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TITLE:
Optimizing Logistic and Warehousing - Maersk Drilling Norge AS

AUTHOR(S)		SUPERVISOR:
Candidate number:	Name:	Prof. Jan Frick
4108 ……	Leah Ruales ……	
4094 ……	Debora Amanda Silitonga ……	

Table of Content

List of Chart

List of Figures

List of Abbreviations

BSC – BALANCE SCORECARD
CCPM – CRITICAL CHAIN PROJECT MANEGEMENT
E & P – EXPLORATION AND PRODUCTION
IFS – INDUSTRIAL AND FINANCIAL SYSTEM
IOT – INTERNET OF THINGS
KPI – KEY PERFORMANCE INDICATOR
O & G – OIL AND GAS
RFID – RADIO FREQUENCY IDENTIFICATION
TOC – THEORY OF CONSTRAINT
VSM – VALUE STREAM MAP

PREFACE

It`s been a hard journey for both of us reaching this final goal which marks the end of this thesis and also complete our Masters study. So many challenges we have met, but at the end we managed all. The initial one was to find a cooperative company, willing to participate since we made a decision to use an example analogy directly in a real situation instead only working based on theory. We are very grateful that we had the opportunity to get access to a company, to study and survey their operation in one of the biggest industries in Norway – the Oil and Gas (O&G) industry. With the intention to connect findings to our background in business administration, warehousing was our topic of choice. Warehousing, as one of the main important part of the company, has many common processes but can be quiet challenging to detangle the process flow between all the partners. Somewhat like our journey – the collaboration of two individual people aiming for one goal, as it says: "there is no *I* in a team! It takes the contributions of a group of people to achieve great things, and warehousing is no different. You have operators, truck drivers, admins, managers, and more. It is a team effort".

Moreover, we would like to acknowledge the people who helped us to succeed in this thesis:

First, we like to thank Maersk Drilling Norway AS, especially to the Supply Chain Manager – Jan Luis Nistad and the Warehouse & Logistic Manager – Thron Gundersen and their team in spending their precious time assisting us.

Second, Jan Frick as our supervisor, for providing guidance in this thesis' evolution.

Third, Mathias, Leo, Marie & Lorenz for their patience, love and never-ending support.

Lastly, to our friends and family who were there for us around the clock.

Thank you very much and God bless you.

1.0 INTRODUCTION

Warehouse is an integral part of a company. Part of its functions is to support the logistics in daily operation such as receiving, storing, distributing material, etc. Unorganized and poor warehouse management can disturb the operation and even stop the entire project (e.g critical material is not available or did not arrive on time). However, to some companies warehousing is not their strategic focus. Oftentimes they neglect its importance and instead opt to focus on how to run daily operation and to capture and maximize opportunities for profit. This has been observed in oil and gas industry, where the daily rig operations cost more compared to a monthly operation in a warehouse. To further elaborate this, we conducted this study to examine and identify how to optimize warehouse operation using lean concept particularly in Maersk Drilling Norge AS.

Correspondingly, Radio Frequency Identification (RFID) – a technology that has been used to replace barcode in terms of identifying material and items specifications, was employed in this study. It was used to further develop on how the innovation process in the concept of Internet of Things (IoT) can help improves the flow of the warehouse and develop the overall supply chain of the reviewed company.

2.0 BACKGROUND

This chapter introduces general information about the oil and gas industry in Norway as the backbone of Norwegian economy along with the challenges of the industry. Moreover, we provide general information of the exploration and production (E&P) industry of the country, where affiliates operated, followed by how E&P works in drilling rig sector and then we introduce the nature of the company - Maersk Drilling Norway AS and its background. General flow is also provided to have an overview on how Maersk works within alliance (tripartite).

2.1 The Oil and Gas Industry in Norway

Petroleum and oil exports are the largest industry in Norway, where oil and gas (O&G) contributed to about 25% of the GDP in 2010 (Economy Watch, 2010). Norway is the third largest exporter of natural gas in the world where nearly all O&G produced on the Norwegian continental shelf (NCS) is exported (Norwegian Petroleum, 2019). In fact, combining O&G exported is equal to half of the total value of goods exported as shown in the graph below. Consequently, O&G is the country's most important export commodity. All the O&G they produce from the licensee's Norwegian shelf are for sale except Equinor (former Statoil) who were additionally instructed by the government to responsibly sell the government share of its O&G production (Norwegian Petroleum, 2019).

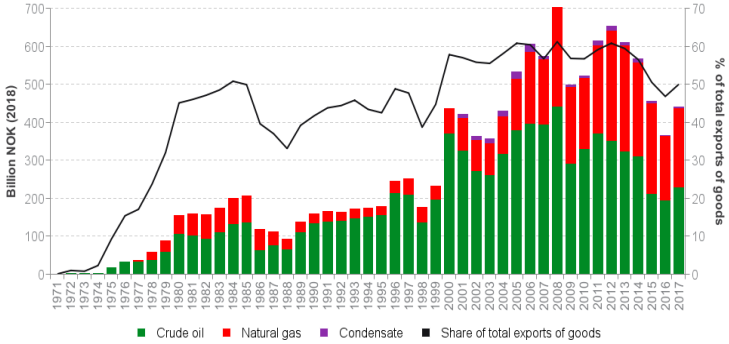


Chart 2.1. Export Value of Norwegian Petroleum 1971 – 2017
Source: Statistics Norway, table 08800

After almost 2 decades of a rising, recession fell into Norwegian's O&G industry in 2014 and many companies went into a typical reduction of investment and of their staff, indeed down to

employment destruction levels. To compensate this, some of the companies went into strategic partnerships to lower cost, which also was associated with risks to ultimately not survive the downturn and competitive environment. One of the strategic alliances established was initiated by the locally newly merged E&P company AkerBP, with tripartite companies AkerBP as the operator, Maersk Drilling as the sole drilling company and Halliburton collaborating as the prime service company. Aside of this alliance "at the end of 2018, a total of 39 exploration and production companies were active on the Norwegian shelf consisting of 25 companies as operators and 14 as partners in licensing production" (Norwegian Petroleum, 2019).

2.2 Challenges of Exploration and Production Industry

The biggest challenge in the E&P industry is complex operations while controlling costs and optimizing the performance in some of the most physically and politically challenging environments. To manage risks, the O&G companies try to increase visibility in all operational tasks. One strategy is fully integrated operations, such as forming a strategic alliance of them as operator, the rig contractor and the service company. This partnership can become a challenge because every company has set their own goals, also their way to execute and perform their piecework within the operation. Working together and aiming for a common goal is challenging and needs clear upsides for all parties. If these strategic partnerships become more common and most companies participate in strategic pacts an agreed time and scope, consequently available opportunities and services offered in the market will be limited.

With all these challenges, companies in this field has encouraged to use safety climate measures in assessing safety performance in the organization (Horbah, Pathirage, and Kulatunga, 2017). Additional challenges mentioned in Businesswire, 2018, as the major challenges in O&G industry, are the following:

- Minimizing costs to remain competitive – this refer to the refined industrial products and crude oil at a lower cost.
- Performance improvement – due to maturity of sites, the challenge to guarantee that their plants are dependable and have no unanticipated shutdowns.

- Meeting environmental regulations – company must meet the environmental standards since O&G is the main consumer of energy and water. Added on is the transparency of the environmental management of their processes.

2.3 Overview of Exploration and Production industry

According to Lavis (2017), there are three forms of player working together for an exploration and production business process in an O&G industry. These are *(1) Operator, (2) Contractor, and (3) Service Company*. The nature of each process are as follows:

Operator – this is the company who has a license to explore and produce hydrocarbon in a designated area. The operator company will launch a tender for service companies and contractors to do the job under the operator plan. When the job is terminated, the operator will sell and supply O&G to the market.

Contractor – as a drilling contractor, the company owns and provides the rig and worker for drilling activities. The contractor normally charges operator by a daily fixed rate and follows the plan and rules provided by the operator; but this does not mean that the contractor cannot intervene. As long as it is for safety reason, contractor and even the service company can interfere with the plan.

Service company – the company who supplied the gaps for the contractors and operators. These can include many different physical products, as well as services such as logistics, supply chain, software and training. The service company will perform specific duties to the rig site as agreed by the operator.

Along these tripartite companies in exploration and production industry, this thesis focuses on the drilling contractor perspective, particularly in its logistics and warehousing supply chain.

2.4 Drilling Contractor Company - Maersk Drilling Norway

“Maersk Drilling supports global O&G production by providing high-efficiency drilling services to O&G companies around the world” (Maersk Drilling, 2018). The company owns 23 offshore rigs (15 jack-up rigs and 8 floaters): out of 15 jack-up rigs, 13 of which are specializing in harsh environment and deep-water drilling operation. Out of these 13, 8 are certified with a Norwegian AoC – Acknowledgement of Compliance (Maersk Drilling, 2018).

Maersk Drilling was founded in 1972 as part of the A.P. Moller – Maersk Group, and has been on the forefront in developing high-end rigs with an operating model supporting some of the world’s leading and most innovative O&G companies. Several records and awards have been achieved over the years underpinned by a well-reputed operational performance and long-term customer relationships and partnerships. At the headquarter in Denmark 2,850 people was employed in 2018 (Maersk Drilling, 2018).

Over the period, Maersk Drilling decided to pursue to demerger on 17 August 2018 via a separate listing of Maersk Drilling Holding A/S and its affiliated companies (Maersk Drilling) on Nasdaq Copenhagen in 2019 (Maersk Drilling, 2018). This decision was set out in September 2016, strategically through focusing on integrating and transforming A.P. Moller – Maersk’s transport and logistics businesses to be separated in O&G related business from A.P. Moller – Maersk (Maersk Drilling 2018).

2.5 General Flow

As mentioned, this thesis will focus on the warehousing of the company and the way they do in the activity cycle. Fig. 2.1 shows the general flow in the company with an extended participation of the other E&P industry, as mentioned above, as tripartite. We present this flow to obtain an overview of the entire industry as connected in the process and to easily track for further observation and analysis.

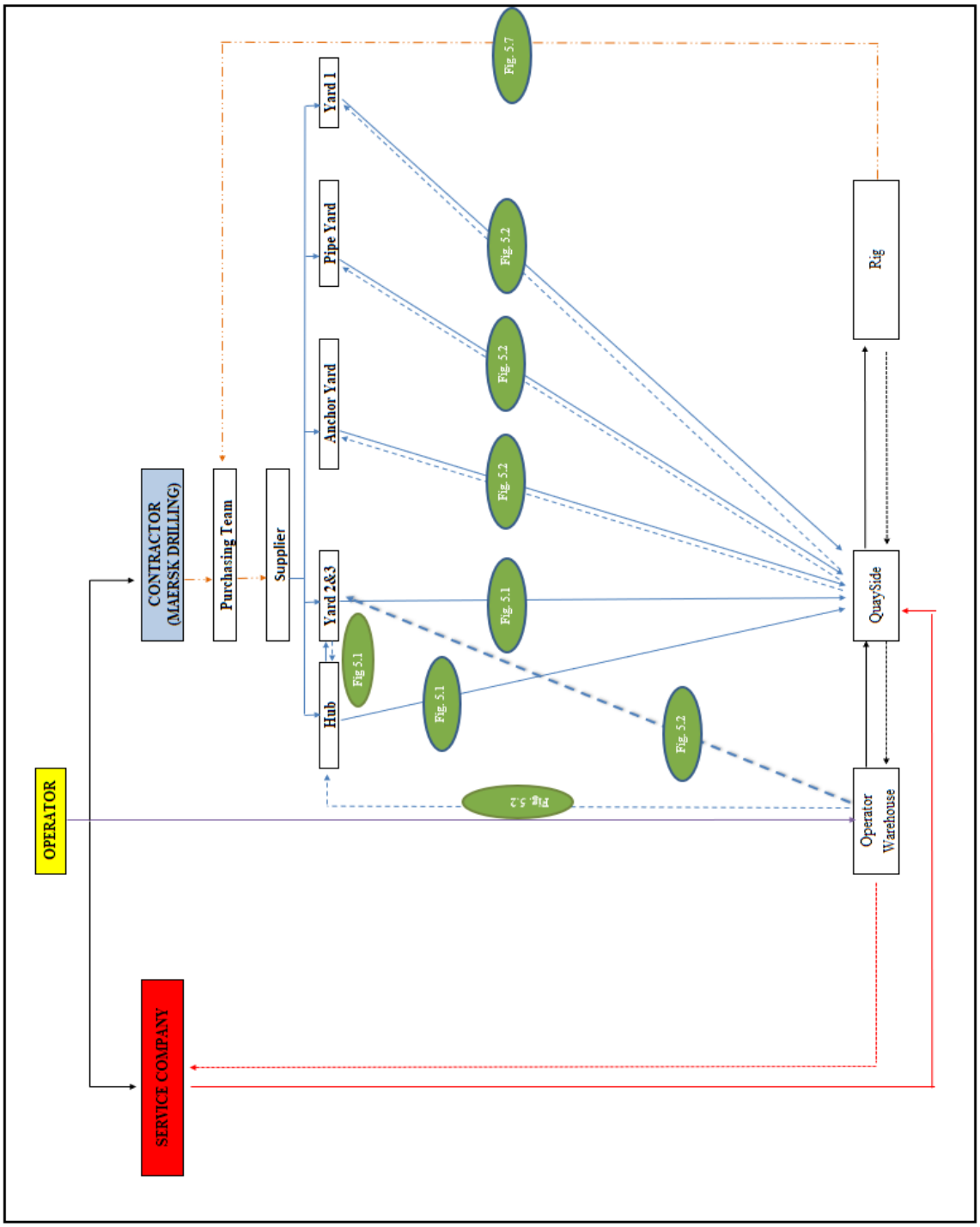


Figure 2-1. General Flow (tripartite)

Legend

Information Flow

Material Flow

Material Flow (from - to)

Fig. X — Figure numbers

2.6 GOAL

The primary goal of this thesis is to optimize the warehouse, considering the innovations nowadays to make it efficient and effective, as well as productive in operation. Moreover, we consider the Lean approach, in analyzing the activities occurred in the workplace, and to understand how the context of Lean can aid the process. Three research questions were formulated to address the main problem and be more specific in getting into probable solutions.

2.6.1 Research Questions

To get into detail in optimizing the warehouse, we propose some of the research questions allowing to narrow down the problem. These research questions are:

- What causes the warehouse operation's ineffectiveness?
- How the supply chain is affected by inefficient operation?
- How innovations can aid the process to be more effective and efficient in warehousing?

2.7 Outline and structure of this thesis

The structure of this thesis is divided into seven [7] main chapters where each chapter is divided into subsections.

Chapter 1: This chapter elaborates the background of the chosen theme.

Chapter 2: Background presentation of the O&G industry in Norway, discussing as well briefly challenges of stakeholders/ companies in O&G industry is presented. Moreover, general information about E&P business models are given in order to understand the responsibility of each player. As the company chosen for analysis is Maersk Drilling Norway AS, its background is presented to some detail. Furthermore, to understand how a tripartite company/ alliance work in the operation, the general flow is provided. Lastly highlighted is the goal of the thesis, which formulates the problem of the research question.

Chapter 3: In this chapter we present relevant theories related to analysis of warehouse management, internal communication, lean concept that includes 5S, VSM, Gemba approach, Theory of Constraint (TOC) and Critical Chain Path Management (CCPM) and Internet of Things.

Chapter 4: This chapter shows the choice of data collection and methodology that has been used for the thesis as well as scope and limitation.

Chapter 5: Here we provide analysis of the collected data followed by discussion on the propositions of the findings.

Chapter 6: This chapter presents validity and reliability of the data source

Chapter 7: Last chapter provides conclusions and suggestions.

3.0 THEORY

This chapter is a collection of relevant theory that is primarily based on warehouse management, internal communication, lean concept that includes 5S, VSM, Gemba approach, Theory of Constraint (TOC), Critical Chain Path Management (CCPM) and Internet of Things (IoT).

3.1 Warehouse

In the context of warehousing, typically it adds up 8-10% cost in the product which make it more significant to an enterprise. The primary objective of the warehouse is to store goods (Heizer, Render, Mundson, 2017, p.457). A typology of the warehouse stated by (Van den Beg & Zijm, 1999, p.520) comes to three different types as follows:

- Distribution warehouse – is a warehouse which products comes with variety suppliers assembled and collected to be distributed to a diverse customer.
- Production warehouse – is a warehouse use for storage of semi-finished products, raw materials and finished products in the facility of production.
- Contract warehouse – it is a facility that performs the warehousing operations in the interest of a customer contracted with them.

3.1.1 Warehouse Management

In managing the warehouse, the usual issues being encountered are the inventory management and assignment of the location where goods are to be stored. Normally, the activities of the warehouse are receiving, storing, picking and shipping (Van Den Berg & Zijm, 1999, p. 521). According to (Harmon, 1993; Tompkins et al., 2003 cited in Faber, Koster, Smidts, 2013, p.1232), the warehouse management objective is to effectively and efficiently organize the entire process of the warehouse and its activities. Therefore, warehouse management includes all the planning and control procedure which are concerned with managing the full warehouse operation activities for customer's satisfaction (Slack, Chamber and Johnstonet, 2001, as cited in Faber et al, 2013, p. 1232). Within planning, (Faber et al., 2013, p1232) distinguish tactical and operational level. That, in tactical decision level, to use the warehouse resources and fulfil the market demand is the main purpose. However, tactical planning demand does not stay for

long time due to the extreme dynamic environment. Whereas, operational level decision uses rules to sequence, schedule, and optimize planned activities (Slack et al., 2001 cited in Faber et al., 2013, p.1232).

