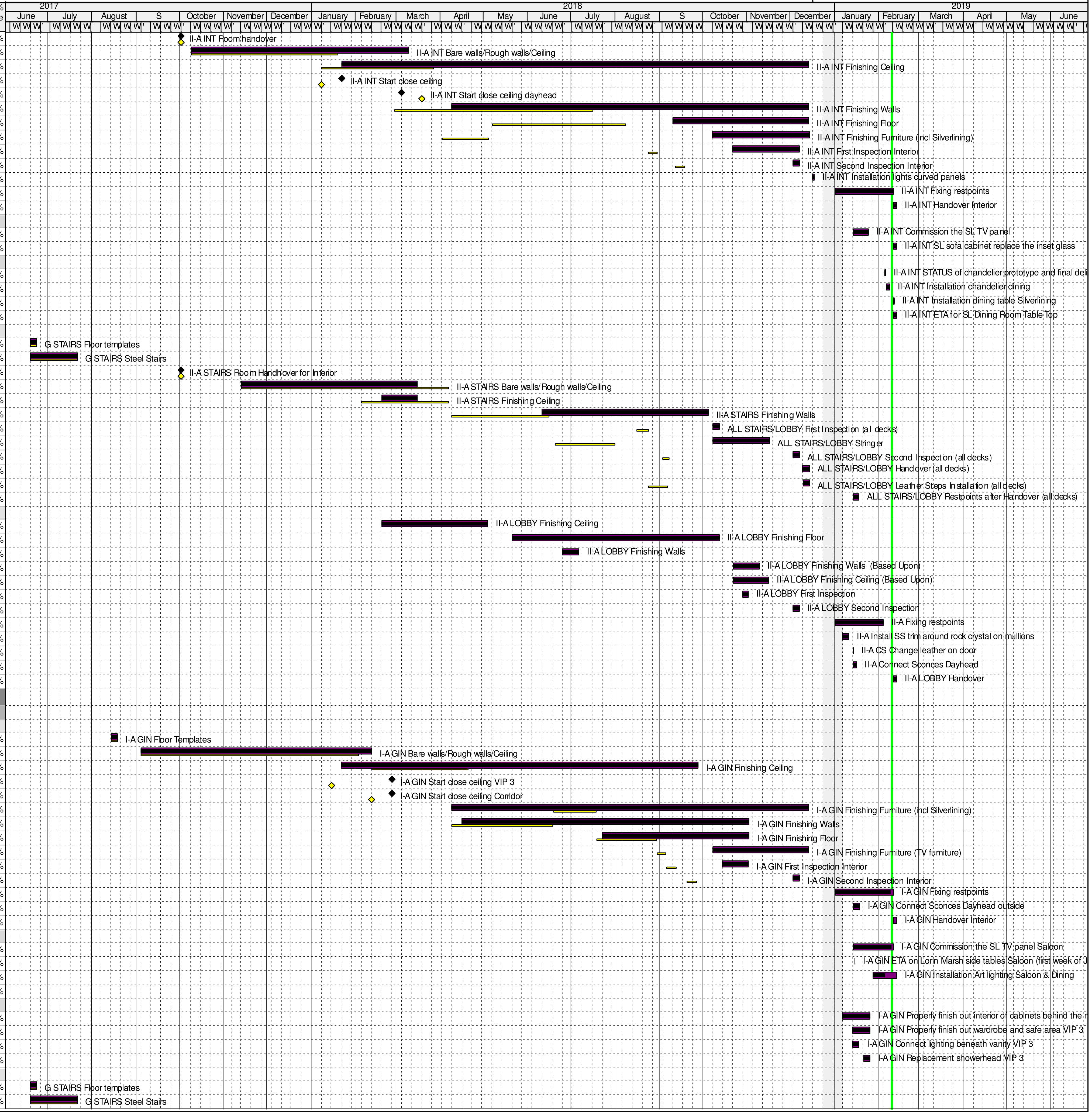
Activity ID	Supplier	Activity Name	Start	Finish	Remaining Duration	Physical % Complete
	SINNEX	II-A INT Room handover	02-10-17 A		0d	0%
	SINNEX	II-A INT Bare walls/Rough walls/Ceiling	09-10-17 A	09-03-18 A	0d	100%
	SINNEX	II-A INT Finishing Ceiling	22-01-18 A	14-12-18 A	0d	100%
	SINNEX	II-A INT Start close ceiling	22-01-18 A		0d	0%
	SINNEX	II-A INT Start close ceiling dayhead	05-03-18 A		0d	0%
	SINNEX	II-A INT Finishing Walls	09-04-18 A	14-12-18 A	0d	100%
	SINNEX	II-A INT Finishing Floor	10-09-18 A	14-12-18 A	0d	100%
	SINNEX	II-A INT Finishing Furniture (incl Silverlining)	08-10-18 A	14-12-18 A	0d	100%
	AYB	II-A INT First Inspection Interior	22-10-18 A	07-12-18 A	0d	100%
	AYB	II-A INT Second Inspection Interior	03-12-18 A	07-12-18 A	0d	100%
	SINNEX	II-A INT Installation lights curved panels	17-12-18 A	18-12-18 A	0d	100%
	SINNEX	II-A INT Fixing restpoints	02-01-19 A	11-02-19 A	0d	100%
	AYB	II-A INT Handover Interior	11-02-19 A	13-02-19 A	0d	100%
		Saloon	14-01-19 A	13-02-19 A	0d	
	SINNEX	II-A INT Commission the SL TV panel	14-01-19 A	25-01-19 A	0d	100%
	SINNEX	II-A INT SL sofa cabinet replace the inset glass	11-02-19 A	13-02-19 A	0d	100%
		Dining	05-02-19 A	13-02-19 A	0d	
	SINNEX	II-A INT STATUS of chandelier prototype and final delivery on actual char	05-02-19 A	05-02-19 A	0d	100%
	SINNEX	II-A INT Installation chandelier dining	06-02-19 A	08-02-19 A	0d	100%
	SINNEX	II-A INT Installation dining table Silverlining	11-02-19 A	11-02-19 A	0d	100%
	SINNEX	II-A INT ETA for SL Dining Room Table Top	11-02-19 A	13-02-19 A	0d	100%
		Lux Stairs	19-06-17 A	18-01-19 A	0d	
	SINNEX	G STAIRS Floor templates	19-06-17 A	23-06-17 A	0d	100%
	SINNEX	G STAIRS Steel Stairs	19-06-17 A	21-07-17 A	0d	100%
		II-A STAIRS Room Handhover for Interior	02-10-17 A		0d	0%
	SINNEX	II-A STAIRS Bare walls/Rough walls/Ceiling	13-11-17 A	16-03-18 A	0d	100%
	SINNEX	II-A STAIRS Finishing Ceiling	19-02-18 A	16-03-18 A	0d	100%
	SINNEX	II-A STAIRS Finishing Walls	11-06-18 A	05-10-18 A	0d	100%
	AYB	ALL STAIRS/LOBBY First Inspection (all decks)	08-10-18 A	12-10-18 A	0d	100%
	SINNEX	ALL STAIRS/LOBBY Stringer	08-10-18 A	16-11-18 A	0d	100%
	AYB	ALL STAIRS/LOBBY Second Inspection (all decks)	03-12-18 A	07-12-18 A	0d	100%
	AYB	ALL STAIRS/LOBBY Handover (all decks)	10-12-18 A	14-12-18 A	0d	100%
	SINNEX	ALL STAIRS/LOBBY Leather Steps Installation (all decks)	10-12-18 A	14-12-18 A	0d	100%
	AYB	ALL STAIRS/LOBBY Restpoints after Handover (all decks)	14-01-19 A	18-01-19 A	0d	100%
		Lobby	19-02-18 A	13-02-19 A	0d	
	SINNEX	II-A LOBBY Finishing Ceiling	19-02-18 A	04-05-18 A	0d	100%
	SINNEX	II-A LOBBY Finishing Floor	21-05-18 A	12-10-18 A	0d	100%
	SINNEX	II-A LOBBY Finishing Walls	25-06-18 A	06-07-18 A	0d	100%
	SINNEX	II-A LOBBY Finishing Walls (Based Upon)	22-10-18 A	09-11-18 A	0d	100%
	SINNEX	II-A LOBBY Finishing Ceiling (Based Upon)	22-10-18 A	16-11-18 A	0d	100%
	AYB	II-A LOBBY First Inspection	29-10-18 A	02-11-18 A	0d	100%
	AYB	II-A LOBBY Second Inspection	03-12-18 A	07-12-18 A	0d	100%
	SINNEX	II-A Fixing restpoints	02-01-19 A	04-02-19 A	0d	100%
	SINNEX	II-A Install SS trim around rock crystal on mullions	07-01-19 A	11-01-19 A	0d	100%
	LIST	II-A CS Change leather on door	14-01-19 A	14-01-19 A	0d	100%
	SINNEX	II-A Connect Sconces Dayhead	14-01-19 A	16-01-19 A	0d	100%
	AYB	II-A LOBBY Handover	11-02-19 A	13-02-19 A	0d	100%
		Main Deck	19-06-17 A	07-01-20	237d	
		Block I-A	19-06-17 A	07-01-20	237d	
		Main Saloon (Guest Interior)	14-08-17 A	07-01-20	237d	
	SINNEX	I-A GIN Floor Templates	14-08-17 A	18-08-17 A	0d	100%
	SINNEX	I-A GIN Bare walls/Rough walls/Ceiling	04-09-17 A	12-02-18 A	0d	100%
	SINNEX	I-A GIN Finishing Ceiling	22-01-18 A	28-09-18 A	0d	100%
		I-A GIN Start close ceiling VIP 3	26-02-18 A		0d	0%
		I-A GIN Start close ceiling Corridor	26-02-18 A		0d	0%
	SINNEX	I-A GIN Finishing Furniture (incl Silverlining)	09-04-18 A	14-12-18 A	0d	100%
	SINNEX	I-A GIN Finishing Walls	16-04-18 A	02-11-18 A	0d	100%
	SINNEX	I-A GIN Finishing Floor	23-07-18 A	02-11-18 A	0d	100%
	SINNEX	I-A GIN Finishing Furniture (TV furniture)	08-10-18 A	14-12-18 A	0d	100%
	AYB	I-A GIN First Inspection Interior	15-10-18 A	02-11-18 A	0d	100%
	AYB	I-A GIN Second Inspection Interior	03-12-18 A	07-12-18 A	0d	100%
	SINNEX	I-A GIN Fixing restpoints	02-01-19 A	11-02-19	0d	95%
	SINNEX	I-A GIN Connect Sconces Dayhead outside	14-01-19 A	18-01-19 A	0d	100%
	AYB	I-A GIN Handover Interior	11-02-19	13-02-19	3d	0%
		Saloon	14-01-19 A	07-01-20	237d	
	SINNEX	I-A GIN Commission the SL TV panel Saloon	14-01-19 A	11-02-19	0d	95%
	SINNEX	I-A GIN ETA on Lorin Marsh side tables Saloon (first week of January at t	15-01-19 A	15-01-19 A	0d	100%
	SINNEX	I-A GIN Installation Art lighting Saloon & Dining	28-01-19 A	13-02-19	3d	50%
	SINNEX	I-A GIN Installation Art lighting in front of tv Saloon TBD	23-12-19*	07-01-20	12d	0%
		VIP Cabin 3	07-01-19 A	25-01-19 A	0d	
	SINNEX	I-A GIN Properly finish out interior of cabinets behind the mirror VIP 3	07-01-19 A	25-01-19 A	0d	100%
	SINNEX	I-A GIN Properly finish out wardrobe and safe area VIP 3	14-01-19 A	25-01-19 A	0d	100%
	SINNEX	I-A GIN Connect lighting beneath vanity VIP 3	14-01-19 A	18-01-19 A	0d	100%
	SINNEX	I-A GIN Replacement showerhead VIP 3	21-01-19 A	25-01-19 A	0d	100%
		Lux Stairs	19-06-17 A	18-01-19 A	0d	
	SINNEX	G STAIRS Floor templates	19-06-17 A	23-06-17 A	0d	100%
	SINNEX	G STAIRS Steel Stairs	19-06-17 A	21-07-17 A	0d	100%



