A Lean approach to improving technical processes and documentation between onshore and offshore in Aibel's Construction Department

- *To identify, analyse and define measures for initiating waste reduction in the process of making a technical installation package*

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Foreword

The thesis is written as an obligatory part of the M.Sc. Grade in Construction and Materials, at the University of Stavanger. The master thesis is valid over a period of one semester and corresponds to 30 study points. I write the thesis in collaboration with Aibel, on the matter of excessive technical documentation flow.

I have come to respect and appreciate the Toyota Production System (TPS) and authors such as Mike Rother for the valuable insight on Lean Thinking. There are extensive lists of books that encompass Lean tools and techniques, but few take the step to understand the underlying reasons as to why the TPS worked. It baffles me repeatedly that Lean is not limited to systemizing work or improving processes, but exists as a natural part of being alive. Lean is a way of thinking, a way of life in which one strives to become better, to oneself and others.

I would like to take this opportunity to thank everyone who has helped me along the way to complete this master thesis. A special thanks to my supervisors, Chandima Ratnayake at the University of Stavanger, Joffre Jatem and Gunnar Haavik at Aibel. Without their help I might not have come this far. Glowing thanks to Dorota Stadnicka for pointing out my errors and coping with my dull questions. Adding to the list of people are the students and my closest friends, Ahmed, Bendik, Zakaria and Mohamed, thanks for keeping me company and motivating me with your jokes and laughs.

Most importantly, I would like to thank my family for providing me with all that I needed, to my mother for staying strong, and my father for always being there for me. Finally, a heartfelt thanks to my best friend and wife for her unwavering support, but also the strict schedules, the patience and the good food that kept me in top form.

Thank you!

Stavanger, 15.06.16

Mohammed Osman Chaudry

Summary

The research addresses the growing concerns over excessive use of technical documentation in the installation package. In conjunction with the overproduction, preparation costs increase from sending the installation package to the offshore platform in physical copies and by boat. The study attempts to identify the main obstacles centered in the process, with the use of Value Stream Mapping (VSM). The analysis determine two rigorous, yet viable hurdles throughout the VSM, highlighting those potential improvements as both necessary and liable to feature Lean tools and techniques. The objectives are ‘irrelevant content reduction’ and new ‘electronic installation packages’. By applying qualitative research, empirical data collection, alongside convenience and snow ball sampling method to gather relevant information from two departments, the study designates towards benefitting from the Lean tool 5S and the implementation cycle PDSA. In doing so, it manages to evaluate the total lead-time of the VSM, inspect the process cycle efficiency and investigate the cost reduction program.

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Definitions

Below are definition of terms used in the thesis.

ALARP – As Low As Responsibly Possible

As-Built (AB) – Final approved documentation ready for handover

BVA – Business Value-Added

Copno – Conoco Phillips Norway

CSM – Current State Map

CPP – Cost per Page

CVA – Customer Value-Added

DCC – Document Control Center

DRE – Discipline Responsible Engineer

EIT – Electro, Instrument and Telecom department

EPCI – Engineering, procurement, construction and installation

ATEX – EU Directive describing equipment requirements for hazardous areas

FEED – Front-end engineering design

FSM – Future State Map

Gemba – Japanese for ‘actual place’

GEMC – Greater Ekofisk Modification Contract

HSE – Health, Safety and Environment

IDC – Internal Document Control

IFC – Issue for Construction

IFR – Issue for Review

IMVP – International Motor Vehicle Program

ISM – Ideal State Map

Kaizen – Japanese for ‘continuous improvement’

Kata – A pattern of movement, routine and thinking behavior

MIT – Massachusetts Institute of technology

Muda – Japanese for ‘waste’

NCP – Norway Capitol Projects

NDE – Non-Destructive Evaluation

NORSOK – Standards developed by the Norwegian Petroleum industry to ensure adequate safety

NVA – Non Value-Added

NVAI – Non Value-Added Improvement

PCE – Process Cycle Efficiency

PDCA – Plan, Do, Check, Act

PDSA – Plan, Do, Study, Act

ProArc – Aibel’s document handling and distribution software

VAI – Value-Added Improvement

VSM – Value Stream Mapping

TPS – Toyota Production System

WP – Work Package

1. Introduction

Every business and organization is conclusively characterized by what it produces. The successful organizations create not only value to the customer, but the production is handled in a manner that preserve and bolster the organizations growth. In terms of quality, cost and benefits, what ultimately creates value for the end customer is reflected through prosperous advancements and further continuous improvements in projects and throughout the organization. A project of high complexity requires proper diligence, good planning and execution, and above all; excellent teamwork and communication, heeding to the principles of LEAN in order to progressively improve every aspect of the project.