3.2. Lean Management

Lean in history is based in Japanese culture circle. It was developed "in Japan in the Toyota's plant and then copied in every organization around the world" (Parkes, 2015, p.106). Being copied, Toyota Production System (TPS) take part in the world-class operation which leads to company's continuous improvement at Toyota Motor Corporation (Heizer et al, 2017, p.638). Aside from its origin, there are also elements of lean that was taken and copied from other philosophies such as Total Quality Management (TQM) concept and H.Ford's plant organization production (Parkes, 2015, p.106). Lean management according to (Parkes, 2015, p.106) is a concept of helping the organization to achieve a "slim shape". From the list of main concepts itself which derives in two philosophical inkling – gives value to the customer as the way they wanted and reducing waste and resources to achieve company's goal (CGMA, 2015). It is driven by workflow initiated by the "pull" of the customer's order (Heizer et al, 2017, p.638). In this sense, the entire process is being slimmed and remove unnecessary loads and possess more flexibilities for effective actions (Bednarek, 2007 cited in Parkes, 2015, p.106).

Lean Concepts has major areas / elements that need emphasis and consideration to be understood as follows:

3.2.1 Operational Fundamental Issues

Three (3) fundamental issues to improve operations in operations manager's perspective (Heizer et al, 2017, p.638-640):

Eliminate Waste

This refers to activity that somewhat not important to the customer because it doesn't give value at all. As per Taiichi Ohno, the following are the seven [7] categories of waste in lean operations which cover many ways of organizations waste or lose money:

1. Overproduction – excess production as to customer's demand and before it is demanded is a waste.
2. Queues – the waiting time, idle time, and to store so much is indeed a waste (it doesn't give value)
3. Transportation – movements of transferring materials in the workstation and or in the plant facility more than once is considered waste.
4. Inventory – every excess in operating supplies, needless raw material, work-in-process (WIP), finished goods are no value and definitely a waste.
5. Motion – the movements of people even equipment is also a waste and adds no value.
6. Over processing – excess work on the product that has no value also waste.
7. Defective product – claims of warranty, returned product, doing rework and even scrap are wastes.

Remove Variability

It refers to variability caused by internal and external factors. Variability is any nonconformity from the optimal process that transports a flawless product on the exact time, every time where it also means as problems. Poor management is also one of the causes of variability and so thus, tolerating waste. The following are many sources of variability:

- Poor procedures which enable suppliers and employees to create quantities or non-conforming units
- Insufficient maintenance for services and procedures
- Unidentified and shifting demands of customer
- Not complete or not accurate bills of material, specifications and drawings
- drawings, specifications, and bills of material

Improve Throughput

Throughput is the frequency of the process where units are moving. Each time the product is still in the books, cost accumulate, the advantage of being competitive is lost. Time in consideration is when the products arrived and ship it to the customer. For example, phone-system manufacturer Nortel had materials pulled directly from qualified suppliers to the assembly line.

A style to increase the throughput is a pull system which is pulling an item whenever it is just needed. Pull system is a usual instrument of Lean. The concept is used both within the immediate production process and with suppliers. This by means, pulling material through the system in very small lots just as needed will reduce waste and inventory are removed. Pulling items through a process just as needed somewhat "push" mode typically reduces cost and progresses performance schedule and enhancing customer satisfaction.

3.2.2 The 5S' System

By definition, 5S is an idea came from five [5] Japanese terms used for generating and satisfying a well-organized workplace that is effective, efficient and fruitful in operation (Agrahari, Dangle, Chandrate, 2015, p.180-187). It is a good checklist for lean operations in considerations with housekeeping concept for a neat, orderly, and efficient workplace and as a means of reducing waste Heizer et al., 2017, p. 639). These 5S's are the following:

1. *Sort/segregate* – clearing the work area. Classify what is needed or not and get rid of the non-value items. All other items must be sorted out to make other places available. In that way, it will make the workplace spacious and help improve the workflow.
2. *Simplify/straighten* – the whole place in working area must be in position and has its own place. You can set all items to have a good working procedure and can minimize wasted motion.
3. *Shine/sweep* – clean daily. Being clean comprises housekeeping efforts, cultivating the ambiance of the area. To clean up the mess every day is a way of getting rid of the dirt rather than cleaning the dirt when it is way mess up (CGMA, 2015).

4. *Standardize* – eliminate variations by emerging standard operating procedures and checklist in the process. Everyone in the working place together with the organization must involve the 5S effort – creating best practices in uniform (CGMA, 2015). Train and reeducate the working team to be able to be ready in all deviations that might occur.
5. *Sustain/self-discipline* – to recognize effort and sustain progress is not easy. Thus, 5S involve culture change. It must be rooted in everyone's values and culture to easily adapt when changes occur. Yet, culture change needs to be ingrained into the organization at all levels to communicate and sustain progress, in achieving culture changes as well (CGMA, 2015).

To consider additional 2S's (Safety and Support/maintenance) added by U.S. managers are the following (Heizer et al., 2017, p. 639):

- *Safety* – to have safety measure practicing the first five [5] activities.
- *Support/maintenance* – Implement maintenance for shine task to support lower variations, costs, etc.

3.2.3 Implementation of 5S

In the case study of Agrahari, Dangle, Chandratre 2015, p. 180-187, a possible guideline in implementing 5S was mentioned. Accordingly, these guidelines are much helpful to improve the warehouse and the process in the cycle of activities. The guidelines are as follows:

a. Sort (Seiri) – excess items are removed immediately which are not needed in the working area for continuous operation (Hough, 2008 cited in Aghari et al, 2015). It is the finest way to create the work center spacious. The guidelines to practice sorting are the red tagging which is to eliminate unnecessary items in the workplace. The steps according to Agrahari et al. (2015), p.182 are:

- keep only what is needed
- keep the amount needed and,
- keep when it is needed.

There are six (6) steps elaborated in generating successful red-tagging process (Agrahari et.al, 2015, p.182):

- Launch the red tag project.
- Identify the red tag targets.
- Set red-tag criteria.
- Attach the tag.
- Evaluate red-tagged items.
- Document the result in red tagging

b. Simplify / Straighten (Seiton) – to arrange the product and equipment in place to easily find and use them when needed ((Bullington, 2003, p. 57). As mentioned in red tagging, labelling the items or equipment that is not usually in use can help easily find the item and identify them. When you have the label, you can even easily know in a glance what are those missing items, items in need and items that are improperly placed. When you have the items in its place, it emphasizes safety, efficiency and effective storage. It can also improve the presence of the workplace and have a pleasant environment (Agrahari et.al, 2015, p.181).

In simplification items (Agrahari et.al, 2015, p.183), it involves activities such as:

- Mark reference materials such as slanted line to easily capture disorder in a distance;
- Store tools near the machine that are often used to have a sequence in work operation;
- Organize files like color coding;
- Store similar items together;
- Store different items in different row or location;
- Use rack or shelves to stack items separately;
- Use small bins to organize small items;
- Use color for quick identification items;
- Label the items and storage clearly for visual control;
- Practice using most visible like see-through cover;
- Use carts that designs for specific organizing tools, jigs, and devices for measure in accordance to its use
- Create tool boards.

c. Shine (Seiso) – after removing all the unnecessary items and putting it in its place, it's time to clean the workplace (Hough, 2008 cited in Aghari et al, 2015, p. 182). "Cleaning implies system maintenance and inspection" (Bullington, 2003, p. 58). To clean up, it needs employees' involvement for data gathering of what is needed and not needed in the area and to get involve on how it is ought to clean (Samuels, 2009, cited in Aghari et al, 2015, p.182). To have a clean environment, is to have a better visibility which will decrease the picking time and guarantees advance quality of work, service and product (Agrahari et.al, 2015, p.183). To effectively practice the third S as value adding activity in a daily operation, the following should be done (Agrahari et.al, 2015, p.184):

Step: 1. Delegate Cleaning Assignments

Step: 2. Know what has to be cleaned. Determine What is to be Cleaned.

Step: 3. Know the procedure which being use

Step 4: Cleaning tools must be prepared as well as materials

Step 5: Equipment must work properly, if defective must be fixed.

d. Standardize (Seiketsu) – to maintain the standard is to integrate the three steps (sort, simplify, shine) to ensures implementation as it formalizes the procedures, schedules, and practices that sustain the system which leads through improvements (Bullington, 2003, p. 59). To have a standard is to make a procedures and simple daily checklist that is visible to everyone in the workplace. This checklist according to Agrahari et.al, 2015, p.184 must involve:

- Job responsibilities;
- Ownership of the responsibilities;
- Actions to be done in maintaining desired condition;
- When the actions be taken place;
- Where it will be applied;
- How to follow compliance of the actions;
- Cleaning procedures;
- Maintenance schedules

e. Sustain (Shitsuke) – next to do after implementing the 4S is for the managers, supervisors, and operators to continue the process to sustain (Ashraf, Rashid, M., & Rashid, H., 2017, p.1795). In this step, it must be habitual to maintain the momentum of the previous four (4)S to

ensure sustainability of the system (Agrahari et.al, 2015, p.184). To make further improvement, PDCA cycle is encouraged to be used effectively by:

- Build awareness of the importance of 5S through training;
- Reward and recognize efforts of staff;
- Use techniques / approaches to sustain activities.

Some of the issues must ponder to practice No. 5S without vigilant leadership yet effective according to Bullington, 2003 are:

- To care about the consistency of the message
- To work in accordance to program together with the actions outside procurement department
- Proper training of new employees is also important
- Appropriate structure must be considered for the program
- Significance of supply base maintenance for employee's performance appraisal

3.2.4 Gemba Approach

Gemba is a Japanese term which means "actual place". It describes the place where the actual process happens, and the value-creating activities can be observed which somehow satisfy the customer. According to (Imai, 2012, p. 24), there are 5 golden rules of doing "gemba". These 5 rules are:

1. When a problem (abnormality) arises, go to the gemba first. - As the axiom goes: "go to the gemba first". Managers must know beforehand the conditions in the gemba. It is management responsibilities to hire and train workers, set standards for their work, and design the product and process. In gemba, management sets the conditions and whatever is happening in it, reflects to the management. Thus, when the managers have the habit of developing gemba, he/she will be confident enough to solve the specific problem. By physically observing the process, it is easy to solve a specific problem instead of just listening to what others were saying.
2. Check the "gembutsu" (relevant objects) - "Gembutsu" in Japanese means something physical or tangible. The word "gembutsu" can be defective materials, returned goods, broken down machine or even customer complain(Imai, 2012, p. 24). By going to the

actual place, talk to the employee and see the process being performed at the shop floor, it is easy to observe the situation and see some other related problems. As the observation goes, the power of "whys" is being asks to know what happens.

3. Take temporary countermeasures on the spot – temporary measures might address only the symptoms, not the root cause (e.g. machine stoppage). In this matter, gembutsu is important to be checked thoroughly and keep asking why until root causes of the problem be identified.
4. Find the root cause – upon using gemba-gembutsu principles and common sense, many problems can be solved. Thus, taking seriously with gemba and looking at the gembutsu to identify root causes, many problems can be solved on the spot. Albeit, some of the problems entail planning and preparation to solve.
5. Standardize to prevent recurrence – manager must standardize work procedure and employee needs to follow the same standard every time to create the same outcome and ensure customer satisfaction. In this sense, every time there is variation it would be easily to track down who does not follow standard procedure.

3.2.5 Value-Stream Mapping (VSM)

VSM is a tool to oversee the whole process by mapping it from door to door, basically from the customer request until the delivery to the customer. Mapping the entire process, not a single process assures to identify non-value added as well the value-added activities. Not only to optimize some areas but to improve the overall process (Rother, M. & Shook, J., 1999). To be able to generate a VSM, below are the steps needed to be followed to get optimized results (Rother, M. & Shook, J, 1999):

1. Material and Information Flow - when making VSM, it is not only material flow that is important but also information flow that need to include. If Material flow is the movement of product, information flow is to guide the process what to make or what to do. Both flows are essential and inseparable.
2. Choosing product family - in the warehouse, there will be a lot of products coming in and out. Therefore, in order to create a VSM it is required to only focus on one product family. It will be difficult and complicated to understand the process of value stream in mapping for all the products in the warehouse. Making a matrix to a product will helps us identify a product family. Family product is a group of products

that going through the same way of process and over equipment in the downstream process.

3. Current – state mapping - the main objective to create the current state map is to understand the current condition in the warehouse by collecting all information that is needed. This information that can help to create a future state drawing. On the current state map besides information and material flow, to have a timeline for each activity is important. By providing the timeline it shows how long it takes for a product stay in one activity before it moves to the next one. Current mapping helps to identify which activity gives non-value added and bottlenecks in the whole process.

4. Future – state mapping - future map is created based on the information that is obtain from the current state map. How to improve the current situation by creating future state map with the adoption of lean concept to eliminate nonvalue activity. Current state map without making further the future state mapping will not get the whole benefit on making VSM.

5. Work plan and implementation - the last step is to plan on how to implement the future state. Once the future state is working on, as on lean concept is a continuous improvement, a new future state map should be made. This future map becomes the current state mapping and the company needs to make the new future state map.

To note: As the time is limited to finish the thesis, we only focus on step 1 until 3 from the 5 steps of VSM.

3.2.6 Theory of Constraint

Theory of constraint (TOC) is a set of management concept that was developed by Dr. Eliyahu Goldratt. Its goal is to help managers decision for "what to change?", What to change to?", "How to use the change?" (tocinstitute, 2019). It also refers to be the weakest link in the chain of a complex system, in any time given. In this sense, only one aspect in that system most often limits the ability in achieving its goal. To attain the substantial improvement of that system, constraint must be known and identified to be able to manage the whole system (CGMA,2015).

When observed to the functional perspective, there are list of problems often describe and viewed as constraint. It can be long in behalf of the problems in each department or function. Although, problems presented or detected are not all be the weakest links in the said chain as

sometimes these problems can be the most important ability of the organization towards achieving the goal. Thus, this weakest link can be resources that the company does not have enough physically or can be non-physical such as deficiency in the demand of the market to the product, relationship towards suppliers or other guidelines or ways (Gupta & Boyd, 2008, p. 993).

3.2.7 Critical Chain Project Management (CCPM)

Critical Chain Project Management (CCPM) is a project management that is an improvement from the Theory of Constraint (TOC). The originator of TOC, Eliyahu M. Goldratt sees that the TOC based on the critical path methods cannot really work on the traditional project management with uncertainty in the time duration and also unknown risk as well in a dynamic environment (Baldwin & Bordoli, 2014, p. 151).

In a project management, there are 3 factors that need to be considered before starting the project. According to Robinson, H. & Richards, R. (2010), these are: (1) *Schedule or time*, (2) *budget or resource*, and (3) s*cope, quality or performance objectives*. By implementing CCPM, it helps the project remove uncertainty about the project execution process, safety margin from individual tasks, change the safety time at the end of the project, or at the end of the task branches and make sure that the project is on time even in a dynamic environment (Luiz, O., De Souza, F, Luiz, J. & Jugend, D. 2018, p.423).

Moreover, the following are the six (6) problems that CCPM focuses on (CCPM lecture slide, October 2017 adapted from Critical point UK):

1. Task padding - in project management, to estimate the time is maybe the biggest problem because of the uncertainty and unknown situation. Therefore, many time estimates include individual safety time to ensure that the project can be accomplished within this time estimate. But in reality, this safety time doesn't work properly. An individual has the tendency to do the task on the last minute because of having the sense of security in time (McKay, K. & Morton, T., 1997, p.760).

2. Deadline scheduling - the purpose on having deadline scheduling is to make sure that the task completes within the time frame. In a traditional project management, it is focuses on individual task and deadline date for each task instead of focusing on the project completion date (Izmailov, A., Korneva, D. & Kozhemiakin, A., 2016) or project throughput. Therefore, there are some negative effects by using deadline scheduling, for example the behaviour of project team members. According to Robinson and Richards (2010) these typical behaviors are:

a. Parkinson`s law and failure to report the early completion of the job - referring to Parkinson`s law which states "… that work expands so as to fill the time available for its completion" (The economist). This can happen because of the tendency to further improve the work or even to be seen as a "reliable estimator" in the team (Cooper, J., 2013). In addition, according to Newbold (2013), no rewards if one can finish ahead of schedule or even being afraid that this can be a new estimator to be able to complete the next task earlier.
b. Student syndrome or Procrastination - is a behaviour to do the task on the last minute before the deadline.

3. Backward-looking metrics - the term "Backward" in the metrics is to show how far individual performance has completed the task. By this metric, it is looking about the past not for the future. Backward – looking metric doesn't help to see how much time is needed to accomplish the task. Therefore, it is a relatively poor measurement (Critical point UK).
4. Overlapping project starts - having too much project starting at the same time can make the process slower, or even can lead to some failures. Having too many projects at the same time will also drain resources, also raises conflicts in priority on which one should start first. Tendency to start the task in a rush by having a picture "start early finish early" but without having proper and complete information this can cause re-work of the task or process. Too much work in progress (WIP) forces to multitask, which can reduce focus in a task.
5. Multitasking - according to Dean, D. & Webb, C. (2011), multitasking work environments are killing productivity, reducing creativity, and worker become unhappy. How much time is lost when switching the task, it depends on how complex and how difficult the task in hand is, how fast this employee able to

figure out where he was and also it depends on individual capacity, therefore multitasking reduces throughput (Fox, K., 2014).