Y718 Bravo L2 planning

Y718 Interior SINNEX

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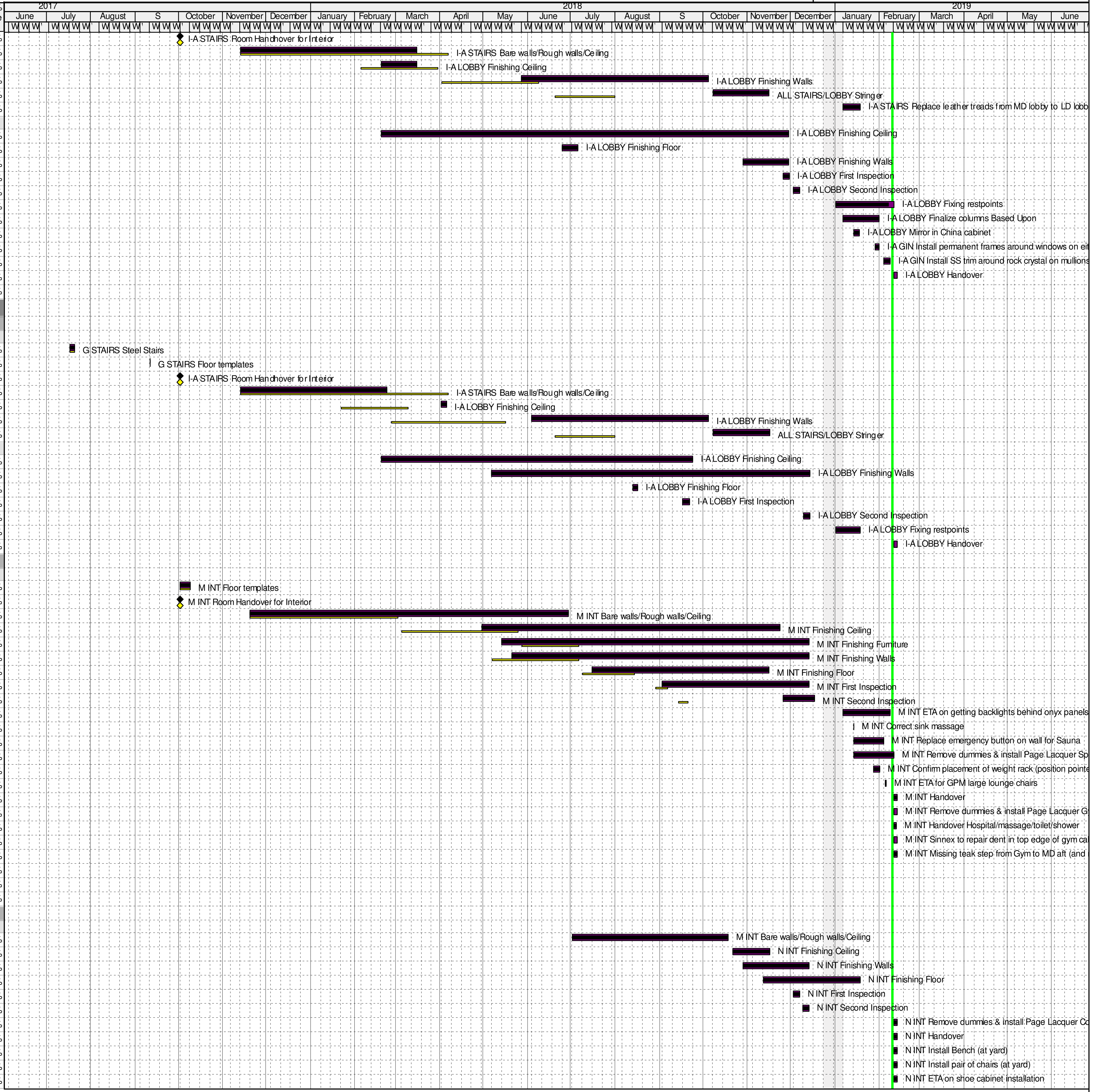
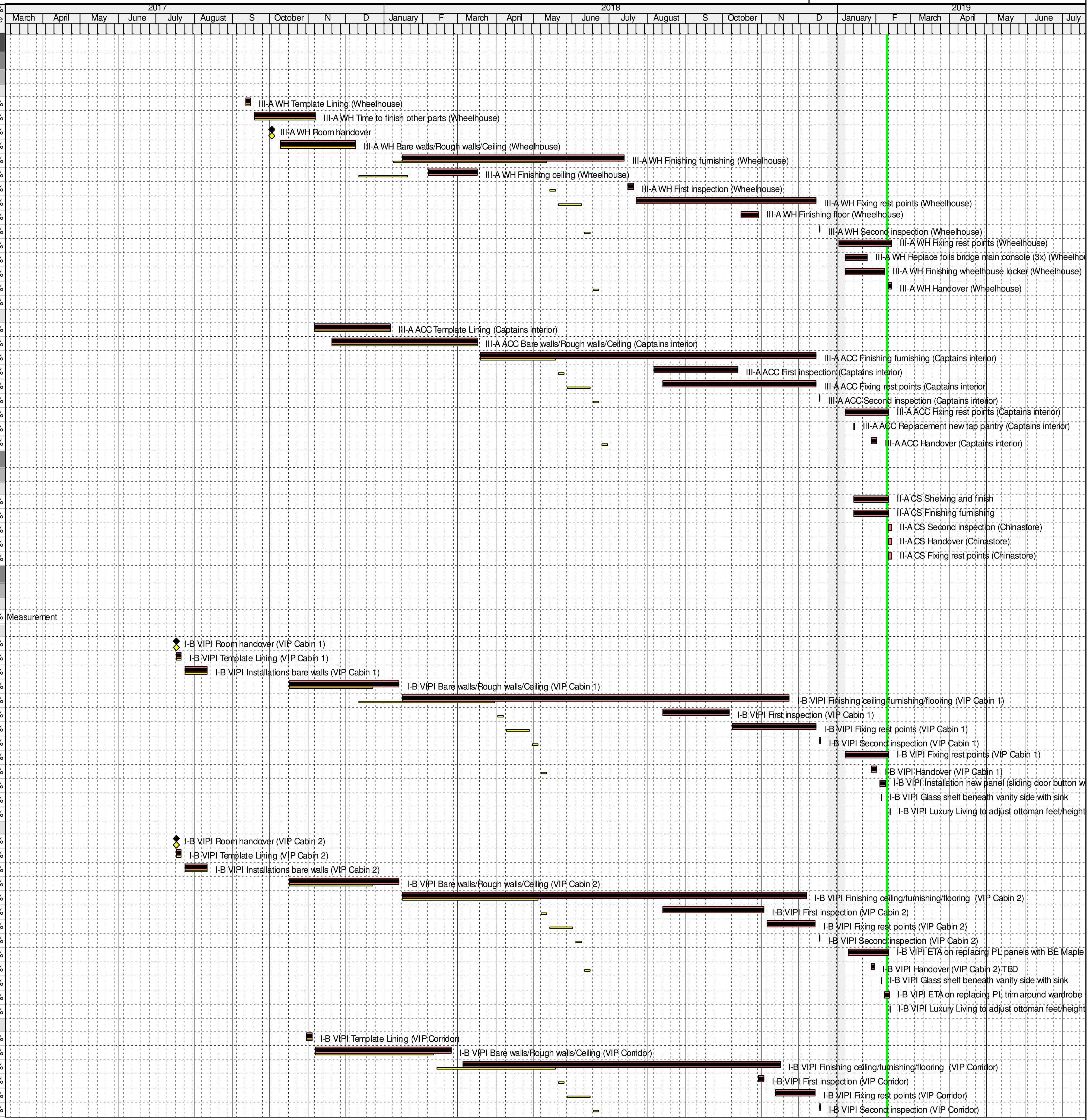
Activity ID	Supplier	Activity Name	Start	Finish	Remaining Duration	Physical % Complete
		I-A STAIRS Room Handhover for Interior	02-10-17 A		0d	0%
	SINNEX	I-A STAIRS Bare walls/Rough walls/Ceiling	13-11-17 A	16-03-18 A	0d	100%
	SINNEX	I-A LOBBY Finishing Ceiling	19-02-18 A	16-03-18 A	0d	100%
	SINNEX	I-A LOBBY Finishing Walls	28-05-18 A	05-10-18 A	0d	100%
	SINNEX	ALL STAIRS/LOBBY Stringer	08-10-18 A	16-11-18 A	0d	100%
	SINNEX	I-A STAIRS Replace leather treads from MD lobby to LD lobby from ceiling	07-01-19 A	18-01-19 A	0d	100%
	Lobby		19-02-18 A	27-12-19	230d	
	SINNEX	I-A LOBBY Finishing Ceiling	19-02-18 A	30-11-18 A	0d	100%
	SINNEX	I-A LOBBY Finishing Floor	25-06-18 A	06-07-18 A	0d	100%
	SINNEX	I-A LOBBY Finishing Walls	29-10-18 A	30-11-18 A	0d	100%
	AYB	I-A LOBBY First Inspection	26-11-18 A	30-11-18 A	0d	100%
	AYB	I-A LOBBY Second Inspection	03-12-18 A	07-12-18 A	0d	100%
	SINNEX	I-A LOBBY Fixing restpoints	02-01-19 A	11-02-19	0d	90%
	SINNEX	I-A LOBBY Finalize columns Based Upon	07-01-19 A	01-02-19 A	0d	100%
	SINNEX	I-A LOBBY Mirror in China cabinet	14-01-19 A	18-01-19 A	0d	100%
	SINNEX	I-A GIN Install permanent frames around windows on either side of main e	29-01-19 A	01-02-19 A	0d	100%
	SINNEX	I-A GIN Install SS trim around rock crystal on mullions Guest Lobby	04-02-19 A	08-02-19 A	0d	100%
	AYB	I-A LOBBY Handover	11-02-19*	13-02-19	3d	0%
	SINNEX	I-A LOBBY Lead time and delivery to replace cracked panels around mul	23-12-19*	27-12-19	5d	0%
	Lower Deck		17-07-17 A	28-02-20	275d	
	Block G		17-07-17 A	13-02-19	3d	
	Lux Stairs		17-07-17 A	16-11-18 A	0d	
	SINNEX	G STAIRS Steel Stairs	17-07-17 A	21-07-17 A	0d	0%
	SINNEX	G STAIRS Floor templates	11-09-17 A	11-09-17 A	0d	0%
		I-A STAIRS Room Handhover for Interior	02-10-17 A		0d	0%
	SINNEX	I-A STAIRS Bare walls/Rough walls/Ceiling	13-11-17 A	23-02-18 A	0d	100%
	SINNEX	I-A LOBBY Finishing Ceiling	02-04-18 A	06-04-18 A	0d	100%
	SINNEX	I-A LOBBY Finishing Walls	04-06-18 A	05-10-18 A	0d	100%
	SINNEX	ALL STAIRS/LOBBY Stringer	08-10-18 A	16-11-18 A	0d	100%
	Lobby		19-02-18 A	13-02-19	3d	
	SINNEX	I-A LOBBY Finishing Ceiling	19-02-18 A	24-09-18 A	0d	100%
	SINNEX	I-A LOBBY Finishing Walls	07-05-18 A	14-12-18 A	0d	100%
	SINNEX	I-A LOBBY Finishing Floor	13-08-18 A	17-08-18 A	0d	100%
	AYB	I-A LOBBY First Inspection	17-09-18 A	21-09-18 A	0d	100%
	AYB	I-A LOBBY Second Inspection	10-12-18 A	14-12-18 A	0d	100%
	SINNEX	I-A LOBBY Fixing restpoints	02-01-19 A	18-01-19 A	0d	100%
	AYB	I-A LOBBY Handover	11-02-19*	13-02-19	3d	0%