Considering these outstanding ideals and resolutions that modern companies and organizations have in their approach to successful project deliveries, we find repeatedly traces of profitable projects turning into a failure. In some instances, when time and cost exceed a certain amount the projects tend to fill the gap quickly, and in their haste, causing an increase in possibility of errors by a tenfold. In addition, some organizations still rely on the traditional management practice based on the principles of Frederick W. Taylor (1911), the writer of "Scientific Management". His approach, although not intended (Hakan Turan, 2015:1), has been conceived as equalizing the organization to machines, which in turn need to be broken into smaller, discrete tasks for studying and understanding. Another similar rectification proposed makes it quite clear that the problem is not people, but the management system (Rother, 2015:xiv). Barry O'Reilly ‚Jez Humble & Joanne Molesky (2014:6) on the humble beginnings of the TPS (Toyota Production System) state that the traditional management system (Taylorism) specify tasks which are performed by specific employees, without the need of understanding any more than doing whatever they do as efficiently as possible. A good example of displaying the possible outcomes of Taylor's management system are the workers and their simplified tasks in the Ford production facilities. In contrast, TPS focuses on aligning goals, creating a work environment where workers and managers cooperate in order to bring kaizen (continuous improvements). This high-trust culture is directed towards implementing kaizen, creating self-aware and autonomous workforce, and aligning it on all levels (O'Reilly et al. 2014:6-7). Imperative to building a large organization is the ability to adapt swiftly to changing circumstances, which is exactly what LEAN provides.

Aibel is a big company with a sufficient market share in the Norwegian continental shelf. Thus, I find the opportunity enticing, and nonetheless important in the aftermath of the sudden negative development that has sent the oil industry into a state of shock. Floating on the waves of recent and hasty efficiency programs, time improvements and cost cuts for projects, this thesis urges towards becoming a demonstrative representation of how even big companies can change themselves rapidly by using LEAN methodology.

1.2 Purpose

From a student's perspective, there is nothing more compelling than setting a goal and accomplishing it. When solving a problem at the right time and moment, where the solution brings about a success for someone else in addition to yourself. When your work has the possibility to set a footprint in history, or create an impact on the future. Even if your contribution is small, a start of an adventure, an embarkation of a journey, a small light of hope may one day end up bigger than you may think.

The purpose of this thesis is to be a catalyst for the upcoming and sorely needed time and cost efficiency projects by utilizing and demonstrating my abilities as a student, in addition, applying my knowledge and skills into performing a practical study related to my professional studies. Secondly, the main reason for the given approach is to create value by studying projects and using LEAN methodology for continuous improvement.

My bachelor thesis, although it revolved around improving Aibel's valve requisition process and only one LEAN method was used, the present thesis will incorporate method and findings from the earlier thesis, as well as working upon new LEAN tools. This is done in regards to increasing the width and depth of the study, likewise extracting results that should yield better conclusions.

By adhering to the propositions and wishes of the company, I base my thesis on a theoretical point of view. It will permit me the freedom to operate as I see fit and engage accordingly. At the end of the thesis, I am determined to see greater improvements in terms of cost and time savings of at least up to 15%. For that to happen, I have to put effort into studying the content of the technical documentation that is in the installation packages, and the process as a whole. It has been done before within the company, but this study turns the tables around by correcting a crucial part of the project: the point of view. One of the main objectives in order to reach our goal is to change the viewpoint from the place where the documentation is being made, to the place where the actual work is done.