6. Critical path (CP) - critical path is a series of tasks from a project with the minimum amount of time that is necessary to complete each task. Because it is a series of tasks there is relationship between one to each other, therefore here should be no delay in the critical task line, as any task delay will delay the entire project completion date (Project management skills). The main problem in CP is that it ignores resource (Critical Point UK). CP focuses on task dependency and duration. Hence, CP only works in the environment without resource constraints.

CCPM can provides a solution that can help to solve the problems mentioned above, such as (CCPM Lecture slides, October 2017 adapted from Critical point UK):

- Project buffers – Removed all the task padding for each task and change it to create a buffer at the end of the project. By doing that it doesn't change the length of the project because it comes from time removed from each task padding.
- Throughput management – It helps to focus on the due date of a project not on the individual task. The purpose is to get the task done as soon as possible in order to be able to reach the final destination as early as possible (Critical Point UK).
- Forward looking metrics – It helps to understand how many days or how long it takes to be able to complete the task.
- Staggered project starts – Review the situation when is the best time to release new project. To release new projects only when key resources are available to handle the new project if possible.
- Single tasking – Reduce multitasking will have instant effect to increase efficiency and productivity.

3.3 Internal Communication

Consider the following figure below in (Welch, 2012, p. 247) adapted from Welch and Jackson (2007).

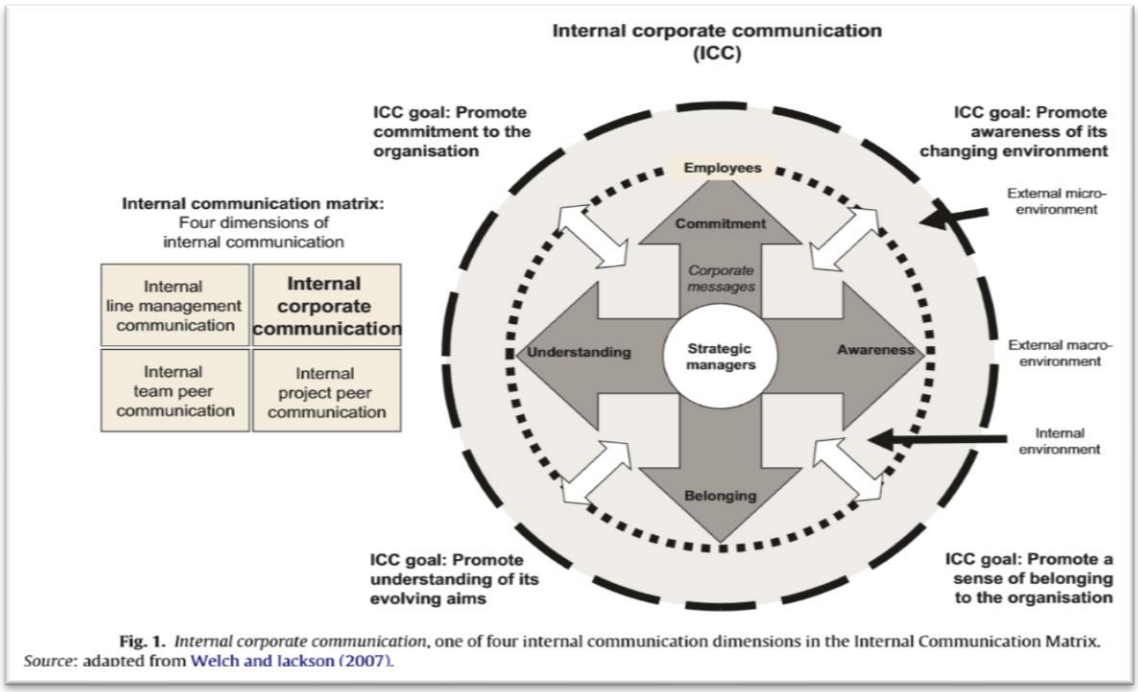


Figure 3-1. Internal corporate communication. Source: Welch (2012)

In the figure, internal communication divided into four dimensions: line management, team peer, project peer and internal corporate communication (Welch and Jackson, 2007, cited in Welch, 2012). As what being said, depending on how the information being relayed to the receiver, it will result for positive and negative response. Welch and Jackson, (2007), as cited in Welch (2012) shows to the reader how communication can aid to promote commitment and the sense of belongingness between strategic managers and internal stakeholders. Somehow, through their internal good communication it can develop awareness to its changing environment and the understanding of its evolving goal.

3.4 Physical Internet of Things

Internet of things (IoT) was first introduced by Kevin Ashton in 1999 in the context of supply chain management ((Gubbi, Buyya, Marusic, Palaniswami, 2013, p. 1646) in his presentation with Procter & Gamble titled “Internet of Things” (Ashton, 2009). Nowadays, IoT has been named into different term such as: Internet of Objects, Web of Things, Connected Devices and Technology Omnipotent, Embedded Intelligence, Omniscient and Omnipresent (Madakam,

Ramaswamy, Tripathi, 2015, p. 166). All these names have the same concepts of IoT. It is about the data created by things and people (Madakam, Ramaswamy, Tripathi, 2015, p. 166).

According to Chen, Xu, & Liu, 2014,p. 349, IoT is a global system network which intelligently connects all things to the internet for the purpose of transmitting information and communication via sensing devices in an agreed protocol. In a straight illustration of internet, behind those servers and routers and so on, is the people Ashton (2009). The people who first: type, press a record button, taking digital pictures and or scanning a bar code were the one first created and captured the data presented in the internet. Thus, in this sense, people first were the big part of all those things presented on the internet yet, it was just left out. Through a limited access of people in the real world, such as time, attention and accuracy – they are not in their best in capturing data about things (Ashton, 2009). Therefore, the world of internet / technology in any other businesses is a huge call.

There are five [5] different kinds of IoT according to Lee & Lee, K, 2015, p. 432, namely:
1. Radio Frequency Identification (RFID)
2. Wireless Sensor Network (WSN)
3. Middleware
4. Cloud Computing and
5. IOT Application Software.

In all these types, we consider RFID as the most applicable solutions that Maersk can consider.

3.4.1 Definition of RFID

According to Gaukler, 2010, p.362, radio-frequency identification (RFID) is a "contactless identification method that transmits information from an identification tag to a reader device via electromagnetic waves". This is useful to all area of supply chain including retail operations, inventory control and logistics, manufacturing and configuration management, as well as verification, fake security and protection. Gaukler & Seifert, 2007,p. 29-30, illustrates RFID in three parts as follows:

a) RFID tag, has two types:
    - First, it is a type of silicon chip which holds certain amount of data with unique identification number and an antenna that used remote reader device to communicate.
    - Second, is a tag that exploit certain RF-reflecting properties of materials. This is a chip less RFID tag and that the unique serial number lies through the properties of the material, e.g. the RF fiber configuration embedded in paper.

b) RFID reader device – through radio-frequency breakers, the reader device can communicate by means of the RFID tag over sending and receiving. There are two types of communications according to Gaukler&Seifert,2007,p.30 it can be:
    - *Passive RFID tags* – does not require power supply as it has an energy stored in the reader device's radio-frequency interrogation scan which is enough to wake up the RFID tag and enable to send responses through reflection by the reader's device.
    - *Active RFID tags* - contains a battery which allows the tag to respond the interrogation of the reader in a stronger signal. In this sense, it increases the distance from which the tag can be read.
    - Apart from passive and active RFID tag, Lee & Lee K.,2015, p. 432) added *semi passive RFID tags* where it communicates the drawing power from the reader using the batteries to power the microchip.

c) Backend IT system – is accountable for cross-referencing from an RFID tag's ID number through database records describing the attached tagged object.

With all the RFID tags mentioned, it depends of the choice and its purpose to be used. Thus, the higher frequency the longer the communication range and the faster the communication is, or the opposite. Accordingly, each frequency has different requirements for tags and reader devices although it can be combined for some applications (Gaukler & Seifert, 2007, p. 30).

3.4.2 Levels of RFID Tagging

There are 3 different level of RFID tagging according to Gaukler, G. & Seifert, R., 2007, p.32, these are as follows:

a) Pallet- level tagging – the tag is attached to the pallet and if the pallet is ready for shipment, the tag ID is automatic. Thus, it will be counter checked with a purchase order and of the inventory list on the pallet. Whereas, at the shipment it will be checked to the database records against the tag ID attached to the pallet with all the information.

b) Case-level tagging – it is the same with pallet tagging, just use the case-level. The advantage of case-level over pallet-level tagging is, it is more detailed in tracking as it is place in cases which is more visible than pallet. In case-level tagging, it also reduces labor time as it automatically counted per case instead of manual counting.

c) Item-level tags – it is part of the package of the item which is place either inside the product's box or to the item itself. This is the most visible and is useful in handling the supply chain. Mostly, this is appropriate in manufacturer as it places in the finished product, yet it is the costliest for them. Accordingly, for retail company this is the best possible solution.

3.4.3 Limitations of RFID

Like any other new entrants in technology, RFID has some limitations. (Gaukler & Seifert, 2007, 32-33) states that due to the law of physics, metals and liquids are two of the limitations that could block radio waves. Basically, RFID tags is not readable when it is surrounded by water and enclosed with metal. Although, some advanced tag and antenna design allow RFID tag to be read in a metal place if the tag is not fully enclosed.

In every problem there is always a solution thus in the case of metals and liquids, it needs multiple readers that challenge to read the tag in different angles for checking the effect. Through multiple readers, it will help improve the read rates with the presence of metals and liquids as well as the overall case. Some companies employed similar method to enhance the

read rates by just single fixed reader wherein the pallet with cases and items on it is rotated for visibility and the reader can see it in different orientations.

Another limitation of RFID is from the fact that it is relatively new in logistics operations. RFID tags might be defective just like in bar code labels may be torn and unreadable, and it could have been an issue for interference that tags could not be read. Hopefully, some of these limitations may find suitable technological solutions especially RFID technology in the recent time is getting mature in the market (Gaukler & Seifert, 2007, p.33).

3.4.4 Benefits / Advantages of RFID

In every new technology comes with advantage and disadvantage as many other new ideas and concepts. Aside from the limitations mentioned, Gaukler and Seifert, 2007, p. 35 revealed the following benefits of RFID in logistic, transportation and warehousing as follows:

1. *Labor and time saving* – from supply chain digest 2005 cited in Gaukler & Seifert, 2007, p. 35), this refer to the concept of "the uninterrupted supply chain" (TUSC). The concept of this is of a big percentage of the time travel of the product in the logistics systems or the supply chain, consuming the time for waiting in completion of manual process and for identification such as accounting identified cases and documentation. Hereafter, stopping points in the flow of goods is continuous. Thus, a use of RFID system can potentially eliminate several of these stopping points which will move the product with less cost and faster in the system.

2. *The benefits to increase visibility* - to know the exact location of the inventory items in real time is allowing the decision makers in the supply chain effectively. The increase of visibility is simply efficient and accurate which is enough to validate in implementing RFID and be realized as benefit (MIT CTL 2004 cited in Gaukler & Seifert, 2007, p. 36).

Gaukler and Seifert 2007, p.30, mentioned major advantages of RFID from the standpoint of application. These are the following:

- The line of sight is not required

- Possible reading of multiple parallel
- The individual item is identified instead of class of an item
- Capability to read and write

3.4.5 RFID - Cost Consideration

The main cost components according to (Gaukler, Seifert, & Hausman, 2007, p.66) are:

- the smart tags,
- stationary readers and,
- the corresponding IT infrastructure.

Consequently, variable cost is the tag cost whereas the installation of the readers and the adaptation of the IT infrastructure are the initial fixed cost. Initial investment to implement this automated smart logistics through RFID probably costly but then once the fixed cost of the infrastructure such as back-end system and readers are considered, additional cost like RFID tags are minimal ((Zhou, Chu. C., Piramuthu, S., &Chu, F., 2017, p.10). Notwithstanding, even trials and implementation of RFID are widely publicized, the low value / low margin items for item level tagging is not yet proven. Thus, this could be a downside to tender this technology to low-value, low-margin items (Gaukler & Seifert, 2007, p.32).

4.0 METHODOLOGY

There are various methods and theories in research to provide information. This thesis focuses on qualitative data obtained from investigating the warehouse operations of Maersk Drilling Norge AS by visiting the site three [3] times. The applied data collection is based on triangular research methods, namely: interview, field visit and observation, followed by analysis using A3 methods.

Interview and Field Visit

The data collection was carried out by several interviews including the field visits (Gemba). In order to make sure that the information is valid and reliable, the interviews were held with the key persons of the company (first level of source) to understand the background of the company and specifically the warehouse operations. Key persons interviewed are:

1. Supply Chain Manager – Jan Luis Nistad
2. Logistics and Warehouse Manager– Trond Gundersen
3. Warehouse staff – five [5] individuals
4. Third party / facility staff - two [2] external workers working for the rented warehouse (Yards 2 and 3)

Three [3] separate interviews were held individually with the supply chain manager in the company's head office. The duration of the interviews were approximately two [2] hours per session. The questionnaire was our own creation, with the aim to understand the nature of the company, the supply chain in logistics and the process of the whole cycle in the warehouse itself. All the information from the supply chain manager is very valuable and relevant for the thesis output and results.

Finally, the focus of the thesis rests in the warehouse operation. With the intention to understand the warehouse operation, we conducted further interviews and warehouse visits with the logistic and warehouse manager Mr. Trond Gundersen. Due to time limitation, only five [5] out of six [6] warehouses as presented in 5.1 were surveyed in one day. After visiting the warehouses, the decision was only to focus on the transit warehouse, because the main activity is in this facility. Afterwards, two opportunities to visit the transit warehouse has been taken with the intention to analyze and observe the flow of material and information to create a VSM as shown in Fig.

5.3. During the visits, some interviews were made with the warehouse staff to further understand their challenges.

4.1 A3 Method

For problem solving, the A3 method is used as a guidance to analyze the data collection from the interviews and "gemba". The steps involved in A3 are shown in figure below.

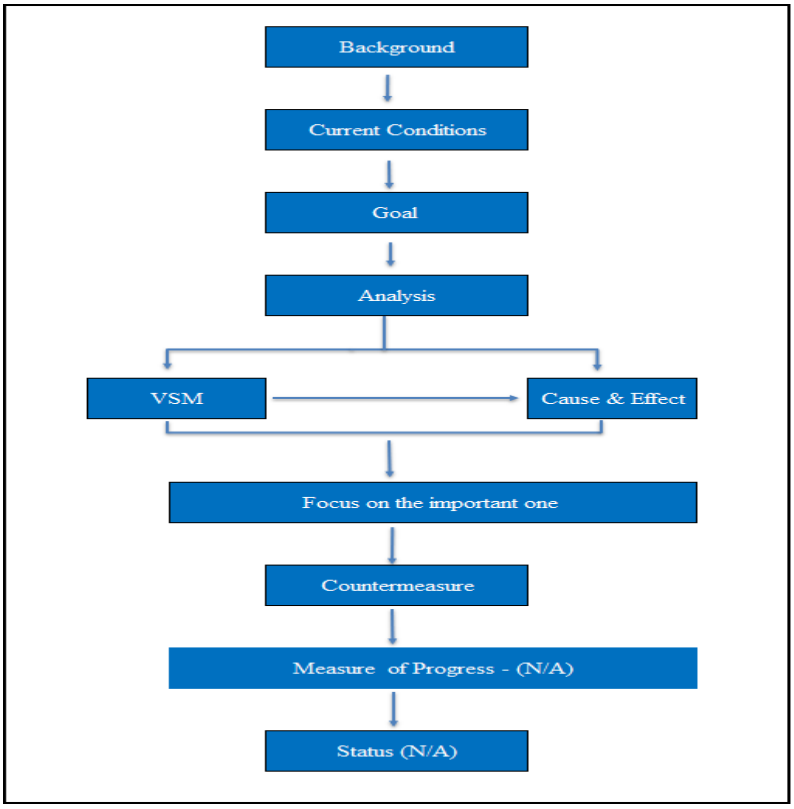


Figure 4-1 A3 Method

A3 method is a problem-solving method developed by Toyota. Toyota named it A3 from the idea of the size of an A3 paper sheet (11" × 17") on which the problem was captured and analyzed as well as communicated to the entire organization or team (Sobek, D. & Jimmerson, C., 2004). This method allows to dig in the situation and to discover not only the symptoms but the root cause of the problem as well. Following the A3, we tend to first look at the main problem of the warehouse, then we burrow in and find out what is happening in the flow of the activity (Fig. 5.3). As we go along with the mapping, to characterize the reasons and effect of the problem, we further do the fishbone analysis, which we can refer to in Fig. 5.5.

To find out the most important cause and reasons of the problem, we reinvestigate the process as we revisit the VSM. In the possible solutions, we come up with different ideas and ways for the implementation of Lean, and to be more innovative: with people, the process and the technological system.

4.2 Scope and Limitations

There are some challenges that somehow limit this thesis, as the following:

Time – originally, the time frame of the programme to make this thesis was 5 – 6 months. Due to some unavoidable circumstances, it took us 3 – 4 months to settle and start our own observation through "gemba".