	Block M		02-10-17 A	28-02-20	275d	
	Beach L / SPA / Hspt / Corridor		02-10-17 A	28-02-20	275d	
	SINNEX	M INT Floor templates	02-10-17 A	09-10-17 A	0d	100%
	SINNEX	M INT Room Handover for Interior	02-10-17 A		0d	0%
	SINNEX	M INT Bare walls/Rough walls/Ceiling	20-11-17 A	29-06-18 A	0d	100%
	SINNEX	M INT Finishing Ceiling	30-04-18 A	23-11-18 A	0d	100%
	SINNEX	M INT Finishing Furniture	14-05-18 A	14-12-18 A	0d	100%
	SINNEX	M INT Finishing Walls	21-05-18 A	14-12-18 A	0d	100%
	SINNEX	M INT Finishing Floor	16-07-18 A	16-11-18 A	0d	100%
	AYB	M INT First Inspection	03-09-18 A	14-12-18 A	0d	100%
	AYB	M INT Second Inspection	26-11-18 A	18-12-18 A	0d	100%
	AMN	M INT ETA on getting backlights behind onyx panels operational Massag	07-01-19 A	08-02-19 A	0d	100%
	SINNEX	M INT Correct sink massage	14-01-19 A	14-01-19 A	0d	100%
	SINNEX	M INT Replace emergency button on wall for Sauna	14-01-19 A	04-02-19 A	0d	100%
	SINNEX	M INT Remove dummies & install Page Lacquer Spa corridor	14-01-19 A	11-02-19 A	0d	100%
	SINNEX	M INT Confirm placement of weight rack (position pointed out by Doreen	28-01-19 A	01-02-19 A	0d	100%
	SINNEX	M INT ETA for GPM large lounge chairs	05-02-19 A	05-02-19 A	0d	100%
	AYB	M INT Handover	11-02-19 A	13-02-19 A	0d	100%
	SINNEX	M INT Remove dummies & install Page Lacquer Gym lounge TBD	11-02-19*	13-02-19	3d	0%
	AYB	M INT Handover Hospital/massage/toilet/shower	11-02-19 A	12-02-19 A	0d	100%
	SINNEX	M INT Sinnex to repair dent in top edge of gym cabinet	11-02-19 A	13-02-19	3d	0%
	SINNEX	M INT Missing teak step from Gym to MD aft (and repair steps)	11-02-19 A	13-02-19 A	0d	100%
	SINNEX	M INT ETA on aspen wood cover for plunge pool TBD	23-12-19*	24-01-20	25d	0%
	SINNEX	M INT Resolve hose / hand shower in steam shower TBD	23-12-19*	28-02-20	50d	0%
	SINNEX	M INT Replace hand shower with same head but smaller in size TBD	23-12-19*	28-02-20	50d	0%
	Block N		02-07-18 A	13-02-19 A	0d	
	Beach Club / Corridor		02-07-18 A	13-02-19 A	0d	
	SINNEX	M INT Bare walls/Rough walls/Ceiling	02-07-18 A	19-10-18 A	0d	100%
	SINNEX	N INT Finishing Ceiling	22-10-18 A	16-11-18 A	0d	100%
	SINNEX	N INT Finishing Walls	29-10-18 A	14-12-18 A	0d	100%
	SINNEX	N INT Finishing Floor	12-11-18 A	18-01-19 A	0d	100%
	AYB	N INT First Inspection	03-12-18 A	07-12-18 A	0d	100%
	AYB	N INT Second Inspection	10-12-18 A	14-12-18 A	0d	100%
	SINNEX	N INT Remove dummies & install Page Lacquer Corridor & Beach club	11-02-19 A	13-02-19 A	0d	100%
	AYB	N INT Handover	11-02-19 A	13-02-19 A	0d	100%
	SINNEX	N INT Install Bench (at yard)	11-02-19 A	13-02-19 A	0d	100%
	SINNEX	N INT Install pair of chairs (at yard)	11-02-19 A	13-02-19 A	0d	100%
	SINNEX	N INT ETA on shoe cabinet installation	11-02-19 A	13-02-19 A	0d	100%



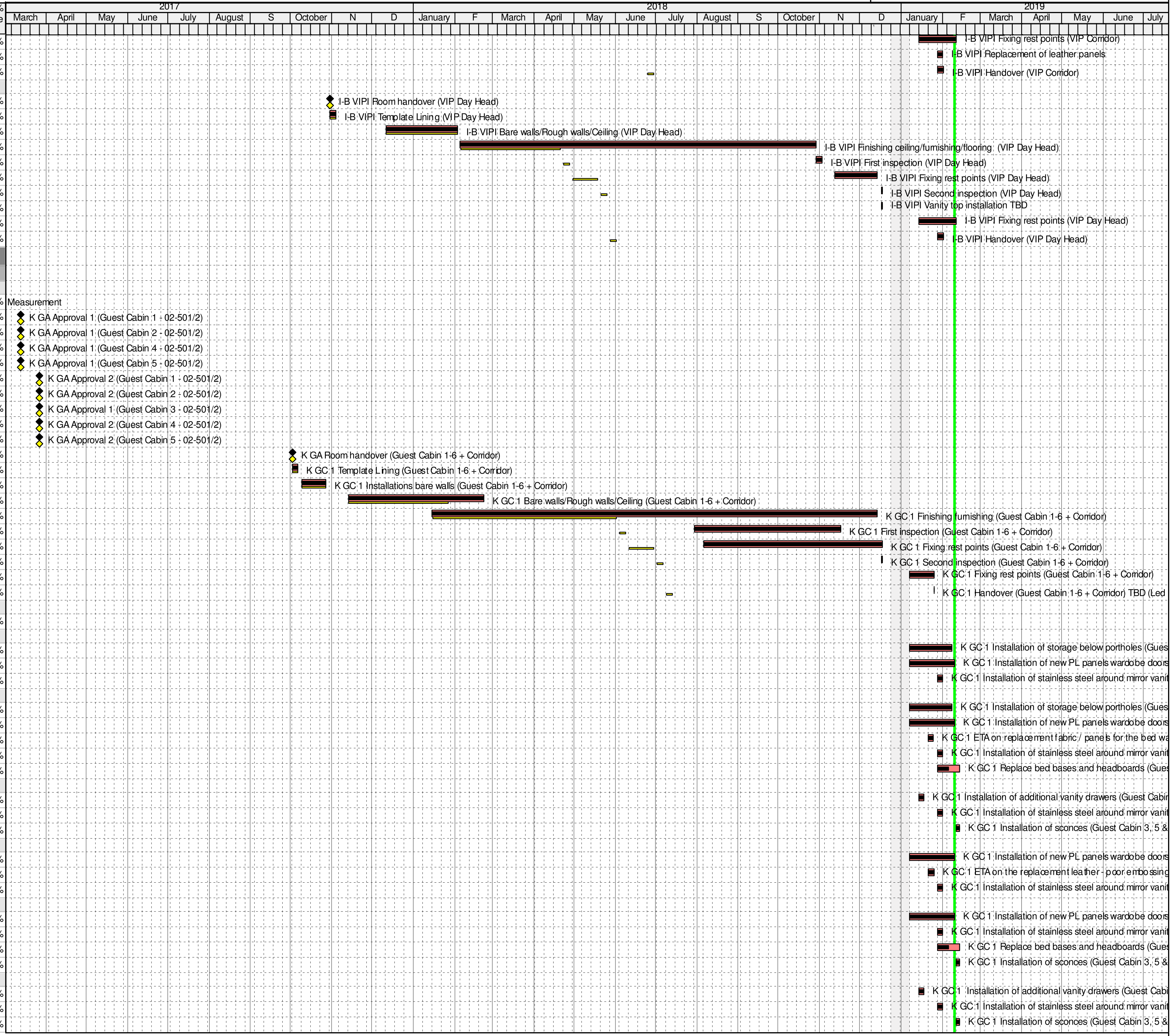
Y718 Interior LIST

Activity ID	Supplier	Activity Name	Start	Finish	Remaining Duration	Physical % Complete
		Interior Area	20-02-17 A	27-12-19	230d	
		Bridge Deck	11-09-17 A	23-12-19	1d	
		Block III-A	11-09-17 A	23-12-19	1d	
		Wheelhouse	11-09-17 A	23-12-19	1d	
	LIST	III-A WH Template Lining (Wheelhouse)	11-09-17 A	15-09-17 A	0d	100%
	LIST	III-A WH Time to finish other parts (Wheelhouse)	18-09-17 A	06-11-17 A	0d	100%
	LIST	III-A WH Room handover	02-10-17 A		0d	0%
	LIST	III-A WH Bare walls/Rough walls/Ceiling (Wheelhouse)	09-10-17 A	08-12-17 A	0d	100%
	LIST	III-A WH Finishing furnishing (Wheelhouse)	15-01-18 A	13-07-18 A	0d	100%
	LIST	III-A WH Finishing ceiling (Wheelhouse)	05-02-18 A	16-03-18 A	0d	100%
	AYB	III-A WH First inspection (Wheelhouse)	16-07-18 A	20-07-18 A	0d	100%
	LIST	III-A WH Fixing rest points (Wheelhouse)	23-07-18 A	14-12-18 A	0d	100%
	LIST	III-A WH Finishing floor (Wheelhouse)	15-10-18 A	29-10-18 A	0d	100%
	AYB	III-A WH Second inspection (Wheelhouse)	17-12-18 A	17-12-18 A	0d	100%
	LIST	III-A WH Fixing rest points (Wheelhouse)	02-01-19 A	13-02-19 A	0d	100%
	AMN	III-A WH Replace foils bridge main console (3x) (Wheelhouse)	07-01-19 A	25-01-19 A	0d	100%
	Fransse	III-A WH Finishing wheelhouse locker (Wheelhouse)	07-01-19 A	08-02-19 A	0d	100%
		III-A WH Handover (Wheelhouse)	11-02-19 A	13-02-19 A	0d	100%
	LIST	III-A WH Install new mullions & black border (Wheelhouse) TBD	23-12-19*	23-12-19	1d	0%
		Captains Interior	06-11-17 A	11-02-19 A	0d	
	LIST	III-A ACC Template Lining (Captains interior)	06-11-17 A	05-01-18 A	0d	0%
	LIST	III-A ACC Bare walls/Rough walls/Ceiling (Captains interior)	20-11-17 A	16-03-18 A	0d	100%
	LIST	III-A ACC Finishing furnishing (Captains interior)	19-03-18 A	14-12-18 A	0d	100%
	AYB	III-A ACC First inspection (Captains interior)	06-08-18 A	12-10-18 A	0d	100%
	LIST	III-A ACC Fixing rest points (Captains interior)	13-08-18 A	14-12-18 A	0d	100%
	AYB	III-A ACC Second inspection (Captains interior)	17-12-18 A	17-12-18 A	0d	100%
	LIST	III-A ACC Fixing rest points (Captains interior)	07-01-19 A	11-02-19 A	0d	100%
	LIST	III-A ACC Replacement new tap pantry (Captains interior)	14-01-19 A	14-01-19 A	0d	100%
		III-A ACC Handover (Captains interior)	28-01-19 A	01-02-19 A	0d	100%
		Upper Deck	14-01-19 A	13-02-19	3d	
		Block II-A	14-01-19 A	13-02-19	3d	
		Chinastore SB (4-839)	14-01-19 A	13-02-19	3d	
	LIST	II-A CS Shelving and finish	14-01-19 A	11-02-19 A	0d	100%
	LIST	II-A CS Finishing furnishing	14-01-19 A	11-02-19 A	0d	100%
	AYB	II-A CS Second inspection (Chinastore)	11-02-19	13-02-19	3d	0%
		II-A CS Handover (Chinastore)	11-02-19	13-02-19	3d	0%
	LIST	II-A CS Fixing rest points (Chinastore)	11-02-19	13-02-19	3d	0%
		Main Deck	20-02-17 A	12-02-19	1d	
		Block I-B	20-02-17 A	12-02-19	1d	
		VIP Interior	20-02-17 A	24-02-17 A	0d	
		Measurement	20-02-17 A	24-02-17 A	0d	100%
		VIP Cabin 1	17-07-17 A	12-02-19	1d	
		I-B VIPI Room handover (VIP Cabin 1)	17-07-17 A		0d	0%
	LIST	I-B VIPI Template Lining (VIP Cabin 1)	17-07-17 A	21-07-17 A	0d	0%
	LIST	I-B VIPI Installations bare walls (VIP Cabin 1)	24-07-17 A	11-08-17 A	0d	0%
	LIST	I-B VIPI Bare walls/Rough walls/Ceiling (VIP Cabin 1)	16-10-17 A	12-01-18 A	0d	100%
	LIST	I-B VIPI Finishing ceiling/furnishing/flooring (VIP Cabin 1)	15-01-18 A	23-11-18 A	0d	100%
	AYB	I-B VIPI First inspection (VIP Cabin 1)	13-08-18 A	05-10-18 A	0d	100%
	LIST	I-B VIPI Fixing rest points (VIP Cabin 1)	08-10-18 A	14-12-18 A	0d	100%
	AYB	I-B VIPI Second inspection (VIP Cabin 1)	17-12-18 A	18-12-18 A	0d	100%
	LIST	I-B VIPI Fixing rest points (VIP Cabin 1)	07-01-19 A	11-02-19 A	0d	100%
		I-B VIPI Handover (VIP Cabin 1)	28-01-19 A	01-02-19 A	0d	100%
	LIST	I-B VIPI Installation new panel (sliding door button without function)	04-02-19 A	08-02-19 A	0d	100%
	LIST	I-B VIPI Glass shelf beneath vanity side with sink	05-02-19 A	05-02-19 A	0d	100%
	LIST	I-B VIPI Luxury Living to adjust ottoman feet/height for dressing vanity side of bath	12-02-19*	12-02-19	1d	0%
		VIP Cabin 2	17-07-17 A	12-02-19	1d	
		I-B VIPI Room handover (VIP Cabin 2)	17-07-17 A		0d	0%
	LIST	I-B VIPI Template Lining (VIP Cabin 2)	17-07-17 A	21-07-17 A	0d	0%
	LIST	I-B VIPI Installations bare walls (VIP Cabin 2)	24-07-17 A	11-08-17 A	0d	0%
	LIST	I-B VIPI Bare walls/Rough walls/Ceiling (VIP Cabin 2)	16-10-17 A	12-01-18 A	0d	100%
	LIST	I-B VIPI Finishing ceiling/furnishing/flooring (VIP Cabin 2)	15-01-18 A	07-12-18 A	0d	100%
	AYB	I-B VIPI First inspection (VIP Cabin 2)	13-08-18 A	02-11-18 A	0d	100%
	LIST	I-B VIPI Fixing rest points (VIP Cabin 2)	05-11-18 A	14-12-18 A	0d	100%
	AYB	I-B VIPI Second inspection (VIP Cabin 2)	17-12-18 A	18-12-18 A	0d	100%
	LIST	I-B VIPI ETA on replacing PL panels with BE Maple	10-01-19 A	11-02-19 A	0d	100%
		I-B VIPI Handover (VIP Cabin 2) TBD	28-01-19 A	30-01-19 A	0d	100%
	LIST	I-B VIPI Glass shelf beneath vanity side with sink	05-02-19 A	05-02-19 A	0d	100%
	LIST	I-B VIPI ETA on replacing PL trim around wardrobe with leather	08-02-19 A	11-02-19 A	0d	100%
	LIST	I-B VIPI Luxury Living to adjust ottoman feet/height for dressing vanity side of bath	12-02-19*	12-02-19	1d	0%
		VIP Corridor	30-10-17 A	11-02-19 A	0d	
	LIST	I-B VIPI Template Lining (VIP Corridor)	30-10-17 A	03-11-17 A	0d	100%
	LIST	I-B VIPI Bare walls/Rough walls/Ceiling (VIP Corridor)	06-11-17 A	23-02-18 A	0d	100%
	LIST	I-B VIPI Finishing ceiling/furnishing/flooring (VIP Corridor)	05-03-18 A	16-11-18 A	0d	100%
	AYB	I-B VIPI First inspection (VIP Corridor)	29-10-18 A	02-11-18 A	0d	100%
	LIST	I-B VIPI Fixing rest points (VIP Corridor)	12-11-18 A	14-12-18 A	0d	100%
	AYB	I-B VIPI Second inspection (VIP Corridor)	17-12-18 A	18-12-18 A	0d	100%