Information – the information gathered was based on the gemba (3 visits) and the interviews employing the guide questions. Thus, other information possibly needed in other days of operation was not provided and may have limited the discussion presented in this thesis.

RFID *System* – being one of the propositions to implement this system in the company, the information we gathered during the thesis work is limited by the knowledge on the system obtained because of the rapid change in its technology.

After the observations through interviews and "gemba", issues addressed were the problems inside the warehouse process itself and the effect of the supply chain. We limit this thesis up to what we understood the company needed to improve and implement a plausible solution. Some of the propositions might have been on process and practice especially for the 5S implementation.

5.0 FINDINGS AND ANALYSES

This chapter presents gathered information about Maersk Drilling's warehouses which are based on the findings from the "gemba" walk and interviews with key personnel and warehouse staff. Moreover, it is followed by a discussion on the analysis using the A3 method as guidance, as well as actions of the A3 based analysis as the solution proposition. The outline of this chapter is as follows. Section 5.1 introduces the 5 warehouses Maersk operates, with a detailed focus in Section 5.1.1, highlighting the activity of the transit warehouse/main hub. Section 5.2, provides important information based on the initial observation. Section 5.3 covers the mapping analysis to understand the activity in the warehouse better, while section 5.4, presents the warehouse layout including the material in and out flow of the warehouse. Section 5.5 analyses and identifies the root causes of the problem using a cause and effect diagram. Section 5.6, specifies the general flow of the warehouse in more detail. Subsection 5.6.1 illustrates important factors that company needs to pay attention to and section 5.7, concludes with the proposition of the analysis using 5S and RFID implementation.

5.1 Presentation of Maersk Warehouses

Based on the interview with the supply chain manager and warehouse manager, Maersk Drilling operates 5 warehouses in Rogaland, Norway. Each warehouse has its own purpose to store equipment. In order to understand what these warehouses are, their cycle and the processes regarding how material flows in and out, a "gemba" walk was conducted. As the time was limited, site visits to the warehouses covered four [4] of the five [5] warehouses, where the single purpose anchor yard was not visited. The following warehouses are:

5.1.a. Yard 1 (refer appendix 1)

The first warehouse is located in Energiveien, Tananger. The warehouse is not owned by the company – it is rented. Owner of the warehouse is SR Group. In this warehouse (and all other warehouses except the main hub warehouse) Maersk does not have direct employees. All equipment is lying on the ground and this warehouse is an open yard. The warehouse has no security measures such as alarm systems or video surveillance as Maersk believes no one would steal such heavy equipment. The equipment is costly, although some of it is rusty and is fully

depreciated and non-functional. The warehouse manager Mr. Trond Gundersen informs us that some equipment might be scrapped (thus, they should sell those scrap to get income out of it). However, the management can only decide for scrapping. Most of the large equipment stored in this warehouse has been there for many years. Some up to 5 – 10 years with no activity required pulling out this equipment for use in operations. The process is: each equipment has its own tag with the specification of the item and a tag number, but in unavoidable cases, the equipment has no tag, the tag is hard to find or broken. In this situation, when Maersk company needs some of the equipment, they either provide a picture of the item or sometimes SR group sends photos to confirm the equipment is the desired and exact one. The loading and unloading of the equipment seem not problematic because the area is so wide in space, although there are also other renters in the same area beside each rented place.

5.1.b. Yard 2 and 3 (refer appendix 2)

The second surveyed warehouse is located in Risavika Havnering, Tananger. This warehouse is the same as warehouse 1 which is also rented out and owned by Kuehne Nagel. There is also no Maersk staff; all the employees are from Kuehne Nagel. The facility consists of a warehouse and an outdoor storage area/yard. Maersk rents one of each space (one indoor and one outdoor). The lease contract is set up per square meter. Whenever the equipment needs to be stored indoors, Maersk company must advise it. Indoor storage has higher rent than outdoors. The equipment has its own-labelled tags. The offshore shipping/transit operation activities mostly happen in this warehouse.

At the moment, whenever there is shipment coming from the supply vessels, Aker BP (being in alliance with Halliburton and Maersk) uses ASCO transport to pull out the containers from the vessel and drop them in their own yard (next to Maersk rented yard of Kuehne Nagel); therefore Maersk as well as Halliburton has to pick up their container. That process and operation, Aker BP – Asco transport – Maersk warehouse, is costly (Trond Gundersen, personal communication). Tentatively, this process will change on May 2019 to a process where ASCO will drop the containers directly into the warehouses of each company to minimize cost. This warehouse is more convenient as it is close to the quayside. Whenever there is shipment to quayside, it is easy for the warehouse personnel to pack and prepare the equipment. Thus, the process is:

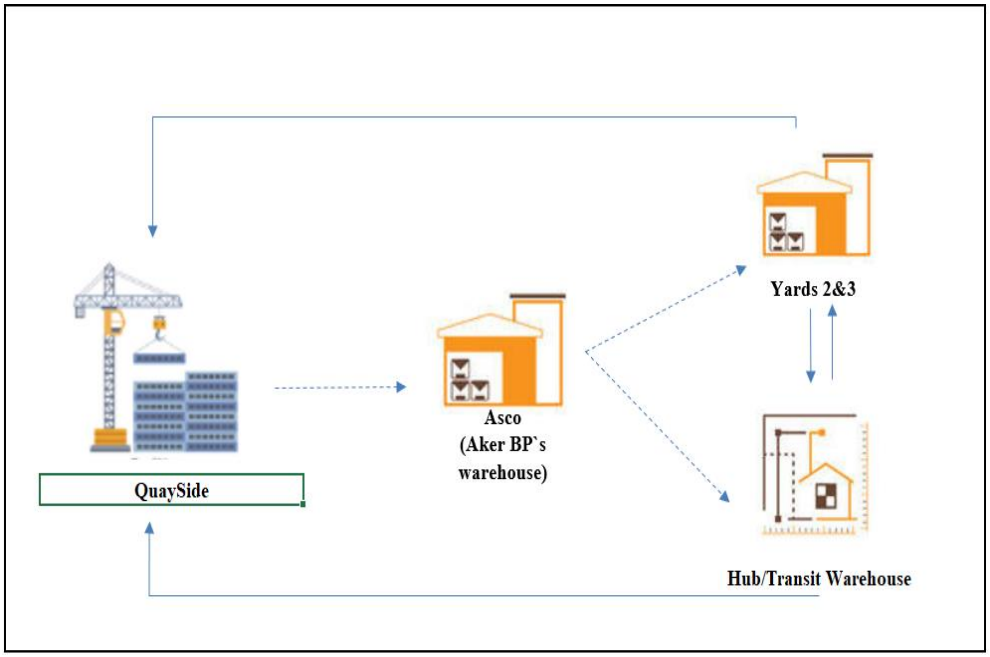


Figure 5-1. Flow of Yard 2 & 3 and Transit warehouse

Consequently, the figure above says that from quayside, the containers dropped and received through Aker BP are picked up by Maersk transport through Kuehne Nagel to be delivered to yards 2 or 3 for storage in lieu of the HUB /Transit warehouse. Internally, whenever there are items that the HUB receives for storage, these items are placed to yards 2 and 3 in some reasons.

5.1.c. Pipe Yard (refer appendix 3)

The location is at Hanasand, Rennesøy. The owner of the warehouse is National Oilwell Varco (NOV) – Tuboscope, who also is the supplier of all the pipes and tubular. It is an open wide space where a variety of pipes is stored. The supplier charges Maersk per pipe when moving the item. Maersk is not involved in the storage of pipes, which is run by the warehouse owner. Maersk is charged per pipe depending on the sizes of the tubular. Thus, the ordered pipe will be directly brought to the quayside for operation in the rig.

5.1.d. Anchor Yard (No photo)

This is a storage facility for anchors not been used for a long time. Storing anchors is very convenient and not costly, thus the equipment can stay there for more than decades (Trond Gundersen, personal communication). It is a long-term parking site for anchors, which are rarely in the operations flow. This warehouse has no picture as we did not visit the area.

5.1.e. Hub or Transit Warehouse (see Appendix 4)

This is the main warehouse and is called MDN – Maersk Drilling Norway hub or transit warehouse. It is where the whole cycle of activities happens and about 90% of the operation cycle is located. The internal process is presented in Fig. 5.2. In most cases, some items are returned from the rig if the equipment is no longer needed or used in the operation. In this case, the items are transferred from the rig, brought to quayside, and from quayside picked up by Aker BP. Then Kuehne Nagel in behalf of Maersk will pick up the items in Aker BP yard and deliver them to any of Maersk warehouses as per advice. If items are large and need more space for storage, they are in most cases delivered to yards 2 or 3, otherwise, delivered to MDN hub.

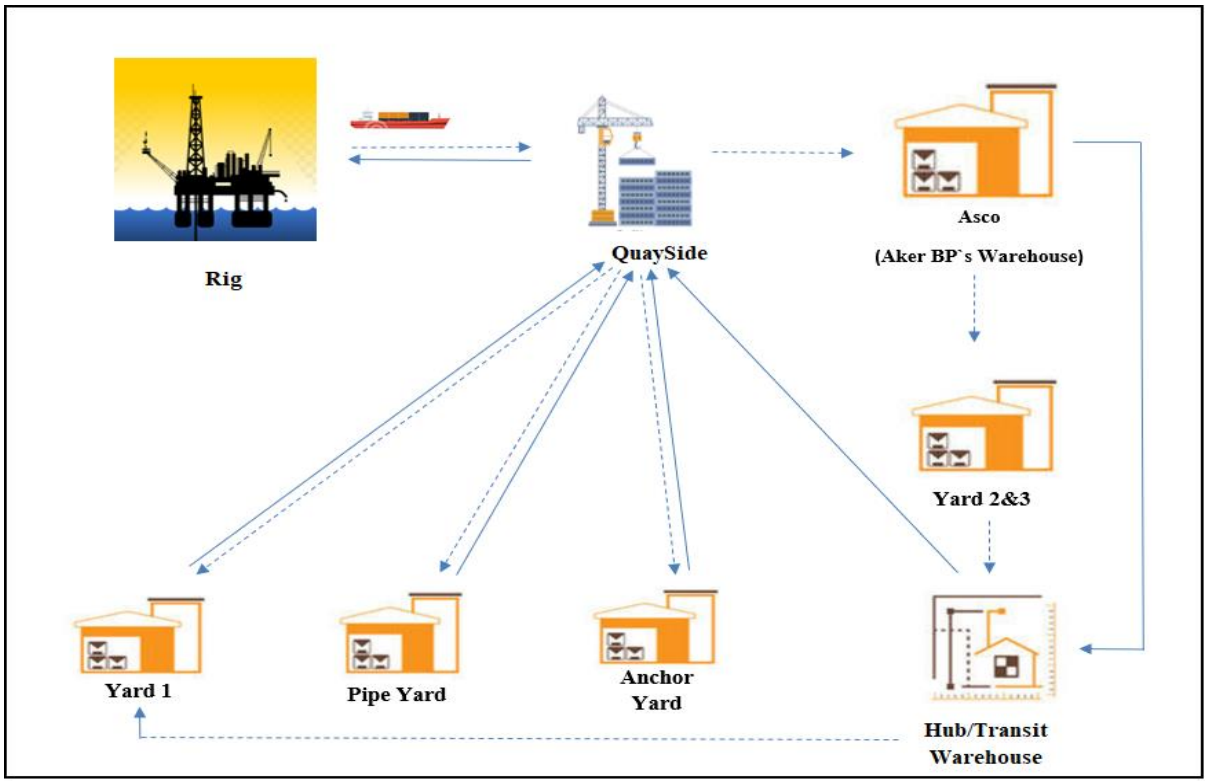


Figure 5-2. internal logistic flow

5.1.1 Focus of the Activity

Considering that the main operation occurs in this MDN hub, we agree with Frazelle, 2002, cited in Faber et al., 2013, p.1230 that the success and/or failure of the business plays vigorously

in the warehouse, therefore it has to be well-managed. Among all the warehouses mentioned, this thesis will focus on MDN transit warehouse/hub. Its daily operation, cycle of activities and management (see Fig. 5.3) are the information used for the value mapping analysis.

There are different types of warehouses existing to serve diverse customers. Among those enumerated by Dolgui and Proth, 2010, Maersk warehouse ensembles in "special warehouses" (SW). This type of warehouse is rented for a long period of time and the products stored are often expensive, bulky and seldom required (see Appendices 1 - 4).

5.2 Initial Observation

During the warehouse surveys, the following was observed:

- Yards 1, 2 and 3 as well as the MDN Hub are all rented. There are no direct staff employee assigned in yards 1, 2 and 3. These warehouses are solely for storage including the anchor yard.
- The company has only eight [8] staff employees assigned in the transit warehouse (MDN hub). Among these eight personnel are the following:
  - One [1] warehouse manager (still contributing to the general warehouse tasks)
  - Two [2] warehouse planners (preparing document such as manifest, order transport and other documentation needed for foreign shipment)
  - One [1] backloading worker (responsible for any incoming material from the rig and returns rented material back to supplier)
  - Four [4] warehouse staffs (receive, load/unload, forklift operator, encoding, wrap items – pallet preparation, etc.)
- There is no proper job designation for each employee, although there is a theoretical one. Six [6] of the employees perform the tasks of receiving, loading/unloading, driving forklifts, etc. The only function purely doing a specified job was the logistic planner, focusing on the documentation in logistics.
- Employees are continuously multi-tasking.
- Maersk still use manual data entry and manually receive the items.
- The warehouse is mixed up with equipment from other departments, which should not be in the MDN hub.

- Lack of internal communications. They did not follow the process of having and using the focal point.
- Bar coding is not fully used.

As the MDN hub is the most expensive Maersk warehouse, proper handling and storing inventory is a must.

5.3 Mapping Analysis

After the initial visit and observations, a value stream map (VSM) was generated in order to understand the whole cycle of activities in the MDN hub warehouse. This allows analyzing how employees perform their tasks and how effective the process that the company uses is.

5.3.1 Overview of the Mapping Analysis

The map analysis (Fig. 5.3) is a current state of the warehouse operation, and starts from the flow of material`s request from rig operations (considering 5 rigs operates) to Maersk supply chain (purchasing team). The purchasing team will order the material to suppliers. Daily supplies come from a variety of suppliers; approximately eighty percent (80%) of the transactions is upon receiving from different suppliers – from medicine supplies, materials for the needs of the rig staff, food supplies, items needed for various operations etc. The remaining (20%) of the items received are from the rig site that are not needed in the operation anymore or could have been done with its use. Incoming material will stay in the warehouse up to 3-6 months and in very seldom cases stay in the hub for 1 year.

According to the warehouse manager, 90% of the items the warehouse receives from outside are just stored for days or a week before being shipped out to one of the rigs, and 10% are for some other purpose (such as backloading, foreign shipping and for storage). The only reason an item stays in the hub is for document preparation to be ready to go. Items received from the rig not useful in the operations can stay in the hub for the said 3 to 6 months and up to years if not needed for operations. That is the reason why they call their main warehouse/hub as a transit warehouse. Materials coming in should come out as soon as possible. Yet, even they mean it as a transit warehouse, the need for optimization is essential considering also that the hub is the

most expensive warehouse of Maersk. As we discuss further through the value-stream mapping and the cause and effect analysis, many instances show alarming lapses of the process which need improvement. Basically, VSM can help the managers to understand how to add value to the flow of material and/or information in the entire process (Jay Heizer, 2017, p.290).

5.3.2. Value Stream Mapping

The purpose of making the value stream mapping (VSM) is to see the overall picture of the process. To see all added and non-value-added activities. We observe the material/item and information flow from supplier through customer's request until the departure for the customer. In the following heading, 5.3.3 - *Understanding the cycle*, we mention the things they do in each step, but for further analysis of the activities in between the timeframe, see section 5.6 – *Revisiting warehouse general flow*.