Y718 Interior LIST

Activity ID	Supplier	Activity Name	Start	Finish	Remaining Duration	Physical % Complete
	LIST	I-B VIPI Fixing rest points (VIP Corridor)	14-01-19 A	11-02-19 A	0d	100%
	LIST	I-B VIPI Replacement of leather panels	28-01-19 A	01-02-19 A	0d	100%
	LIST	I-B VIPI Handover (VIP Corridor)	28-01-19 A	01-02-19 A	0d	100%
		VIP Day Head	30-10-17 A	11-02-19 A	0d	
		I-B VIPI Room handover (VIP Day Head)	30-10-17 A		0d	0%
	LIST	I-B VIPI Template Lining (VIP Day Head)	30-10-17 A	03-11-17 A	0d	100%
	LIST	I-B VIPI Bare walls/Rough walls/Ceiling (VIP Day Head)	11-12-17 A	02-02-18 A	0d	100%
	LIST	I-B VIPI Finishing ceiling/furnishing/flooring (VIP Day Head)	05-02-18 A	29-10-18 A	0d	100%
	AYB	I-B VIPI First inspection (VIP Day Head)	29-10-18 A	02-11-18 A	0d	100%
	LIST	I-B VIPI Fixing rest points (VIP Day Head)	12-11-18 A	14-12-18 A	0d	100%
	AYB	I-B VIPI Second inspection (VIP Day Head)	17-12-18 A	18-12-18 A	0d	100%
	LIST	I-B VIPI Vanity top installation TBD	17-12-18 A	18-12-18 A	0d	100%
	LIST	I-B VIPI Fixing rest points (VIP Day Head)	14-01-19 A	11-02-19 A	0d	100%
		I-B VIPI Handover (VIP Day Head)	28-01-19 A	01-02-19 A	0d	100%
		Lower Deck	20-02-17 A	27-12-19	230d	
		Block K	20-02-17 A	27-12-19	230d	
		Guest Area & Corridor	20-02-17 A	27-12-19	230d	
		Measurement	20-02-17 A	24-02-17 A	0d	0%
		K GA Approval 1 (Guest Cabin 1 - 02-501/2)	13-03-17 A		0d	0%
		K GA Approval 1 (Guest Cabin 2 - 02-501/2)	13-03-17 A		0d	0%
		K GA Approval 1 (Guest Cabin 4 - 02-501/2)	13-03-17 A		0d	0%
		K GA Approval 1 (Guest Cabin 5 - 02-501/2)	13-03-17 A		0d	0%
		K GA Approval 2 (Guest Cabin 1 - 02-501/2)	27-03-17 A		0d	0%
		K GA Approval 2 (Guest Cabin 2 - 02-501/2)	27-03-17 A		0d	0%
		K GA Approval 1 (Guest Cabin 3 - 02-501/2)	27-03-17 A		0d	0%
		K GA Approval 2 (Guest Cabin 4 - 02-501/2)	27-03-17 A		0d	0%
		K GA Approval 2 (Guest Cabin 5 - 02-501/2)	27-03-17 A		0d	0%
		K GA Room handover (Guest Cabin 1-6 + Corridor)	02-10-17 A		0d	0%
	LIST	K GC 1 Template Lining (Guest Cabin 1-6 + Corridor)	02-10-17 A	06-10-17 A	0d	100%
	LIST	K GC 1 Installations bare walls (Guest Cabin 1-6 + Corridor)	09-10-17 A	27-10-17 A	0d	100%
	LIST	K GC 1 Bare walls/Rough walls/Ceiling (Guest Cabin 1-6 + Corridor)	13-11-17 A	23-02-18 A	0d	100%
	LIST	K GC 1 Finishing furnishing (Guest Cabin 1-6 + Corridor)	15-01-18 A	14-12-18 A	0d	100%
	AYB	K GC 1 First inspection (Guest Cabin 1-6 + Corridor)	30-07-18 A	16-11-18 A	0d	100%
	LIST	K GC 1 Fixing rest points (Guest Cabin 1-6 + Corridor)	06-08-18 A	18-12-18 A	0d	100%
	AYB	K GC 1 Second inspection (Guest Cabin 1-6 + Corridor)	17-12-18 A	18-12-18 A	0d	100%
	LIST	K GC 1 Fixing rest points (Guest Cabin 1-6 + Corridor)	07-01-19 A	26-01-19 A	0d	100%
		K GC 1 Handover (Guest Cabin 1-6 + Corridor) TBD (Led strip problem)	26-01-19 A	26-01-19 A	0d	100%
		Guest Corridor	23-12-19	27-12-19	5d	
	LIST	K GC 1 Installation of new PL panels guest corridor TBD	23-12-19*	27-12-19	5d	0%
		Guest Cabin 1	07-01-19 A	10-02-19 A	0d	
	LIST	K GC 1 Installation of storage below portholes (Guest Cabin 1 & 2)	07-01-19 A	08-02-19 A	0d	100%
	LIST	K GC 1 Installation of new PL panels wardobe doors & bathroom sliding doors (Gu	07-01-19 A	10-02-19 A	0d	100%
	LIST	K GC 1 Installation of stainless steel around mirror vanity (Guest Cabin 1-6)	28-01-19 A	01-02-19 A	0d	100%
		Guest Cabin 2	07-01-19 A	13-02-19	3d	
	LIST	K GC 1 Installation of storage below portholes (Guest Cabin 1 & 2)	07-01-19 A	08-02-19 A	0d	100%
	LIST	K GC 1 Installation of new PL panels wardobe doors & bathroom sliding doors (Gu	07-01-19 A	10-02-19 A	0d	100%
	LIST	K GC 1 ETA on replacement fabric / panels for the bed wall (Guest Cabin 2)	21-01-19 A	25-01-19 A	0d	100%
	LIST	K GC 1 Installation of stainless steel around mirror vanity (Guest Cabin 1-6)	28-01-19 A	01-02-19 A	0d	100%
	LIST	K GC 1 Replace bed bases and headboards (Guest Cabin 2&5)	28-01-19 A	13-02-19	3d	50%
		Guest Cabin 3	14-01-19 A	13-02-19 A	0d	
	LIST	K GC 1 Installation of additional vanity drawers (Guest Cabin 3 & 6)	14-01-19 A	18-01-19 A	0d	100%
	LIST	K GC 1 Installation of stainless steel around mirror vanity (Guest Cabin 1-6)	28-01-19 A	01-02-19 A	0d	100%
	LIST	K GC 1 Installation of sconces (Guest Cabin 3, 5 & 6)	11-02-19 A	13-02-19 A	0d	100%
		Guest Cabin 4	07-01-19 A	10-02-19 A	0d	
	LIST	K GC 1 Installation of new PL panels wardobe doors & bathroom sliding doors (Gu	07-01-19 A	10-02-19 A	0d	100%
	LIST	K GC 1 ETA on the replacement leather - poor embossing - for the bed wall (Guest	21-01-19 A	25-01-19 A	0d	100%
	LIST	K GC 1 Installation of stainless steel around mirror vanity (Guest Cabin 1-6)	28-01-19 A	01-02-19 A	0d	100%
		Guest Cabin 5	07-01-19 A	13-02-19	3d	
	LIST	K GC 1 Installation of new PL panels wardobe doors & bathroom sliding doors (Gu	07-01-19 A	10-02-19 A	0d	100%
	LIST	K GC 1 Installation of stainless steel around mirror vanity (Guest Cabin 1-6)	28-01-19 A	01-02-19 A	0d	100%
	LIST	K GC 1 Replace bed bases and headboards (Guest Cabin 2&5)	28-01-19 A	13-02-19	3d	50%
	LIST	K GC 1 Installation of sconces (Guest Cabin 3, 5 & 6)	11-02-19 A	13-02-19 A	0d	100%
		Guest Cabin 6	14-01-19 A	13-02-19 A	0d	
	LIST	K GC 1 Installation of additional vanity drawers (Guest Cabin 3 & 6)	14-01-19 A	18-01-19 A	0d	100%
	LIST	K GC 1 Installation of stainless steel around mirror vanity (Guest Cabin 1-6)	28-01-19 A	01-02-19 A	0d	100%
	LIST	K GC 1 Installation of sconces (Guest Cabin 3, 5 & 6)	11-02-19 A	13-02-19 A	0d	100%



F

Total inventory level "as is" model

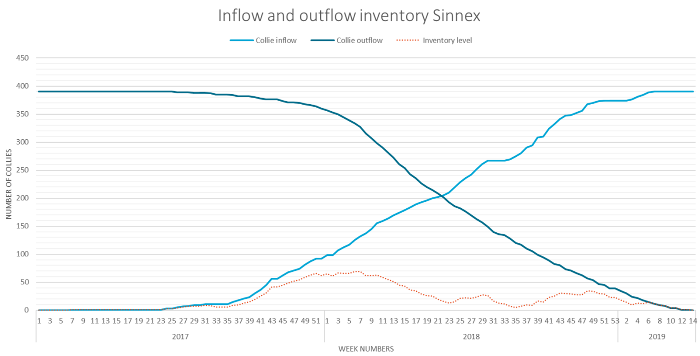


Figure F.1: Total inventory level including number of collies to inventory and out of the inventory Sinnex

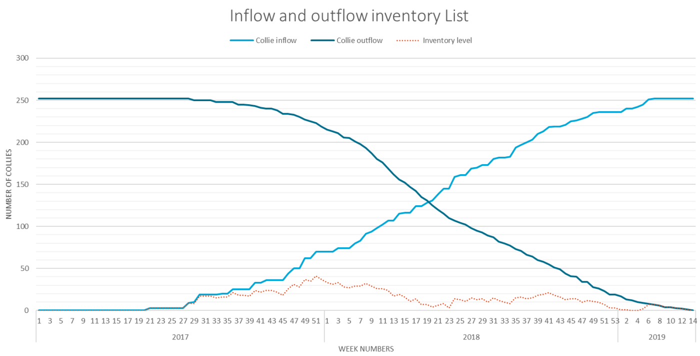


Figure F.2: Total inventory level including number of collies to inventory and out of the inventory List

G

Gantt sheets by implementing lead time management tool

Lead time management tool Sinnex				
Room	*Start*	*Finish*	*Duration [working days]*	*Duration total*
BD corridor/lobby	27/11/2017	12/10/2018	230	319
UD Owners area 89-108	18/09/2017	11/01/2019	345	480
UD Owners area 80-88	15/01/2018	21/09/2018	180	249
UD Saloon dining	20/11/2017	31/08/2018	205	284
UD Lobby	14/05/2018	08/03/2019	215	298
MD Saloon	06/11/2017	21/12/2018	295	410
MD Lobby	14/05/2018	08/03/2019	215	298
LD Lobby	14/05/2018	08/03/2019	215	298
LD Beach lounge/SPA	27/11/2017	19/10/2018	235	326
LD Beach club	02/07/2018	04/02/2019	156	217

Figure G.1: Start and finish dates by implementing lead time management tool for Sinnex

Lead time management tool List				
Room	*Start*	*Finish*	*Duration [working days]*	*Duration total*
Wheelhouse	04/12/2017	29/06/2018	150	207
Captains interior	26/03/2018	21/09/2018	130	179
Guest Area & Corridor	25/12/2017	12/10/2018	210	291
VIP Cabin 1	09/10/2017	03/08/2018	215	298
VIP Cabin 2	09/10/2017	07/09/2018	240	333
VIP Corridor	22/01/2018	07/09/2018	165	228

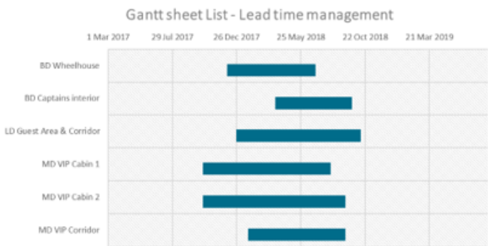


Figure G.2: Start and finish dates by implementing lead time management tool for List

H

Research lead time management tool delay during interior process

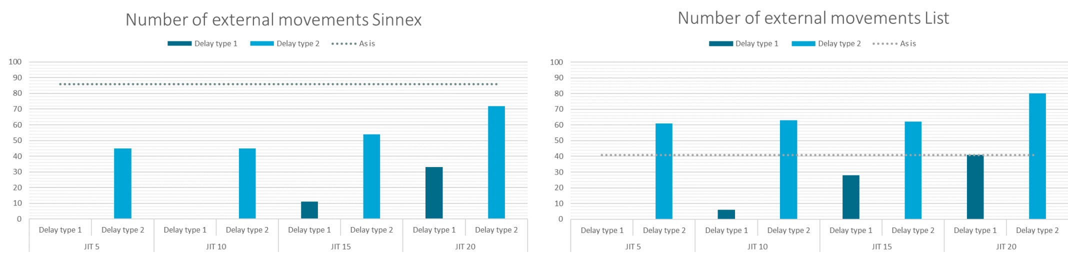
The lead time management tool in the report calculates the effect on non-value added movements using a delay at the start of the interior process. This section does the same calculation, but with a delay during the interior process. This type of delay is called delay type two. It is not possible to compare the reduction of the non-value added movements with the results of the “as is” model of project Y718, due to the fact that the "as is" model deals with a delay at the start of the process. For this case the production time of the interior items is important. By a stop within the installation process, the production time determines the height of the inventory level. Table H.1 shows the input values for the model.

	Sinnex lot size: 7 collies	**List** lot size: 7 collies
Duration delay	60 days	60 days
Start date delay	03/01/2018	03/11/2017
Finish date delay	27/03/2018	25/01/2018
Production time	48 days	53 days

Table H.1: Input value model delay type two - Sinnex and List Y718

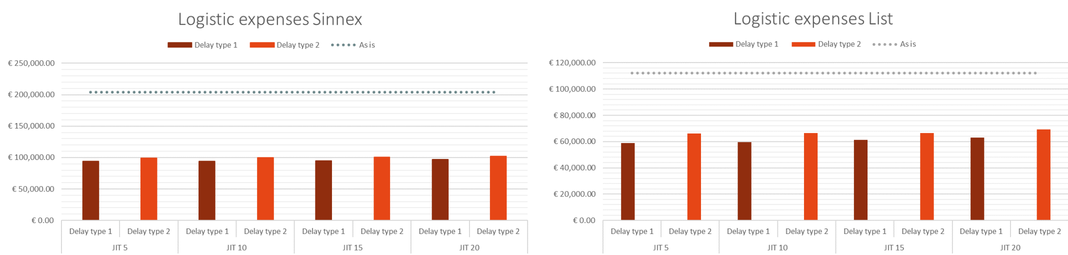
From the table it can be noticed that the production time of List is different relative to the production time given in table 6.1.2. Table 6.1.2 shows that the production time of the lobbies causes the high average value of the production time. In this case, the lobbies are located at the end of the delay timeframe, which are hardly affected by the delay. Therefore, the production time of the lobbies are not included in the average production time value which generate a different production time. The delay timeframe of both co-makers is located in the first phase and a beginning of the second phase of the undisturbed installation approach shown in figure 7.4. For this research the same improvement model is used, where some minor adjustments have been made.
Figure H.1 and H.2 shows the number of external movements and logistic expenses of this type of delay relative to the delays in scenario one. The “as is” line in this figure serves as a reference line.
Figure H.1 shows that the number of external movement increases for delay type two. When looking to the variation in number of external movements between the co-makers, it can be seen that for both co-makers the number of movements of this delay type have doubled for most JIT values. List has planned to install 89 collies in the delayed timeframe and Sinnex has planned to install 85 collies. However, the variation between the different delay types for List is larger than for Sinnex. This is due to the higher production time of List. List delivers in the delay timeframe 79 collies against the 62 collies of Sinnex, which explained the difference between the co-makers. Thereafter, the “as is” reference line lays for List much lower due to the more efficient process than Sinnex, which sketches a distorted view at the number of external movements for List. Figure H.2 shows that the difference in logistic expenses between the different delay types are small. The lot size stays the same, only the number of external movements changes which creates the small increasing of the

expenses for delay type two.
Table H.2 shows the improvement delta by the external movements and logistic expense of the pre-determined constant delay relative to delay type two. It can be concluded that if the delay is already known before the production and installation of the interior starts, the process must be rescheduled before the start instead of during the process. Figure H.3, H.4, H.5 and H.6 shows the results and the inventory flow by the different JIT and lot size values.



(a) Sinnex (b) List

Figure H.1: Number of external movements delay type two - Sinnex and List Y718



(a) Sinnex (b) List

Figure H.2: Logistic expenses delay type two - Sinnex and List Y718

	Sinnex lot size: 7 collies JIT: 15 days	**List** lot size: 7 collies JIT: 10 days
Number of external movements	39 (-72%)	57 (-90%)
Total logistic expenses	€ 5.324,00 (-5%)	€ 7.081,00 (-11%)

Table H.2: Improvement delta constant delay relative to delay type two - Sinnex and List Y718

Lead time management tool Sinnex – delay type 2				
Batching 3	JIT 5	JIT 10	JIT 15	JIT 20
Number of drives	128	128	128	128
Number of external movements	43	43	45	54
Total collie week	374	417	471	629
Transportation expenses	€ 215.577,60	€ 215.577,60	€ 215.577,60	€ 215.577,60
External storage expenses	€ 3.885,68	€ 4.169,48	€ 4.591,80	€ 5.931,24
Transportation expenses Maat	€ 1.017,00	€ 1.017,00	€ 1.017,00	€ 1.243,00
Total logistical expense	€ 220.480,28	€ 220.764,08	€ 221.186,40	€ 222.751,84
Batching 5	JIT 5	JIT 10	JIT 15	JIT 20
Number of drives	78	78	78	78
Number of external movements	46	46	51	73
Total collie week	400	446	500	679
Transportation expenses	€ 131.367,60	€ 131.367,60	€ 131.367,60	€ 131.367,60
External storage expenses	€ 4.156,16	€ 4.459,76	€ 4.980,96	€ 6.887,48
Transportation expenses Maat	€ 1.130,00	€ 1.130,00	€ 1.243,00	€ 1.695,00
Total logistical expense	€ 136.653,76	€ 136.957,36	€ 137.591,56	€ 139.950,08
Batching 7	JIT 5	JIT 10	JIT 15	JIT 20
Number of drives	56	56	56	56
Number of external movements	45	45	54	72
Total collie week	391	436	501	867
Transportation expenses	€ 94.315,20	€ 94.315,20	€ 94.315,20	€ 94.315,20
External storage expenses	€ 4.063,80	€ 4.360,80	€ 5.086,44	€ 6.993,12
Transportation expenses Maat	€ 1.017,00	€ 1.017,00	€ 1.243,00	€ 1.695,00
Total logistical expense	€ 99.396,28	€ 99.693,00	€ 100.644,64	€ 101.985,64