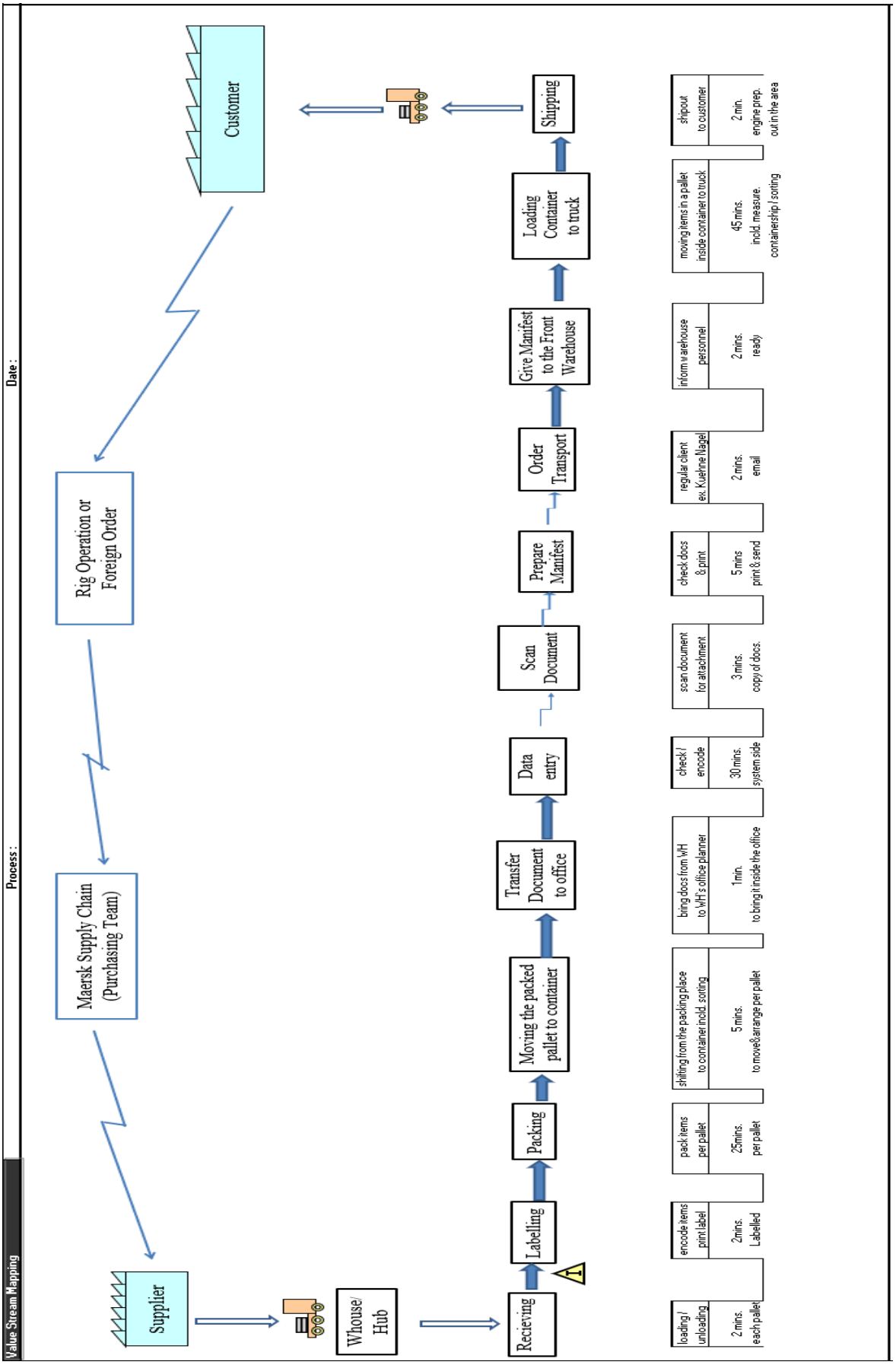


Figure 5-3. MDN Value Stream Map – Cycle of warehouse activities

5.3.3 Understanding the Cycle – VSM

The value stream mapping (Fig. 5.3) is based on our "gemba" walk/visit to the warehouse. As presented in the VSM, the chain from the purchaser to the supplier to the warehouse is an example how it could affect the whole process considering costs and the services along the activity cycle. As what Kiefer and Novack, 1999 exactly stated about warehouses, it would play a great role in intermediating the supply chain members. Knowing the chain and those affected are critical, although it is not easy to follow. According to Imai, 2012, p. 24, it is important to know how and why problems occur when they happen, and it's just right to go for "gemba" and follow the five [5] golden rules (see 3.2.4).

Going for "gemba" is to see the process and understand the problems that the employees are coping with. Here are the following discussions and the time frame, we estimated in every step in the daily cycle of activity as per Fig. 5.3.

a. *Receiving*

It takes approximately 2 minutes per pallet for the staff to sign the delivery order until the pallet has been unloaded to a "not exact place" but just to drop it off at an available space. The staff uses the nearest or best fitting available space to drop off the pallet, because the individual was performing another task to be continued. He/she performs whatever most urgent. There is no check performed with the delivery order against the purchase order, nor material inspection of what shipment contains. Doing and re-doing tasks afterwards are time consuming and depend on what activities the staff was doing before they cater the receiving items. This does not follow but rather disrupts the flow. Therefore, lack of people does not give any value.

b. *Labeling*

It takes 2 minutes to prepare the label per pallet. Although this includes encoding and printing the label, the preparation time is quite long since the IFS system works slowly.

c. *Packing*

This is done when the boxes and pallet are full. The pallet is wrapped with plastic using a wrapping machine. It takes up to twenty-five [25] minutes to wrap and prepare the pallet with all the measurements required to transfer it to the container. All dimension

information, also from the container, are required to order the trucking capacity for this shipment.

d. Moving the Packed and Prepared Pallet to the Container

It takes 5 minutes to move and transfer the pallet, considering and including the arrangements of (spacing) and the sorting of some of them already placed in the container.

e. Transfer Documents to Office

Delivering the documents to the office lasts for 1 minute. The warehouse staff received these documents from the supplier, then encoded them in the system and recorded the necessary dimension for warehouse planners' information. From labeling to transferring the documents to the office, the physical motion is unnecessary if everything is connected in one system. Then the warehouse planner team could fetch the all required data straightaway from this digital interface system.

f. Data Entry and Scanning of the Document

Data entry and scanning of the document are the longest part of the whole process, which includes preparation and checking of the documents, data entry and scanning all the paperwork. The observation of this cycle lasted for thirty-three [33] minutes confirming the long timespan. The planner needs to prepare all required documents for hazardous goods and material while following a specific template for each customer. This is especially time-consuming for foreign shipments, which are more demanding with respect to documentation (Trond Gundersen, personal communication). Again, the transactions depend on the speediness of the system; if the system is slow so is the preparation process (waste of time).

g. Prepare Manifest and Order Transport

To prepare the manifest and order the transport last for ~7 minutes. The planner needs to check first and to make sure the documents are correct. Whenever the documents are not yet prepared due to the slow performance of the system, the planner cannot order the transportation yet as they need to know all the information, both related to size and quantity of the containers.

h. *Give Manifest to the Front Warehouse*

Once all the documents are ready, warehouse planner has to give the manifestation to the warehouse staff and keep it until the truck arrives.

i. *Loading Container*

Through estimation, loading of the container lasts for ~45 minutes. This process includes loading the pallets to the container, arranging and measuring the dimension of the pallet to assure its fit into the container and up onto the truck. After all this loading and sorting, the truck is ready for shipment.

5.4 Warehouse Layout Based on Gemba

To continue the analysis in the VSM (Fig. 5.3), we consider the warehouse layout made based on our observation of the area.

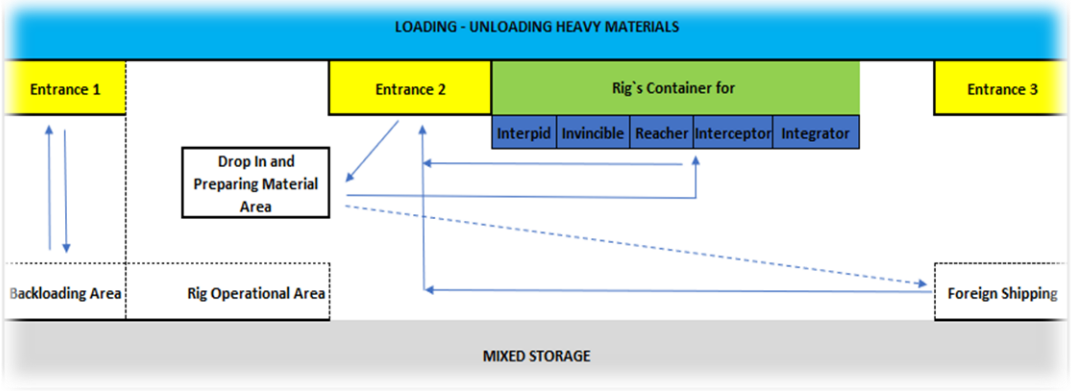


Figure 5-4. Transit warehouse layout

The transit warehouse layout consists of three main areas for different purposes as discussed below:

1. Backloading Area

   An area that company uses to store equipment from rig operations. This equipment is either 3rd party-rented equipment or equipment owned by Maersk. From this area, Maersk should either backload and return the equipment back to the supplier or move it to one of Maersk's warehouses. Mostly, the "in and out equipment" from backloading

is pushed to and pulled from entrance #1. About 10% of the stored items in the warehouse is for backloads.

2. Rig Operational Area

   A specific warehouse area that the company uses to store and prepare for the 5 rigs currently operated in Norway, namely Invincible, Interceptor, Reacher, Intrepid and Integrator. Entrance #2 is the main gate for items in (from supplier) and out (to be shipped).

3. Foreign Order Area

   Maersk does not only serve operational assets within Norway, but also send equipment outside Norway such as United Kingdom, Ghana, Azerbaijan, Egypt and Australia. Items coming in and out are from entrance #2. Entrance 3 is barely in use as inlet.

Other areas in the transit warehouse:

4. Mixed Storage

   No specific or dedicated area to store items. It is a zone mixed between backloading, rig operational, foreign order or Maersk internal items from another department. In this place, there is a huge storage rack not necessary and not needed in the warehouse. This rack should rather be transferred to one of the rented warehouses. If this happens, the hub would be more spacious as the racks really fills in the space (Trond Gundersen, personal communication).

5. Loading and Unloading Area

   The loading/unloading zone is an outdoor area. Large and heavy equipment is stored, loaded and unloaded in this area.

6. Drop in and Preparing Items Zone

   This area is where items are dropped off, and for preparations of items to be shipped out. The items already packed for shipping and waiting for transfer to container for sorting, are in this place.

5.5 Cause and Effect Analysis

Reviewing the warehouse layout and through the value stream mapping, the root cause is identified and captured. In “gemba” we observed inefficient and unproductive operations in all the activities and processes. In this sense, we use the fishbone diagram to highlight every cause of the problem according to its category: measurement, materials, method, environment, manpower and machine. Each cause is elaborated in the succeeding categories mentioned below the diagram (Fig. 5.5).

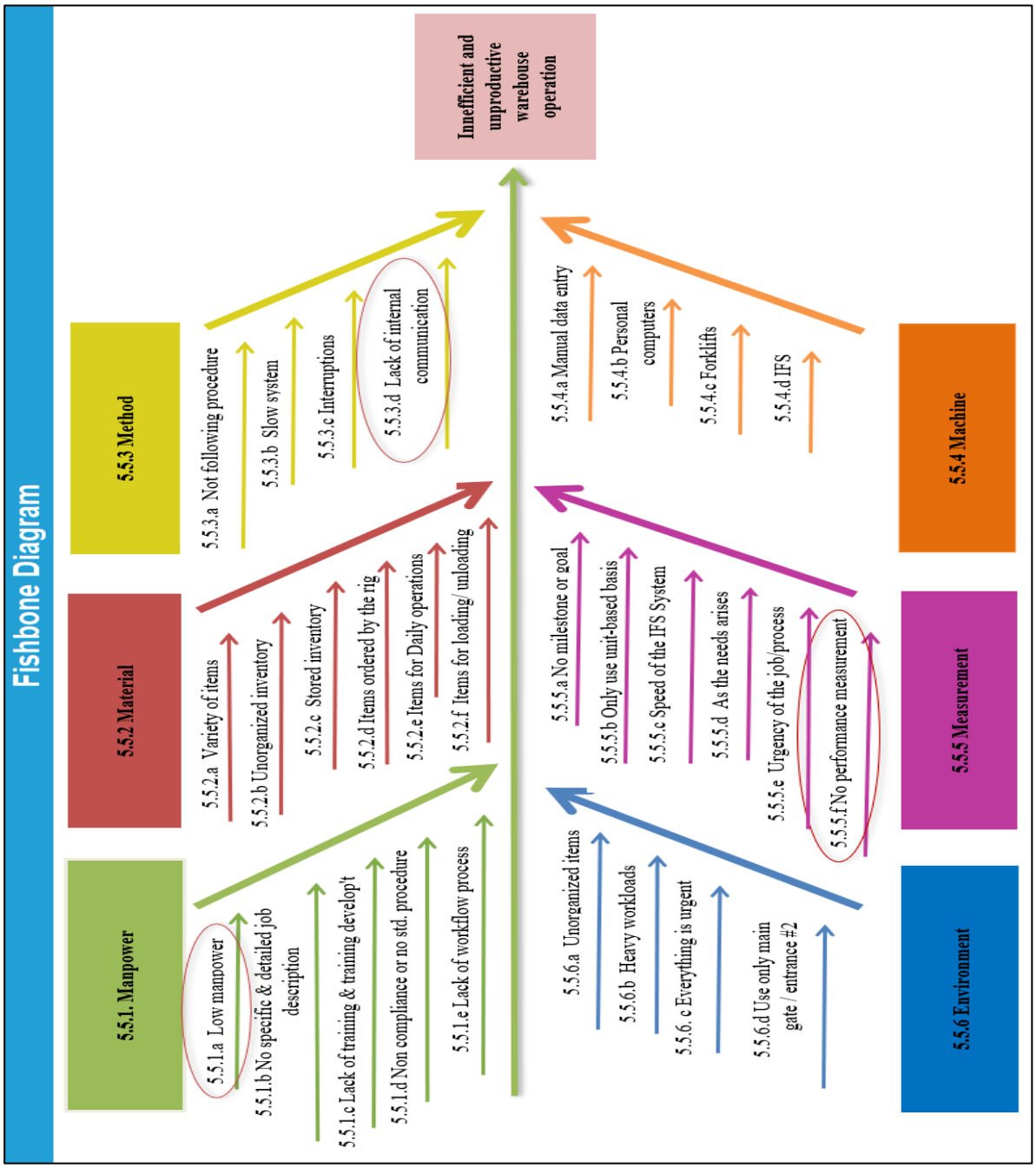


Figure 5-5. Fishbone diagram. Warehouse Cause and Effect – Maersk Drilling Norway

In the problem stated above – which is “inefficient and unproductive warehouse operation” – the reasons that hinder the task to be well-performed are mentioned in the following.

5.5.1. Manpower

This section elaborates on how staff is needed for a productive and efficient operation. Reasons that hampers the process are: insufficient number of workers, no defined job descriptions, distractions/interruptions, lack of training, workers not following procedures or standard work instructions and lack of workflow process in general.

5.5.1.a Low Manpower

As presented in section 5.2., the department has only eight [8] staff members including the warehouse manager, which points to a lack of manpower. This might be the reason why almost every individual performs all tasks of the warehouse operation and cannot follow a specific, and therefore efficient, core job description. Aside from the two colleagues working in the office (desk) considered as the warehouse planners, and warehouse manager, the five [5] remaining employees perform similar jobs at the same time, such as encoding, driving forklifts and general workloads. Because of this random task distribution, the department lacks organized planning and alignment.

5.5.1.b No Specific and Detailed Job Description

Staff may have their own job descriptions. This refers to specific and certain job definitions and limitations, so they know their task every day. From the flow diagram (Fig. 5.5) it is obvious, that the team is in need for an additional member in the receiving part. For example, if one staff can do this part, i.e., receive item + encoding & labelling + sorting & putaway + forklift driver + maintain the lifetime of the forklift, the other staff could possibly process & prepare orders + picking + packing + forklift driver.

5.5.1.c Lack of Trainings and Training Development

The reason we say they do not have proper training and training development is because the staff are busy enough to do the work in the warehouse. They do not really have time to do the training. Missing one person for training will give a higher load to the team.

5.5.1.d Noncompliance of Procedures or no Standardization of Procedures

Some of the employees do not follow procedures. For example, on the rig, whenever the concerned person or the rig manager requires some items, they want it as early as possible, which is in contrast to the procedure determining how to order or get the items. In this sense, this affects the warehouse personnel, especially when orders are urgent and the staff is forced to prioritize seamless rig operations.

5.5.1.e Lack of Workflow Process

Since Maersk has not enough manpower in the warehouse, staffs prioritize to receive material from supplier no matter what job they were performing at the moment. Therefore, this could lead to no proper sequence possible.

5.5.2. Materials

Materials or inventory items are the foundation and reason for a warehouse. Consider the reasons below how these items being treated by the company in the hub such as variety of items, foreign items, stored inventory, items required by the rig, items in daily operations and items for loading/unloading.

5.5.2.a Variety of Items

There are variety of items in the hub, which is practical to sort for a smooth operation. Putting items in place according to its purpose in the warehouse area, such as for backloading or for foreign shipment, is a basis to easily manage and find the items.

5.5.2.b Unorganized Inventory

Items determined for foreign shipment have its specific place, yet sometimes this place is mixed up with items for local use. Thus, the placing or positioning of the items itself is unorganized.

5.5.2.c Stored Inventory

In the MDN hub, which Maersk calls a transit hub, 90% of the items is in transit and volatile, as mentioned in section 5.3.1. Usually they do not store the items longer than 3 months and a few specific items 1 year at maximum. The rest of the items (10%) stored

somehow are not so in demand in operations, and maybe transferred to another warehouse to make use of the space considering it is big and fills up the space. Yet, it is costly as per the supply chain manager Mr. Jan Nistad (personal communication).

5.5.2.d Items Ordered by the Rig

Items present in the hub are mostly required by the rig. A good internal communication from the rig to the purchasing team, and from the purchasing team to the warehouse team, will give a good flow in the warehouse operation. In actual, Maersk`s warehouse staff claims they do not know what material is coming and when it will come, consequently, congestion happens because the team cannot prepare a place to load and unload a shipment.

5.5.2.e Items for Daily Operations

As mentioned above, 90% of the materials are for transit. Because it takes some days to process the orders after they are received, many items are delayed in shipping. Also, an efficient decision regarding the most urgent items to ship would be time consuming and are lacking.

5.5.2.f Items for Loading/Unloading

In the hub, items are disseminated everywhere. Whenever they receive an item, they unload and place it wherever it is enough space for it. To load the item, they go to the place where the items are being prepared, wrapped and made ready. In theory but not in reality, no distinct place exists for loading/unloading of the items.

5.5.3. Method

Methodical reasons for inefficient and unproductive operations are; procedures not followed, slow systems, interruptions, repetition or iteration of inquiry, and the lack of internal communication.

5.5.3.a Not Following Procedures

Most of the people involved, both in the warehouse and on the rig site, are not following procedures. For example, they do not contact a focal person for inquiries and relay messages/information properly.

5.5.3.b Slow System

This refers to the IFS application. Maersk relies on the IFS system for their transactions. Thus, to speed up the process they also need a speedy and swift performing system. Whenever the system slows down the transactions will be slower and in a worst-case scenario even shut down.

5.5.3.c Interruptions

A process slows down by interruptions. Obviously, it is hard to escape all interruptions along daily transactions. The point in here is, that whenever a question is asked from the rig to the hub, it should be asked by the rig's focal person. Still, another rig person may inquire to emphasize the same question again. This is just one of the most common examples that interrupts the cycle.

5.5.3.d Lack of Internal Communication

The process of receiving the items is shown in the IFS system or is emailed from the purchasing team. That allows the warehouse staff to check and verify the items to be received and its background. The problem is, considering the undermanned staff, the workforce is not checking the system reports or emails.

5.5.4. Machine

This part drives the equipment available, and the staff's ability to utilize this equipment in the firm is necessary for an efficient and productive operation. Examples are manual data entry, personal computers, forklift, and the IFS.

5.5.4.a Manual Data Entry

The warehouse personnel use manual entry to encode receiving items and the transportation of the items to the IFS system. In this sense, human error is the alarming risk potentially occurring and intervention at some points is critical.

5.5.4.b Personal Computers

In the warehouse hub for receiving items, only one [1] PC is used mostly for encoding. If one individual performs slowly, and two individuals need to use the PC at the same time, there is a problem.

5.5.4.c Forklift

The hub has four [4] forklifts, which is enough even for a busy loading/unloading operation. In effect, the space of the warehouse is relatively small for a full operation of all 4 forklifts. There is a tendency of interference by means of collisions, considering they use only gate #2.

5.5.4.d IFS

The system they use is IFS application. The system is subjectively not so fast according to the staff. Whenever the system is slow, it affects the whole process since it is their only way of communicating the work process and for full documentation up to the warehouse operator.

5.5.5. Measurement

No milestone or goal, unit-based system, as the needs arises, urgency of the job/process, and no performance measurement are reasons for inefficient and unproductive operation under measurement category.

5.5.5.a No Milestone or Goal

Although every company has its goal and moments to work on, we observe that at some extent, the goal and the motives for an efficient and productive warehouse operation were dragged down because all employees are so busy doing their daily tasks.

5.5.5.b Only Use Unit-based Basis

Maersk uses the IFS application as their business system. IFS is an enterprise software that helps a company to be integrated and communicative through different levels and departments. In the warehouse department, IFS is used only unit based (quantitative) as the measurement. It can be alarming since units is not a good way of measuring success rather than performance (qualitative).

5.5.5.c Speed of the IFS System

In the cycle of activities to make things happen in a productive way, everything received to be loaded and shipped must be encoded in the system. If the system is too slow, encoders has to wait and waste time. To measure the work depending on the system is not adequate as you cannot measure the fact to detect when the system was perceived fast and slow.

5.5.5.d As the Needs Arises

In the daily operations things arise unplanned and out of nowhere, especially in the O&G industry. It is hard for a contractor company to avoid that things sometimes do occur, and suddenly these inquiries are on the top priority list. In the warehouse, whenever the need calls for urgency, it interrupts the cycle and of course can delay the overall process and performance.

5.5.5.e Urgency of the Job/Process

Measuring the job through urgency of the matter is difficult. On daily basis in the O&G industry, many parties believe everything is urgent. The word “urgent” is often abused. If the work will rely just on urgency, then it is hard to follow or accomplish. No one will know or judge properly when things are truly urgent.

5.5.5.f No Performance Measurement

A key performance indicator (KPI) is needed for the operation. It will help the company to assess the progress of its strategic and operational goal. Since the company does not have it, it is hard to measure the performance of its employees as to the progress of their work and even for the entire warehouse operation.

5.5.6. Environment

In this segment, unorganized items, heavy workloads, urgency, and “main gate only being used” make the warehouse inept and unsafe.

5.5.6.a Unorganized Items

It is hard to track items quickly when not organized. This will restrain the process and delay tasks if one cannot easily locate items needed to pick up or to prepare.

5.5.6.b Heavy Workloads

This occurs if the department is lacking manpower. In the long run heavy workloads can lead to fatigues and create more mistakes. This can lead to unproductive work.

5.5.6.c Everything is Urgent

When the surrounding is urgent, more often it is the effect of an unorganized environment. It is hard to plan well and organize properly if almost everything is in need at once. In the hub, most of the items were set to be urgent and were required as early as possible.

5.5.6.d Use Only Main Gate/entrance #2 (see Fig.5.4)

The hub has three gates. Main gate is the center gate among the three. In most cases, only the main gate/entrance #2 is used for loading/unloading of items. Using one gate for incoming and outgoing of loading and unloading of items (or items in a pallet) can cause commotion and can hit one another more probably as they use forklifts. Entrance #3 is barely in use because some materials are stored behind this entrance. Entrance #1 is used only for backloading purposes.

5.6 Revisiting Warehouse General Flow

Figure 5-6. Warehouse general workflow

Receiving, storing, sorting, picking and shipping are the basic characteristics every warehouse has, which also applies to the surveyed MDN transit warehouse. As compared to the other warehouses, the main activities of receiving and outgoing of goods/items happen in this hub. Based on the conducted survey, some observed problems occur mostly because of internal factors. Those, which interrupt the flow of the items and information of the warehouse, are highlighted below. This consequently has impact on the effectiveness and efficiency of the warehouse operation itself.

a. Receiving

As discussed above in understanding the map (Fig. 5.3.3), when supplier or suppliers deliver and drop the order, one random available employee or employee being close to entrance #2 (see Fig. 5.4) will receive the delivery order and sign it. As Maersk has low manpower, all current eight [8] employees need to do multi-task. This means that if the receiving employee was performing something else, he or she will need to stop his/her current activity to receive the items or goods. If the item is large or heavy, the supplier will leave it outside the loading and unloading area (see Fig. 5.4) and the employee will take it with a forklift or leave it outside. If the item is small and light, it is placed straightly in the drop-in and preparation area for packing.

No material inspection according to the packing list is performed. Instead, a final check is performed when the material arrives in the rig; on the same or the next day. If the items are not checked before shipping to the rig, and it is revealed that the arrived item is not the correct one, probably they will use chopper to send the item if urgent. Other causes may be that the material is defective and the quantity is not based on the purchase order. However, no one in the transit warehouse is qualified or assigned to check all the incoming items.

- After that, the Maersk employee will create a label to determine to which container and shipment the items should go. On the drop-in and preparation area there is a chance that items are mixed or mistakenly placed on the wrong pallet. Maersk uses some pallets to determine each rig operations, and these pallets are placed next to each other.
- Moreover, a lack of internal communication in Maersk causes transit warehouse difficulties to handle the receipt of goods, especially when items come all at once from

outside, either from 3rd party supplier or from the rig itself. Warehouse staff is only notified from the supplier when the material is ready for pick up or for delivery to the warehouse. As shown in Fig. 5.7, warehouse staff is not involved in the communication between the rig site and the purchasing team when ordering items. Since warehouse is the one receiving the items, they must be notified in advance. It is based on the pull order system. After that, a request from the rig to purchase the needed item will pass to the purchasing team/purchaser. They will purchase the request and deal with the supplier. Each rig operation has their own dedicated buyer, and these buyers are located in the main office in Forus where the transit warehouse is. Despite their colocation, the purchaser has no direct connection or transaction with the workforce on the transit warehouse itself. The internal process from the rig to warehouse/hub is:

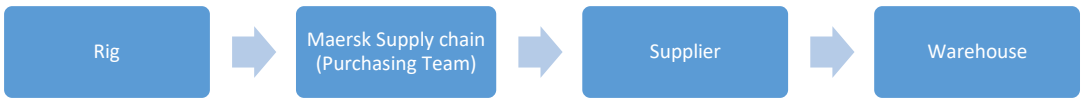


Figure 5-7. Internal order workflow

b. Storing

The area of the transit warehouse is relatively small, as per Maersk, the purpose for this warehouse is only for transit - equipment coming in should go out as soon as possible. However, there are items that are stored in the transit warehouse as a buffer or for backup purposes because of frequent or priority usage such as safety PPE, spare parts, medicine, etc., in addition to some regular equipment from the general rig operation (stored at the backloading area), material from other departments and material for the mentioned foreign order. The company stores the equipment in designated shelves or on the floor if it is needed to be used as soon as possible. Alternatively, the equipment is positioned outside the warehouse building if it is too large or heavy for the loading & unloading area (Fig. 5.4). As mentioned, there is no continuous or proactive communication internally in Maersk organizing the storage of the equipment, thus becoming a problem in the warehouse.

c. Picking

Maersk uses a tag to identify the items and encode the information into the system to know in which shelf or high rack the items are stored. Regarding components on the floor or in the loading and unloading area, there are no actual location and number to

identify. Thus, finding a specific component positioned on the floor or outside needs physical and manual searching, which is time consuming. As the transit warehouse is relatively compact/small and some equipment is stored on the floor, it is a challenge for the staff to pick up an item especially the heavy ones, which require technical support. When more than one [1] forklift operate inside the warehouse, and the in and out material exchange is performed from the entrance #2 only, the entire flow is disturbed. If the activity is close to entrance #2, the other forklift needs to halt and wait until the area is cleared.

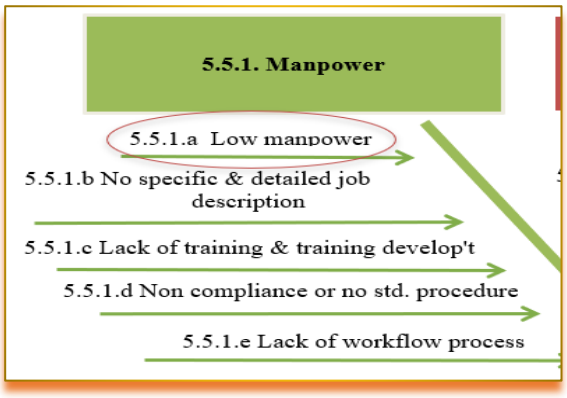
d. Shipping

Every week, Maersk has a fixed timetable and schedule when the company needs to ship to the quayside. The warehouse team needs to be able to finish the packing at minimum 24 hours before the scheduled time. The warehouse planner will only be able to order transportation once he/she receives all information from the warehouse staff, and when the items are prepared and packed. Accordingly, only after the planner finishes with her/his data entry the information is transferred to the client, so she/he can accumulate or count the load and judge the number of containers needed to be shipped out. Any delay in this transfer of information to the planner might cause a delay in delivery of the equipment to the quayside.

5.6.1 Important Factors

After all the mapping analysis, the cause and effect analysis and revisiting the warehouse general flow, we have identified several **root causes for the inefficient and unproductive operation** in Maersk`s warehouse (Fig. 5.5) as per category. In this section, we would like to highlight the main root cause in the warehouse that affects the warehouse effectiveness and productivity and eventually the whole cycle of activity.

5.6.1.1 Low manpower (5.5.1.a)



Manpower is one of the most important resources in the company, especially for the type of warehouse requiring mainly manual work like Maersk Drilling. Low manpower is significantly affecting the entire flow in the warehouse as shown in VSM (Fig. 5.3); from the receiving until shipping to the customer. Manpower unarguably is one of the most expensive cost in a warehouse. Therefore, many companies are internally asked to keep the cost low to get higher benefit by a reduced or minimum number of employees. Nonetheless, low manpower can affect productivity and job performance in the warehouse and has side impact, such as:

a) Safety

In a warehouse environment (5.5.6) where workers need to perform monotonous work and multitasking, and work long hours, insufficient manpower can affect safety. In addition, packing, driving forklift, and loading/unloading, are typical manual work in the warehouse that can also affect to the safety of the worker as well the working area. Safety of the employees deals with all the sub-causes in each category as shown in Fig. 5.5 (5.5.1 – 5.5.6).

b) Stress and fatigue

The level of stress in the warehouse can increase especially in peak operations, e.g. material arriving at the same time in the warehouse and urgent material orders from the rig which requires more and faster work. With low manpower the workload will be higher than it should be. Combined with long working hours this may cause the employee’s being exhausted leading to continuous unproductive work.

c) Multitasking

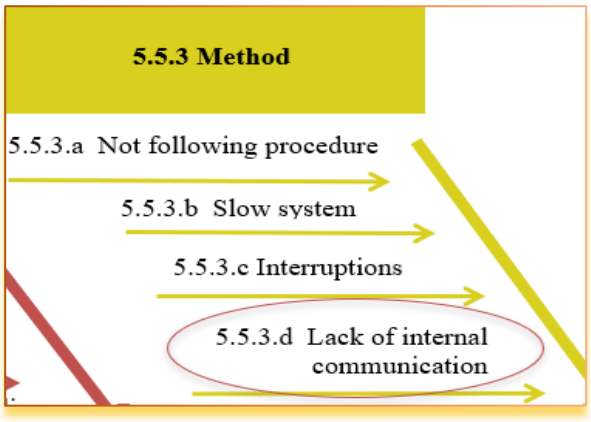
Low manpower consequently creates a multitasking environment for the work force. According to the American Physiological Association, 2006 there are three [3] different types of multitasking: “1) perform two tasks at the same time. 2) switching from one task to another without completing the first one. 3) perform two or more tasks in rapid succession”. Therefore, multitasking seems efficient on the surface but at the end it actually takes more time and can cause more mistakes (American Physiological Association, 2006), because workers need to concentrate on more than one activity. As a consequence, multitasking reduces warehouse productivity and throughput (see section 3.2.7).

All consequences caused by insufficient number of manpower in the warehouse (safety, multitasking, fatigue and stress) will create more cost and waste to the company, and at the end create unproductive work. Moreover, low manpower will create and affect:

a) No specific and detailed job description (5.5.1.b) for the employees because they need to handle various tasks (multitasking).

b) Lack of a workflow process (5.5.1.e), interruptions (5.5.3.c) and as well as heavy workload (5.5.6.b) – due to insufficient staff numbers, the individual worker needs to be able to perform multitasking jobs. Referring to section 5.6.a - receiving: when a random employee needs to receive items from a supplier, he or she needs to set aside the current activity before it is completed to commence or do another task. Interruption will delay the job to be completed and it means longer lead times. This employee needs to start over again, and it takes time to get back into it. The time lost when switching tasks depends on their complexities, and how fast an employee is able to figure out where she/he was in the previous process, in addition to be influenced by personal characteristics ((Fox, K., 2014).

5.6.1.2 Lack of internal communication (5.5.3.d)



Internal communication means how a message and information are distributed from top management to the employees and how it can be translated to be understood by the latter, which is vital within the organization (Welch, 2012). This information can be the company`s vision, mission and goal, and even down to each task given from a manager to their staff. Internal communication strengthens organizational effectiveness regarding good relationship between employees from senior managers to subordinate staff. Although, depending on how the information passes to everyone, internal communication can somehow inadvertently damage the internal relationship. Therefore, internal communication will affect work performance and thus affect the organization.

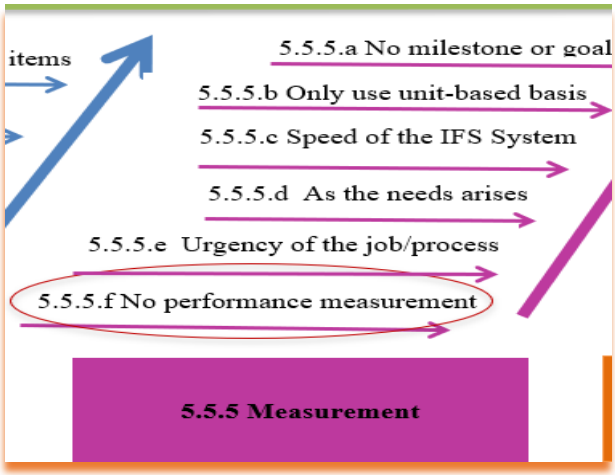
Lack of internal communication can lead to misunderstanding, mistrust and doubts on how employees need to perform the work. Hence, this can create stress in the work environment and can affect employee's performance. Just as shown in value stream mapping (Fig. 5.3), it also affects the flow. The communication is the key to understand each of the activity cycle. For instance, the warehouse team cannot anticipate what items going to be delivered, what dimensions and sizes, and where to allocate the incoming items - apparently, it affects the productivity in the warehouse.

For Maersk warehouse staff, it is important that the internal communication in the way of delivering information is clear, smooth and understandable so the one who receives the items or the information are aware of its purpose. For instance, purchasing team who has contact initially with the supplier and the rig must inform the warehouse staff about the background of the items, so they will know how to handle it. Yet, since no follow up nor information from the

purchasing team, considered that all the information of the items received are in IFS system, somehow warehouse staff were not able to check and verify it. This instance creates disorder and misunderstanding more often.