Figure H.3: Result delay type two - Sinnex Y718

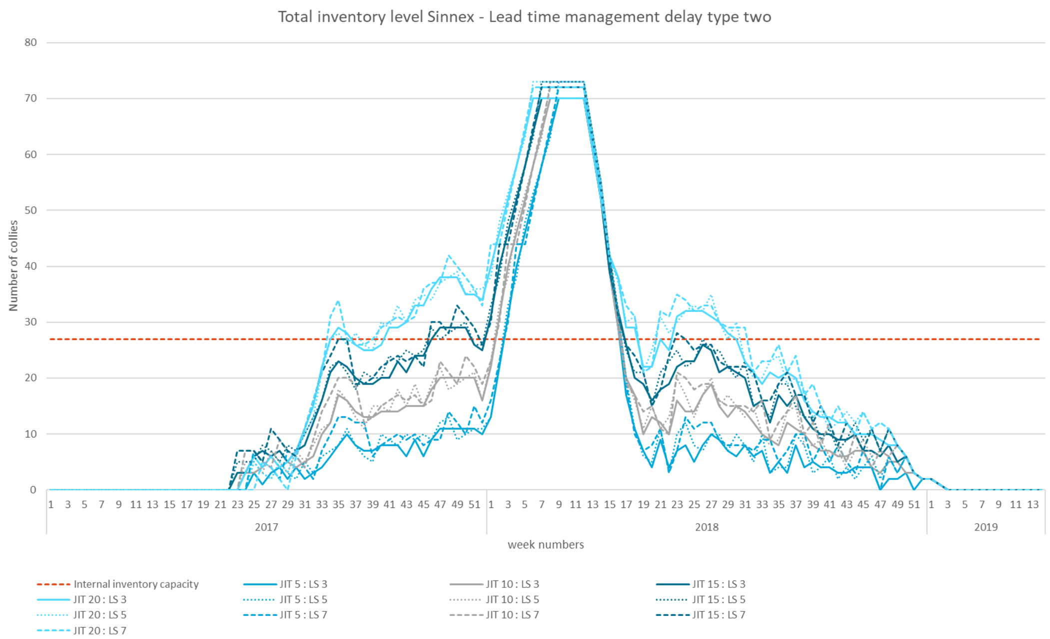


Figure H.4: Total inventory level delay type two - Sinnex 718

Lead time management tool List – delay type 2				
Batching 3	JIT 5	JIT 10	JIT 15	JIT 20
Number of drives	83	83	83	83
Number of external movements	58	58	59	70
Total collie week	503	561	564	789
Transportation expenses	€ 136.070,20	€ 136.070,20	€ 136.070,20	€ 136.070,20
External storage expenses	€ 5.231,48	€ 5.614,28	€ 5.667,04	€ 7.514,60
Transportation expenses Maat	€ 1.356,00	€ 1.356,00	€ 1.356,00	€ 1.582,00
Total logistical expense	€ 142.657,68	€ 143.040,48	€ 143.093,24	€ 145.166,80
Batching 5	JIT 5	JIT 10	JIT 15	JIT 20
Number of drives	51	51	51	51
Number of external movements	59	60	62	69
Total collie week	511	573	579	821
Transportation expenses	€ 83.609,40	€ 83.609,40	€ 83.609,40	€ 83.609,40
External storage expenses	€ 5.317,24	€ 5.759,40	€ 5.864,92	€ 7.692,84
Transportation expenses Maat	€ 1.356,00	€ 1.356,00	€ 1.469,00	€ 1.582,00
Total logistical expense	€ 90.282,64	€ 90.724,80	€ 90.943,32	€ 92.884,24
Batching 7	JIT 5	JIT 10	JIT 15	JIT 20
Number of drives	36	36	36	36
Number of external movements	61	63	62	80
Total collie week	545	608	613	867
Transportation expenses	€ 59.018,40	€ 59.018,40	€ 59.018,40	€ 59.018,40
External storage expenses	€ 5.607,56	€ 6.089,28	€ 7.089,32	€ 8.359,00
Transportation expenses Maat	€ 1.469,00	€ 1.469,00	€ 1.469,00	€ 1.808,00
Total logistical expense	€ 66.094,96	€ 66.576,68	€ 66.576,72	€ 69.185,40

Figure H.5: Result delay type two - List Y718

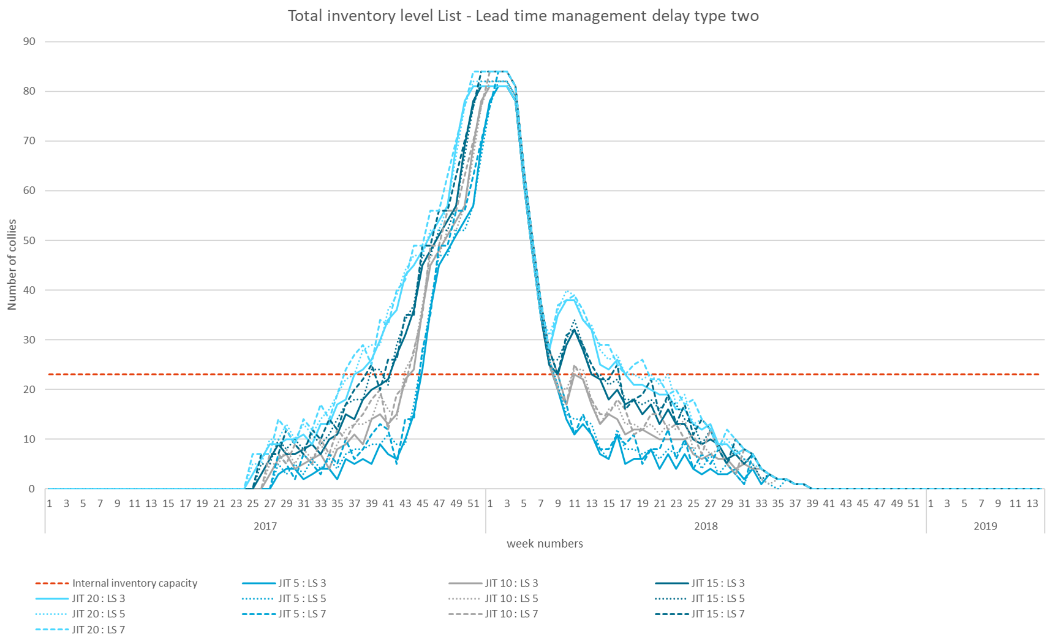


Figure H.6: Total inventory level delay type two - List Y718

Output financial milestone scenario one

Output results scenario 1 Sinnex				
Batching 3	JIT 5	JIT 10	JIT 15	JIT 20
Number of drives	128	128	128	128
Number of external movements	0	0	3	30
Total collie week	0	0	9	149
Transportation expenses	€ 215.577,60	€ 215.577,60	€ 215.577,60	€ 215.577,60
External storage expenses	€ 0,00	€ 0,00	€ 158,28	€ 1.972,20
Transportation expenses Maat	€ 0,00	€ 0,00	€ 113,00	€ 678,00
Total logistical expense	€ 215.577,60	€ 215.577,60	€ 215.848,88	€ 218.227,80
Batching 5	JIT 5	JIT 10	JIT 15	JIT 20
Number of drives	78	78	78	78
Number of external movements	0	0	7	49
Total collie week	0	0	10	186
Transportation expenses	€ 131.367,60	€ 131.367,60	€ 131.367,60	€ 131.367,60
External storage expenses	€ 0,00	€ 0,00	€ 296,72	€ 2.842,64
Transportation expenses Maat	€ 0,00	€ 0,00	€ 226,00	€ 1.130,00
Total logistical expense	€ 131.367,60	€ 131.367,60	€ 131.890,32	€ 135.340,24
Batching 7	JIT 5	JIT 10	JIT 15	JIT 20
Number of drives	56	56	56	56
Number of external movements	0	0	15	43
Total collie week	0	0	26	208
Transportation expenses	€ 94.315,20	€ 94.315,20	€ 94.315,20	€ 94.315,20
External storage expenses	€ 0,00	€ 0,00	€ 666,00	€ 2.790,08
Transportation expenses Maat	€ 0,00	€ 0,00	€ 339,00	€ 1.017,00
Total logistical expense	€ 94.315,20	€ 94.315,20	€ 95.320,20	€ 98.122,28