When you have sense of belonging and you are aware of your surroundings, the sense of responsibility comes with it. In an organization, workers try to do their task as smooth as possible and to have a good standing at work. If the communication is not clear from the start, it would not give the advantage that the employees strive hard and make effort to perform the job well.

5.6.1.3 No Performance Measurement (5.5.5.f)



The performance of the product and even the employees is crucial in determining the factor that affects the total performance of the company, particularly in each department. In the causes above, as mentioned in 5.5.5.f, there is no performance measure made. As stated in 5.5.5.b, the company only check IFS based on the quantity of the item. In this case, the performance measurement system is important. By doing so, it will give the company a dependable information to set targets to execute company's progress strategies.

The purpose of performance measurement is not only to measure the performance of the employee, but also to measure how the company operates to achieve its goal. If Maersk`s warehouse only relies on quantitative measurement on how many materials comes in and comes out, it is difficult to evaluate the success of the warehouse operation. If there is no target or goal to achieve, the definition of success can be different from one person to another person, one

department to the other department etc. However, no standard for evaluating this process exists. Therefore, warehouse team does not know which areas that is in need for improvement. (Trujilo, P., 2016). Without performance measurement wrong or no delivery, or lack of delivery on time from supplier, cannot be seen. Maersk`s warehouse team only measure based on their own memory. As a consequence, the company cannot evaluate the supplier's performance. This can lead to unproductive performance in the warehouse, especially when the ordered material is the important material for the operation.

5.7 Actions and Propositions

This part presents several implementations Maersk can apply and proposes innovative ideas in the process, which could aid the warehouse operation efficiently. They are based on the problems outlined above as well the important factors considering the mapping analysis and the cause and effect analysis.

5.7.1 Lean in Implementing 5S

5.7.1.1 Sort, Simplify and Shine – Receiving, Storing, Shipping

From the VSM analysis (Fig. 5.3) supported with the content of Fig. 5.4, the warehouse operation is judged as disorganized. This applies to the usual things performed inside the warehouse as described in 5.6, which are: receiving, storing, picking, and shipping. All the activity from storing to shipping must be in sequence, which needs to be sorted out. Looking back to the main problem above, it is quite challenging to begin with the implementation of 5S because it is laborious and the company lacks manpower.

5S represents sorting, simplify, shine, sustain, and standardize. Sorting is needed to organize all the inventories to achieve a vibrant appearance of a working place (Bullington, 2003, p. 56). All items must have its dedicated place and position. When Maersk sorts all those items present in the warehouse, following the guidelines mentioned in 3.2.3 in implementing 5S, we agree with Howell (2009) stating that, tools that are kept in a shadow board will be visible at a distance and thus help reduce time for searching.

Considering the spacious yard 1 presented in 5.1.a prepared for storing big equipment, some of the items or equipment in the hub/transit warehouse can be transferred to it. As mentioned before, various items are not required or necessary in the hub and just consume space, such as some high storage racks, non-demanding equipment/tools including administrative stuff (e.g. car boxes) etc. Therefore, a management decision is needed to move and transfer those items to yard 1 or other warehouse. It could also be a smart decision to sell or scrap some of the items, especially some big equipment in yard 1. Thus, when Maersk has completed the sorting and simplified all the items into the right place and right position, sweeping and cleaning the working area takes place. This cleaning needs housekeeping efforts and employee's involvement and dedication. Therefore, a demand for a dedicated employee in here is also a must to progress. Considering that staff is limited with all the manual tasks performed, the housekeeping efforts will add further job assignments to each employee.

In spite of the easiness in the implementation phases of *Lean*, traceable and lifelong result can be reached over consistency throughout the process.

5.7.1.2 Standardize and Sustainability – Process and People

Standardization and sustainability are the fourth and fifth of the 5S. Theoretically, it removes variations in developing standard operating procedures and the checklists. To standardize the process, the status of the employees (such as job responsibilities) and the actions in maintaining the desired condition will improve throughput. It is also within standardization to train and retrain the employees. Giving additional learnings such as seminars and workshops is also a drive for critical success. Noting the cause and effect above in Fig. 5.5, employees are not properly trained. A lot of instances calling for a standardization are listed under manpower and methods in 5.5.1 and 5.5.3. Accordingly, the reasons are:

- No specific job description
- Lack of trainings & development
- No standardization of procedure
- Lack of workflow process
- Not following procedures
- Slow business system
- Distraction/interruptions
- Lack of internal communications

These causes require and call for standardization. How will an employee follow the procedure if there is no clear-cut standard procedure? Aside from that, considering the company uses an IFS system for all operations, which is perceived underperforming and slow; how can it be the procedure be followed? Interruptions are most of the reasons for delays. As mentioned above

in 5.6.1.2, lack of internal communication is a serious reason for standardization for a productive operation. Another strong reason highlighted above is the lack of manpower (5.6.1.1). Accordingly, when staff is not adequate available and the cycle of activity requires mostly manual tasks, it is a must to standardize the people and their capabilities so they strictly follow the process. When a standard procedure is present and the checklist is clear and strong, it will result in a smooth workflow leading to a successful operation.

5.7.1.3 Visual Effect of Forklifts when Implementing 5S

To figure out the effect after 5S being implemented, it will create huge impact to the movements of forklift and lead time. Consider the type of forklift usage: first, is to move unloaded items from the depot to the reserve locations, second, is to move the items from the reserve locations to fill the corresponding pick up locations (Estanjini, Lin, Li, Guo, & Paschalidis, 2011). Forklifts in Maersk are used in every movement of the large items, especially when moving items on pallets, upon receiving the items from suppliers and when shipping (transferring the pallet to the container). We agree with (Estanjini et.al, 2011), that the issue for optimizing is the dispatching of the forklift. Spontaneously, traffic congestion, operational readiness of forklifts and the urgency when items are needed are the factors that are desirable for consideration.

In lieu of the warehouse activities presented in the map (Fig. 5.3), forklifts play a vital role in optimizing the warehouse considering being the only machinery used for moving all equipment. To have more space to move around easily without collisions, especially when most forklifts are in use, is very important for safety and organized environment.

5.7.2 Additional Manpower is Required

In the warehouse, when the task needs to be executed in sequences and each activity or step mainly requires manual performance (receiving/sorting/picking/packing/shipping), it is essential to have adequate manpower. Low manpower does not allow “any space” for employees to have proper training because of the high workload, especially in a dynamic environment like here. An absence in the warehouse (for example due to training or sickness) creates additional workload to the remaining staff and results in lower productivity. Thus, additional manpower should be added as soon as possible. Especially in the team planning, as

mentioned in 5.3.3.f (data entry and scan of the document), preparing documentation for foreign shipments is the most demanding task.

Additional members in team planning will have large impact and reduce and balance some workload of the team. As the name “planner” means to plan, an additional team member in this section could assure a proper plan on incoming items and goods. Aside from adding staff in the planning team, we identify a need to have additional staff in the receiving part based on our VSM map (5.3.3.a Receiving). Being delayed or stuck in the receiving part becomes a bottleneck for the entire flow. By having additional workforce in the warehouse, it will reduce multitasking requirements of the current employees. For instance, currently, four [4] warehouse staff members (5.2) do multitasking jobs such as receiving, load/unloading, forklift driving, encoding and labelling, wrapping, etc. every day. Roughly, it means each warehouse staff needs to do six [6] main tasks continuously, and by having additional manpower in the receiving part it will reduce the task of each staff.

As suggested to the theory of CCPM about multitasking (3.2.7), it is recommended that employees perform a single task or at least a minimum of tasks. Single tasks will increase the speed in the warehouse flow as well as making it more manageable. Therefore, it will gain productivity.

5.7.3 KPI - Balance Scorecard

In the warehouse operation, key performance indicator (KPI) is highly recommended. As what is mentioned in 5.6.1.3, the performance measure of employees is neglected as well as the product measure is only based on quantity (section 5.5.5.b). Implementing KPI will help improve the entire operations in a way of determining the strength and weakness of the process. By using KPI’s, it will guarantee that targets will be met considering that KPI is measurable and specific (Bgateway, 2018). Inventory accuracy, order picking, Storage capacity utilization rate, percentage of Inventory items incorrectly located, Perfect order measurement, etc these are some of the example what can be measured in the warehouse (KPIlibrary as cited in Gergova, I, 2010, p. 86). By having measurement in the warehouse, entire warehouse staff will aim the same goal and can evaluate the area that need more attention to.

Accordingly, in the case of setting up targets they should be achievable, which will inspire and motivate the employees. The targets must be realistic as well, which means to be fair on people to reach the target, and time bounded for the employees to work quick in having clear deadlines by which they can be assessed in their progress. Finding it necessary to have KPI, the company can use balanced scorecard (BSC) in determining the progress. The BSC connotes the words "objective", "measure" and "initiative". "Objective" focuses on the strategy the organization must accomplish. "Measure" will guide the employee to understand if the objective is accomplished. And the "initiative" refers to the key action programs which develops in achieving the objectives. This refer to project, actions and activities (Lucco, 2019).

5.7.4 Internet of Things through RFID

Given that people have limited time, accuracy, and attention, Ashton (2009) makes it important in relating these attributes to the "Internet of Things" (IoT) concept, stating that people are not the best in capturing data of items or things in the real world. Thus, if we have computers understanding everything and all information about the things without the help or presence of a human interface, it might be able to track down and count everything all the time and everywhere. In connection with internet, even without the requirement of human-entered data, RFID and sensor technology allows computers to detect, classify and comprehend the world (Ashton, 2009).

Based on the following proposition in this thesis, RFID will be introduced to the warehouse operation, were it has its role in minimizing movements, lead time, human error, and also cost (Zhou et. al, 2017, p.1). Before a company decides to implement RFID technology in their system, it needs to identify what is the root cause of the problem that needs a solution specifically in the warehouse. As this system has its implementation costs, it is important to review the benefits to guarantee the return on the investment given.

5.7.4.1 RFID as Replacement of Barcode

Maersk Drilling Norway AS is still using manual data entry in the computer and works on printed paper-based manifests, specifically in the goods receiving department (Figs. 5.3 and 5.5). Consequently, manual data entry may lack accuracy and quality of the information (Chow,

H.,Choya, K., Lee, W., Lau, K., 2006, p. 561). The interviewed supply chain manager and warehouse manager confirmed these problems. There is a need to reduce human error from manual data entry, to improve data quality and prepare documents faster. Therefore, according to Chow, H., et al, 2006, p.561, a systematic approach should be developed and adapted in order to make sure material handling is accurate. As mentioned above, in the past Maersk Drilling Norway AS used barcoding to support the warehouse operations. However, its utilization is not optimized. This might be because the staff does not follow the procedure to consistently scan all the material coming to the warehouse. Moreover, unorganized placement (fishbone diagram Fig. 5.5) of incoming goods in the warehouse could be a problem too. Especially when employees store the material on the floor without any identification of the barcode as is the case in the shelfs. Searching later for those items is ineffective and time consuming.

By using RFID manual scanning and manual data entry are avoided. The attached digitalized information is always present and is more accurate. For example, if a company install a reader on the entrance of the warehouse, any material coming in will automatically be scanned for all items with a RFID tag, and the received information will be automatically distributed through the business system to the entire organization. Subsequently, RFID is not limited to the line of sight, as long as the reader can read the tag within the signal range (3.3.4 advantages of RFID), and this reader can read numerous tags at the same time (Delen, Hardgave, & Sharda, 2007, p.615). Therefore, RFID does not need warehouse's staff to stand up near the tagged item and scan each label one at a time, like it is required with analog barcodes. An example from O&G company BP: BP finally decided to choose RFID over barcodes for safety reason when the company builds a platform. For instance, Laine Tookey, a senior technology consultant to the chief technology officer of BP's information technology and services (IT&S) division stated: "No one should be climbing equipment to reach for a scan at a difficult angle" (Swedberg, C., 2013). Moreover, the material and the RFID tag itself is more durable compared to barcodes. Barcodes are printed onto plastic and paper that easily torn, resulting in damaged labels which cannot be read. On the other side, RFID tags use different types of material and layers. Inlays, smart labels and a hardcase are the layers in the RFID tag, which makes the tag more solid to last longer, where the base material can be paper based or made from various strong plastics (RFID4u, 2019).

5.7.4.2 RFID – Warehousing (Storing, Tracking & Identifying)

One of the basic things to consider in the warehouse is storing of inventory. To be organized and to be able to identify the items inside the warehouse, it is highly important to assure a smooth flow of the process. Whenever an item is needed, it is important to know directly where the specific item is located. Checking in IFS is not efficient because it does not identify an item`s location. IFS only provides logical inventory, which is the total quantity inventory in the computer record (Gaukler&Seifer, 2007,p.36). Moreover, inventory accuracy is important, which is a balance between physical inventory in the warehouse or stock and logical inventory in the system (Gaukler&Seifer, 2007,p.36). For some reasons, physical inventory and logical inventory cannot be matched due to shrinkage, misplacement, loss of goods, or an error of encoding (Gaukler&Seifer, 2007,p.36). This reflects Maersk Drilling Norway AS as they rely on their IFS to check the quantity in the system, and because of manual counting of the warehouse stocks. How often the warehouse team updates the stock in the system will be in question. As the warehouse is lacking manpower and all the staff is under heavy workload, granting extra time to take stock and update the system is ambitious. Therefore, by using RFID, the problem of inaccurate inventory can be avoided. RFID will automatically update the quantity in the system every time RFID tagged material (either with pallet-, case- or/item-tag) moves in and out from the warehouse in real-time. By having visibility and automated adjusted real-time inventory will create efficiency in the warehouse, as well for the decision makers to know when to replenish the stock or to minimize too much safety stock in the warehouse (Gaukler&Seifer, 2007,p.36)

Another issue to consider in using RFID is product tracking and identification. In this sense, it helps to track the items of its location and lessen the misplacing of items. Additionally, it enables counterfeit protection and can possibly connect RFID tags with environment detectors Gaukler&Seifer, 2007, p.38) As to the purpose of RFID, which is to reduce the searching time, to remove human errors and to lower costs, is highly important. Based on a study of Zhou et al., 2017, in traditional warehousing inventory, the cost of searching and finding items is very high and increases the lead time, which highly affects the process. Considering that this is redundant with RFID-tags, as whenever items in shelves are being transferred or moving out for shipment, it is manageable to track down as it is recorded. This is available in real-time when items are transferred or sent out for shipment with a high-level of accuracy.

Case and Pallet tagging

As mentioned in the theory above (3.5.2), RFID sensor tag can be installed in case and pallet. The counter checking of the id tag is through the purchase order and the inventory list. Accordingly, when Maersk avail the tagging system in case and pallet let say, every time the pallet is available for shipment, it would not be that complicated to do the process. As stated above from VSM analysis (Fig. 5.3), before the shipment is ready, a lot of process has been made such as manual receiving of items, labelling, moving items from pallet to container, packing, transferring of documents (from warehouse vicinity to warehouse office planner), scanning of documents, data entry, and preparing manifest before loading to the truck until loading to container to get ready. Through an automated process using RFID, approximately 60% of the manual job will be reduced.

5.7.4.3 RFID - Enabled Flexible Warehousing

The focus of flexible warehousing using RFID is the tracking of items wherever it is in the vicinity or even in a distance introducing the mobile handheld device reader. An alternative of finding the items is to apply using a mobile handheld RFID reader and RFID tags as a homing device. Through that device, the content in a container will be easily detected through the data entered in the RFID tags, thus this information will be used to find out the content of the container (Gaukler & Seifer, 2007,p.38). The flexibility to track the items outside the warehouse like when the items are out for shipment also provides a big impact to the warehousing activities. Thus, when items are out, the information that the items are out from the warehouse will be known in real-time. Additionally, to know the location of every item just by tracking through the handheld device and in the computer system can be of less time, less motion and less interruptions.

In the presence of flexible warehousing with RFID-tagged items, these are traced and tracked, and can all be placed randomly in any space available. Thus, all items are always visible in the system with minimal additional cost (Zhou et.al, 2017, p.10). Moreover, even if the items are not in proper place through these mechanisms, the worker who load and drop the items to the most convenient available location reduces cost as in the classical logistic system. Although the unloading of the items received is not centralized, the information is available in the system in a centralized database and is still easy to locate in time needed as the information system

receives immediately, and the information in the system is in real-time upon dropping or unloading the item (Zhou et.al, 2017).

5.7.4.4 Integrate (RFID and ERP) – Tripartite Supply Chain

The global market today makes high demands on innovations to people, process and technology. It challenges every business by running it in an integrated and well-balanced manner, in order to be successful in promoting their goods and services and to sustain a competitive advantage (Oghazi, 2009, as cited in Oghazi, P., Rad, F.,Karlsson, S., & Haftor, D., 2018, p. 171). In this regard, the alliance in a tripartite company (consisting of Aker BP AS – Halliburton Skandinavia – Maersk Drilling Norge AS) forms a coalition aiming for the same goal and mission. It is not about competition anymore, thus, this alliance should take higher levels by integrating their supply chain systems. The purpose behind the integration in the supply chain system is to remove barriers between the companies and "enable synchronization and sharing of valuable information" (Kouvelis, P., C. Chambers, H. Wang, 2006, as cited in Delen, Hardgrave, and Sharda, 2007, p.614). Supply chain integration will improve, create visibility and facilitate the flow of material, information and finance through the chain (Oghazi, 2009, as cited in Oghazi, P., Rad, F.,Karlsson, S., & Haftor, D., 2018, p. 174). The visibility in the information between the players in the supply chain can help on forecasting of goods, ease of decision making, sales, etc. and as a result create a superior competitive advantage.