Figure I.1: Result values scenario one - Sinnex Y718

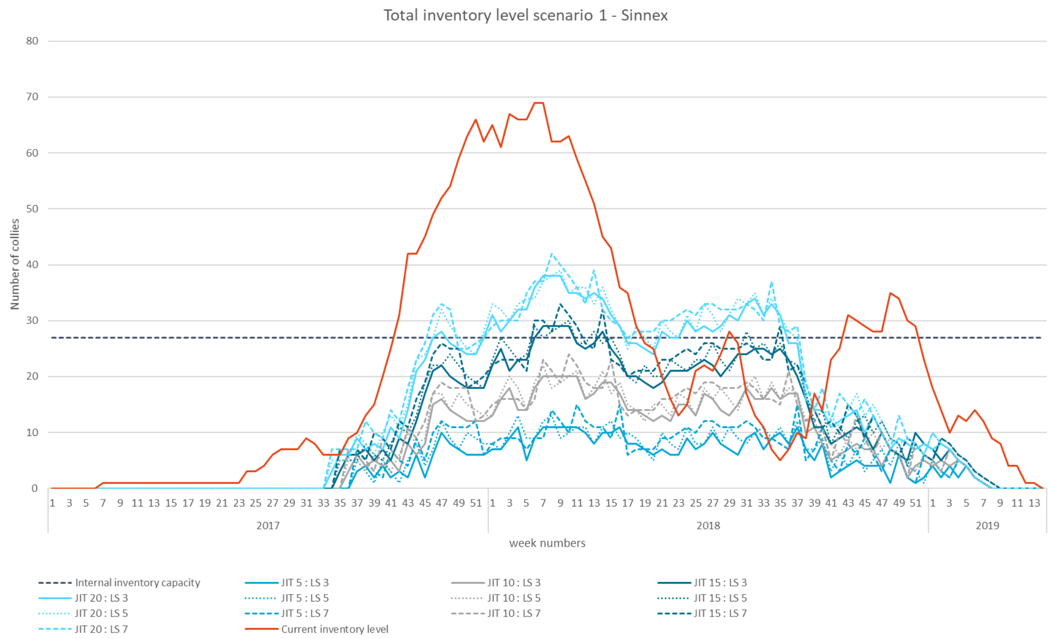


Figure I.2: Total inventory level scenario one - Sinnex Y718

Output results scenario 1 List				
Batching 3	JIT 5	JIT 10	JIT 15	JIT 20
Number of drives	83	83	83	83
Number of external movements	0	0	6	36
Total collie week	0	0	12	175
Transportation expenses	€ 136.070,20	€ 136.070,20	€ 136.070,20	€ 136.070,20
External storage expenses	€ 0,00	€ 0,00	€ 276,96	€ 2.341,56
Transportation expenses Maat	€ 0,00	€ 113,00	€ 226,00	€ 904,00
Total logistical expense	€ 136.070,20	€ 136.070,20	€ 136.573,16	€ 139.351,76
Batching 5	JIT 5	JIT 10	JIT 15	JIT 20
Number of drives	51	51	51	51
Number of external movements	0	1	13	40
Total collie week	0	1	26	216
Transportation expenses	€ 83.609,40	€ 83.609,40	€ 83.609,40	€ 83.609,40
External storage expenses	€ 0,00	€ 39,56	€ 600,08	€ 2.744,00
Transportation expenses Maat	€ 0,00	€ 113,00	€ 339,00	€ 904,00
Total logistical expense	€ 83.609,40	€ 83.761,96	€ 84.548,48	€ 87.257,40
Batching 7	JIT 5	JIT 10	JIT 15	JIT 20
Number of drives	36	36	36	36
Number of external movements	0	6	14	47
Total collie week	0	8	30	234
Transportation expenses	€ 59.018,40	€ 59.018,40	€ 59.018,40	€ 59.018,40
External storage expenses	€ 0,00	€ 250,56	€ 659,44	€ 3.093,52
Transportation expenses Maat	€ 0,00	€ 226,00	€ 339,00	€ 1.130,00
Total logistical expense	€ 59.018,40	€ 59.494,96	€ 60.016,84	€ 63.241,92

Figure I.3: Result values scenario one - List Y718

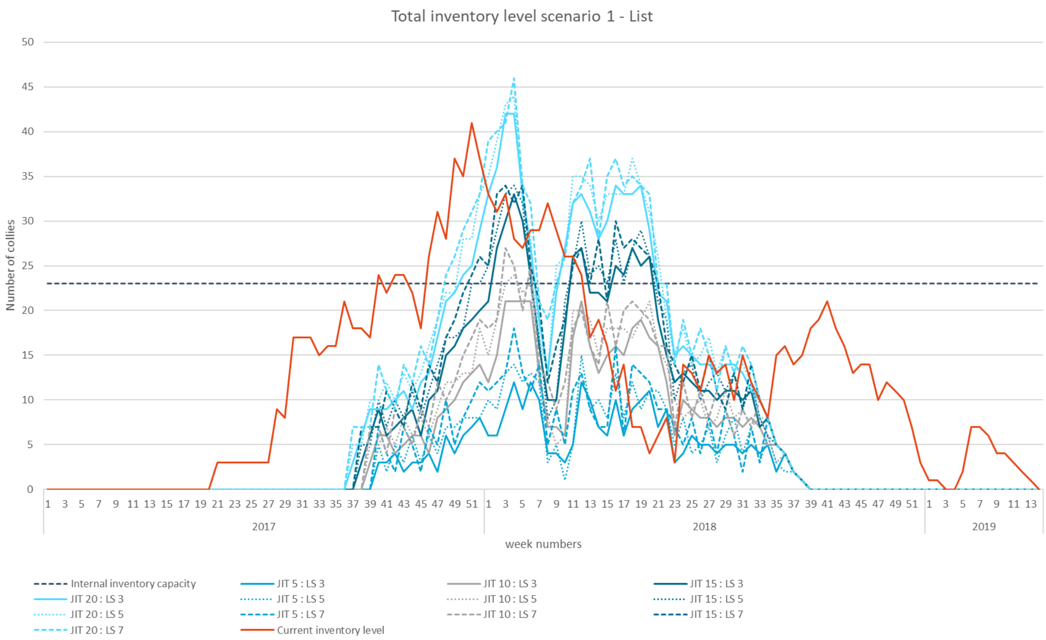


Figure I.4: Total inventory level scenario one - List Y718

J

Implementation roadmap Oceanco

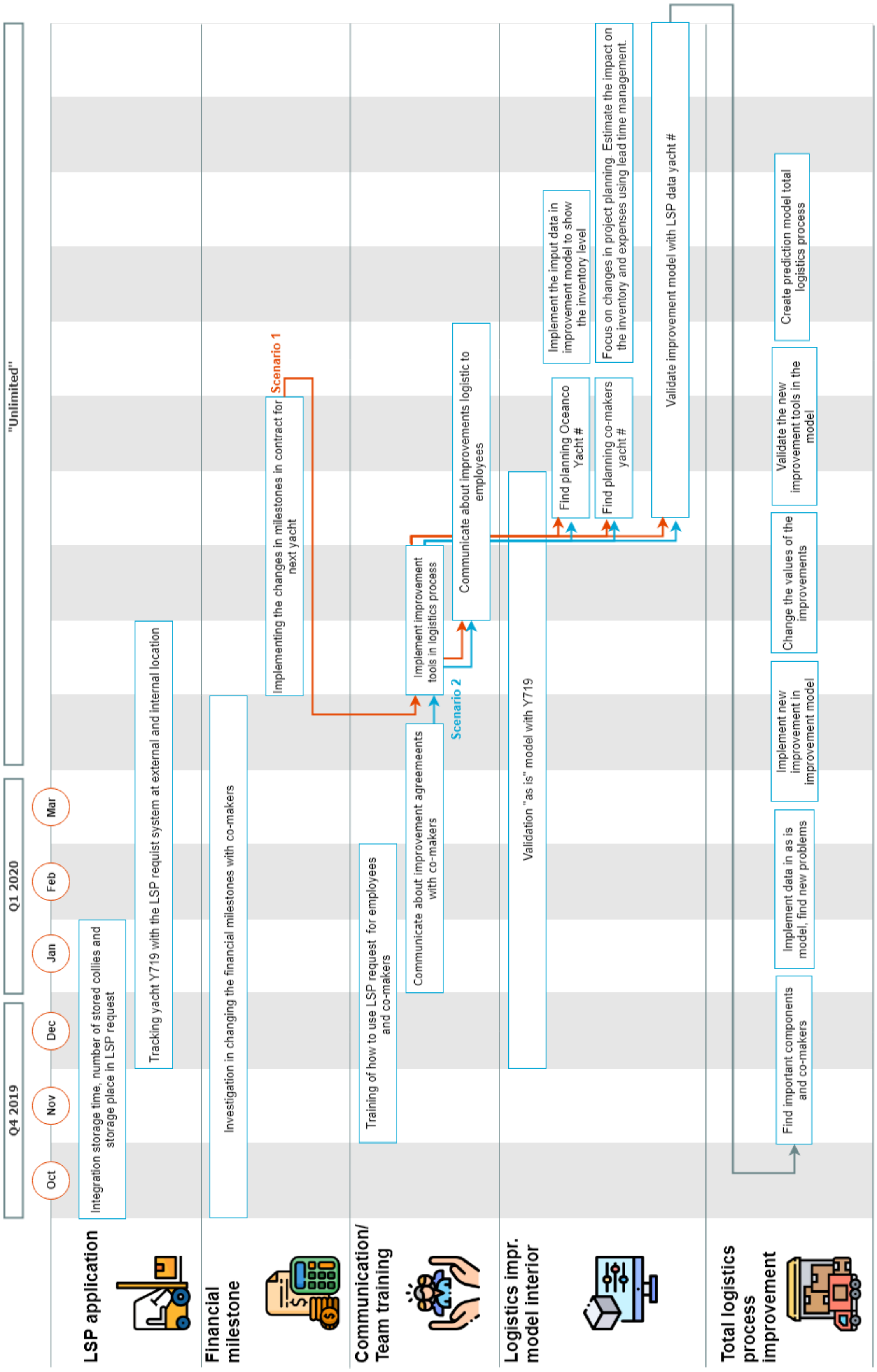


Figure J.1: Enlarged implementation roadmap Oceanco