Therefore, Oghazi, et. al, 2018,p.177 suggest to combine ERP and RFID in an integrated supply chain, to facilitate the information flow and visibility across the supply chain,. According to their suggestion, this can help managers in controlling, planning and supports decision making by having total access to the attached information (Oghazi, et. al, 2018,p.178).. This integration can be both in upstream and downstream supply chain partners (i.e. supplier, supplier's suppliers, customer etc.) (Wook Kim, 2006; Flynn et al., 2010; Wiengarten et al., 2016 as cited in Oghazi et al, 2018,p.174).

Further, Oghazi,et al., 2018, p. 176-179 mention the four [4] levels of integration, namely: *1) internal integration, 2) integration with supplier, 3) integration with customer and 4) integration throughout the supply chain*. The explanation as follows:

1) Internal integration

By connecting RFID to the ERP system within the entire organization, the information from the RFID tagged product or material can be shifted to any part of the entire organization by providing real time information.

2) Integration with suppliers

The second level of integration, very similar to the first one, is to connect with the suppliers. The improving difference is that RFID tags can inform companies about what, where and when RFID tagged product or items will be shipped and where its current location is. This information will be connected and can be transferred through interconnected ERP system of the supplier and company (or buyer).

3) Integration with customers

Here, referring to the B2B relationship, RIFD tagged products and integrated ERP systems allow the product information to be stored in microprocessors and distributed through the integrated ERP system by both partners.

4) Full integration

At this level, ERP system and RFID will enable to distribute information from RFID tags to the whole supply chain actors by interconnected ERP systems. As a result, it will allow for interactive planning and tasks being performed on time and very effective. Moreover, it will provide more accurate demand forecasting which can help to side-step possible bullwhip effects occurring and enables sales information distribution between the actors through an integrated ERP system.

5.7.5 Summary of Analysis

The purpose of this analysis is to narrate what is happening in the whole part of the study. As mentioned, data were gathered and done through “gemba” where we visited five [5] warehouses aside from the anchor yard. Through all the interviews and observations, value stream mapping was decided (Fig. 5.3) to be the basis of our first hand analysis and to see the whole picture of activities, looking through the value and non-value activities in the cycle of operation. By that,

fishbone diagram (see Fig. 5.6) was also framed to see the “cause and effect” of the root cause of the problem being formulated, which is “inefficient and unproductive warehouse operation”. After finding out the causes and what it affects, the important factors were highlighted to look more closely to it and how these factors impacted the warehouse operation. Important factors are the lack of manpower, lack of internal communication and the product measurement which somehow has domino effect with other categories that causes the problem.

Through all the observation and analysis, recommendations were raised for probable solutions. Thus, implementation of 5S is a must for organizing the warehouse and the whole cycle for the items/inventory, and for standardization of the process as well as the people. In connecting and dealing with the innovative solutions as what businesses are mostly doing nowadays, internet of things through RFID is also mentioned and were proposed to solve the issue.

Unfortunately, due to the limited time and access of the study, it is hard to define the progress following the procedure in A3 method. Instead, key factor is suggested to measure the progress. In this regard, things to consider in measuring the progress could have been to create a map of the future goal upon implementing the plausible solutions, when they implement 5S for example, it will be written in the map or chart the progress of the people and the environment. Taking the progress every week or every month is a smart idea. Thus, to check the progress, one person will be assigned to monitor it.

6.0 VALIDITY/RELIABILITY

Validity and reliability are two of the important criteria in establishing and assessing the quality of any research. Lincoln and Guba; Guba and Lincoln in Bryman,2012 highlighted the terms and ways of establishing and assessing the quality of qualitative research. In this thesis, we tried to maintain the principles of validity and reliability in the process of data collection and drawing the findings from the data. In so doing, we have used the triangular research methods namely: interviews, observation and field of visits that were suitable in generating the integrity of this thesis result.

Further, from the interview gathered, the first level of source executed was from the personnel with high position in the company, which is the supply chain manager itself down to warehouse manager and then to the warehouse staffs. In the interview, questions have been asks with all transparency in the field of logistics and warehousing. Apart from that, we use A3 method to supplement the interview questions and observations and by following the method, we attest that all the information given to this study are valid and reliable considering the sample being chosen is a well-established company. Although, this thesis has limited time as we comply the time frame needed from our studies which only takes five [5] to six [6] months. Other than that, all data collected and gathered are considered valid and reliable.

7.0 CONCLUSION

After the actual visits, surveys and interviews, the analysis of those including the process observations, and upon formulating the problem, the company has a huge potential to improve and to strengthen their warehouse operation cycle. Starting by reevaluating all current five (5) warehouses Maersk operates in (Yard 1, Yard 2&3, Pipe Yard, Anchor Yard and the MDN hub), the company should consider reducing them to minimize the warehouse premises. Presumably Yard 1 and the Anchor Yard could be cleared and vacated, considering there are no actual in- and outbound activities of equipment within the company`s warehouse operation. Thus, for cost saving purposes the company should contemplate to consolidate these two (2) warehouses into one, even though the individual renting leases are quite low.

Moreover, as the MDN Hub is a main warehouse for the operation, a successful or failed operation depends on the management of this facility. Therefore, a good warehouse management is a must. There are various lapses in the MDN Hub that obviously point out for improvement highlighted in this thesis. First and foremost, the lack of manpower is the prime reason for the ineffective and unproductive warehouse operation. Lack on manpower hampers the entire activity in the warehouse considering Maersk is performing the main job-related activities and tasks manually. In addition, and in second-order, the lack of internal communication needs to be addressed and action to improve. Not only in the chain of the operation and activities but more importantly a clearer and standardized communication line between the stakeholders (manager – supervisors – subordinates).

Thereafter, we also highlighted the need of implementing a performance measurement system to measure and scale both, the employees and operational performance. By realizing that, the employee not only can be measured, but also aim for mutual goal or individual key performance objectives; as well the company can identify through a normalized review which areas need improvement.

Furthermore, in virtue of innovative technology and as a probable solution, introducing RFID technology into the process can greatly affect the full operation cycle and provide benefit to almost all steps. Not only in the internal warehouse part, but also to the entire organization. RFID will help on employee`s tasks and therefore will increase productivity in the warehouse. Hence, before deploying RFID (with but also useful even without RFID) it is critical to review

the current business system which is apparently underperforming. Most likely the utilization of RFID can`t be optimized if the using current system will be maintained.

Lastly, in order to optimize the collaboration between Aker BP – Maersk - Halliburton, the alliance needs to work more efficient together and embrace possible IT and cloud-based solutions, to build a digital ecosystem not only for detailed planning and forecasting but also to standardize processes and visibility in information.

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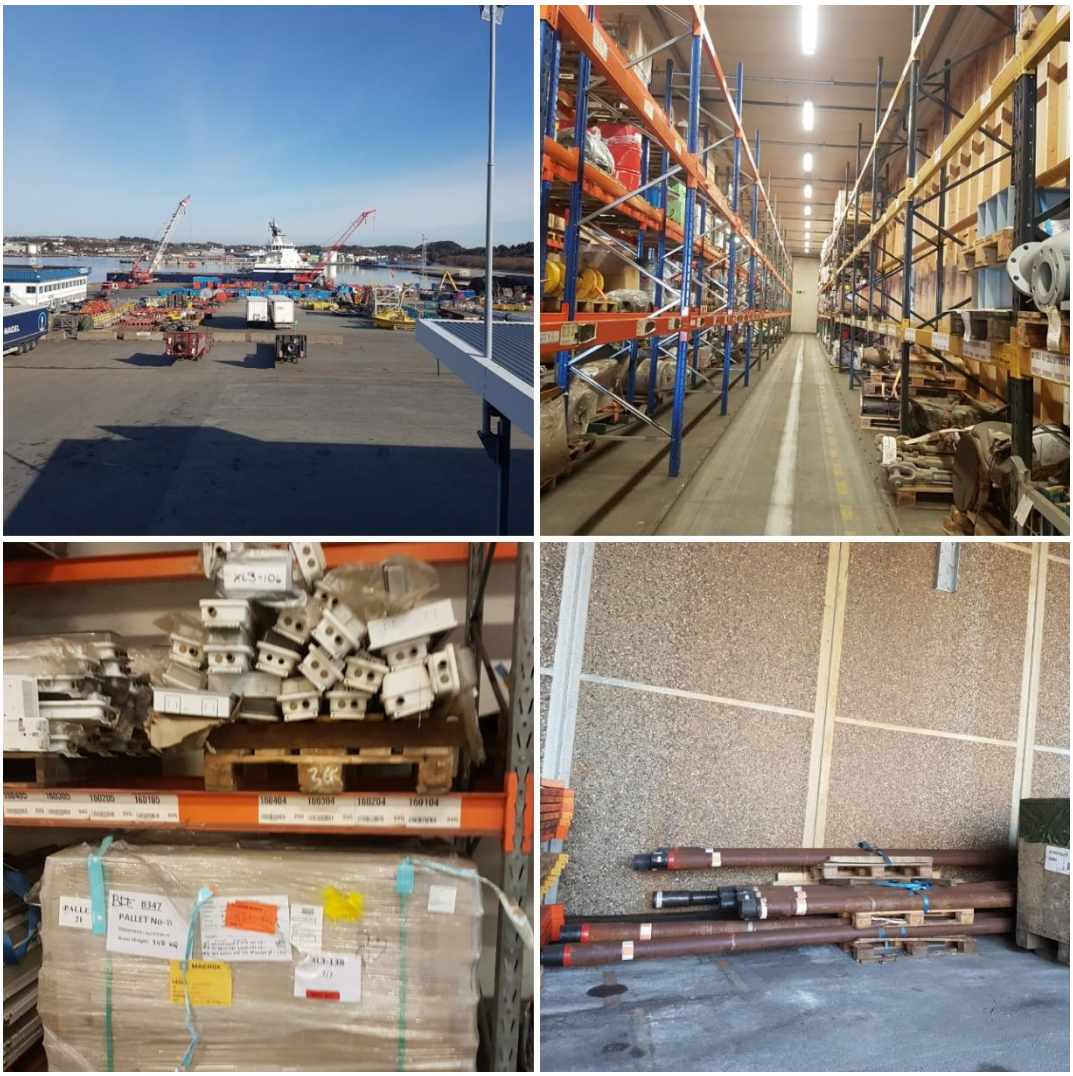
Appendices

Appendix 1. SITE VISIT – 19 MARCH 2019

Picture 1: Warehouse 1 / Yard 1 - Tananger

Appendix 2.

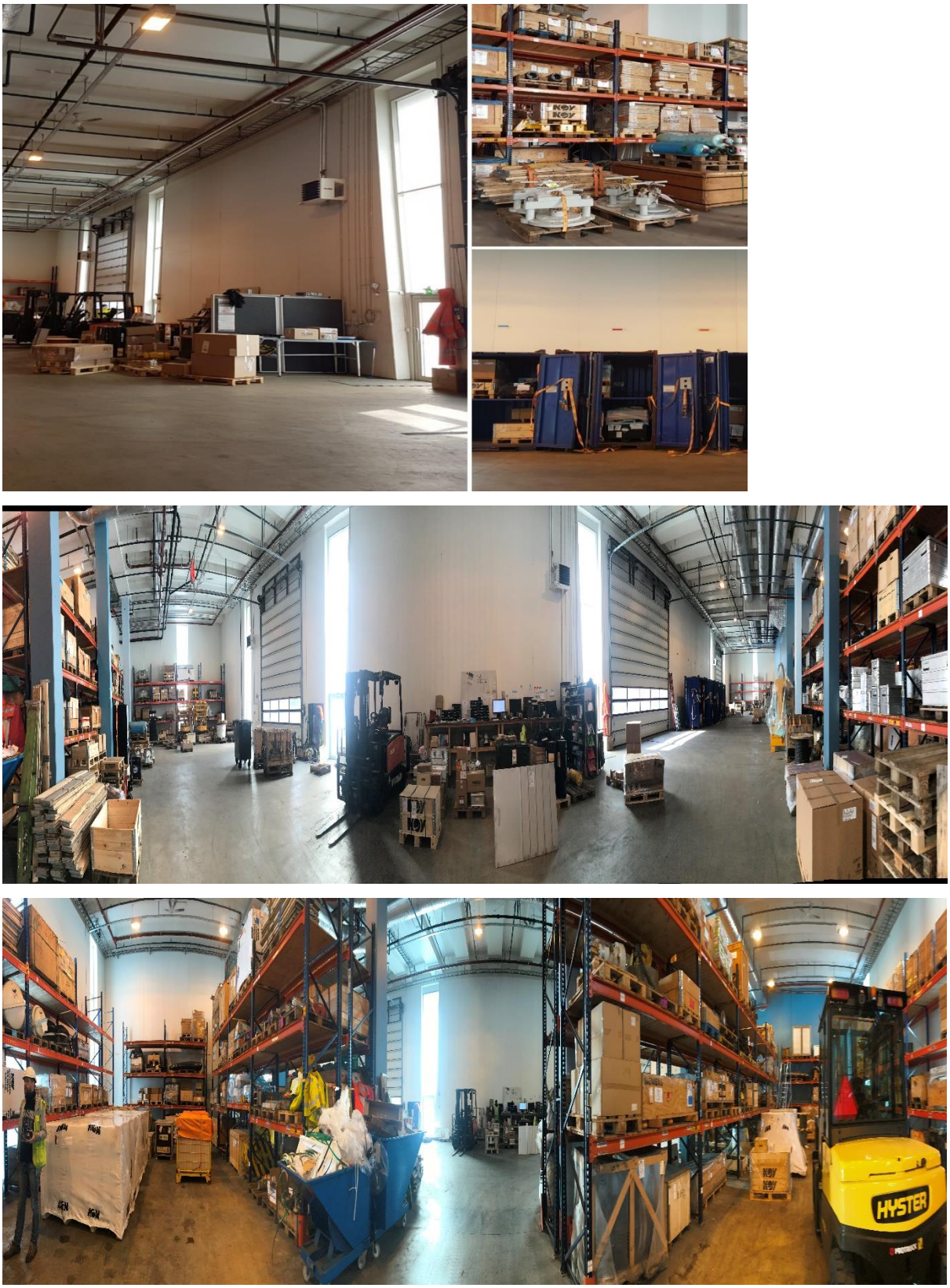


Pic 2: Warehouse 2: Yard 2 and 3 - Tananger

Appendix 3.

Pic 3: Pipe Yard – Rennesoy

Appendix 4.



Pic 4: Transit Warehouse / Hub – Forus

Appendix 5. QUESTIONNAIRE:

Supply chain Manager

1. Can you tell us about Maersk Drilling?
2. Are you connected with any other company like partnering or making alliance with? Which company?
3. How the system works to get a job to drill?
4. Who is responsible with the material in the container from quayside to the rig? And in the rig?
5. Does the rig personnel / manager have a direct contact with your company's suppliers?

Warehouse and Logistic Manager:

6. How many warehouse Maersk has? Where are they located?
7. What is the purpose of each warehouse? What items normally stored in each of the warehouse?
8. How did you manage the warehouses? the warehouse staff? the items/inventory?
9. What is the source of transportation of the company? Does the company own a truck for transporting goods and equipment?
10. Does Maersk own the warehouses?
11. How many employees assigned in the warehouse? What are their individual job responsibilities?
12. Are you satisfied with the performance of your staff?
13. Are the employees assigned in the warehouse enough for the job?
14. If you need equipment from one of the warehouses, how does it work?
15. How does the employee being measured in their job performance? Do you have key performance index (KPI)?
16. How do you measure the product performance?
17. Which business system is use?
18. Which area is the most demanding one in the warehouse? backloading? rig operation? foreign shipment?

Hub/transit warehouse

19. How many forklift Maersk has?
20. Do suppliers have time slot to drop materials?
21. Who is responsible to receive incoming material from suppliers? Who is responsible to drive the forklift?
22. How many entrances the warehouse has? Which one is the main gate? Why only use the gate#2 for incoming material in and out?
23. How is the process after one of the staffs receive material from supplier?
24. Is there anyone check the material from supplier? why? What happen if the material not the same quantity as requested? How big is the chance missing item in the supplier?
25. How long normally inventory stay here?
26. What is the purpose of backloading area? Foreign area?
27. Do you know if supplier will drop material to the warehouse?
28. When there is no time slot for supplier to drop the material, what if many suppliers come on the same time?
29. Why do you have so many big pipe and equipment outside the HUB warehouse (in the yard within hub premises)?

Warehouse staffs:

30. What is your job designation?
31. How do you manage your task?
32. What do you do with the items received?
33. When you received items from supplier, what you need to do next?
34. How do you do the labelling?
35. How is the speed of the system? Are you happy with it?
36. What do you think Maersk IFS system? Is it complicated?
37. How do you split each of the material to the right container to be shipped to one of the rig operations?
38. Do you do any training?
39. What is the problem that you encounter in the warehouse?
40. So, once you have done prepare document (manifest) what do you do next?