1.3 References

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2. Background

2.1 Study background

An organization needs a management in order to effectively create valuable products and services for its customers. We define management (Rother 2009:xiv,15) as

> *“The systematic pursuit of desired conditions by utilizing human capabilities in a concerted way”*

Albeit management in the current era is focused on becoming less traditional in their approach towards creating a better working environment (Bernard Burnes, 2004), implementing newer ideas and solutions in order to improve operations, competitiveness and to stay healthy. We do not have to look far to realize that the predecessor to the current organizational trend, command and control, was in fact a common practice amongst the big organizations and companies (O’Reilly, 2014:12). The decentralization process revolutionized the west, partly through the Japanese manufacturing company Toyota where the executives Mr. Toyoda and Mr. Ohno started identifying different kinds of wastes in the production system (Black & Miller, 2008:4; M. Verkverk 2005:100). More and more organizations see the benefits of recent lean studies that show that adaptive companies tend to improve faster, while generating higher revenues and lower defects. Until now, a specific lean teaching and learning program standardized for management system is not entirely in place (Debashis Sarkar, 2009). In the other hand, the manufacturing industry has enjoyed great improvement results. It does not come as a surprise when the organizational thinking of LEAN from TPS is related with manufacturing production (Micheal L. George, 2003:8). A big chunk of the LEAN methodology can be found scattered around in applicable forms for different organizations to implement. Still, it is worrisome that organizations in the West consistently ignores the one single most important part of LEAN (Rother 2009:5), as seen in figure X.

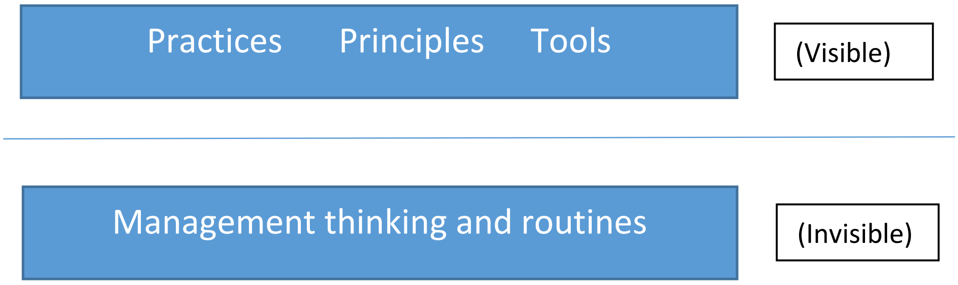

Figure 1: Toyota's visible tools and techniques are built upon invisible management thinking and routines

It is fruitless to implement TPS practices with existing management thinking, the techniques will not work properly unless we understand Toyota's hidden logic.

2.1.1 Installation package

The offshore industry has lowered its cost of rig operations in the North Sea in the wake of statistics showing an alarmingly expensive trend from the year 2000 until 2015. While the offshore engineers are continuously being prepped with improvement programs and efficiency sermons, the overall productivity is tad better than what we experience onshore.

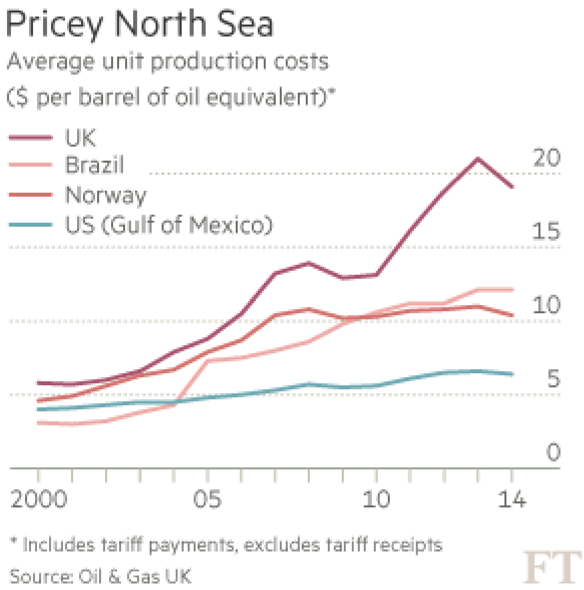

Figure 2: A comparison of the average unit production cost increase in the last decade

At the start of each project, the FEED study initiates the work that has to be done for the project to be successful. The work is divided into sections called work packages, where each work package is pertinent to milestones set for the project. A work package is often a single job, or a variety of tasks correlated by area, compatibility and priority. Given that Aibel is a supplier of services for EPCI contracts, a substantial effort is made to garnish procurement material for the work packages. Another significant time consuming activity is to obtain confirmation and consent from client (Chaudry, 2014:32). Just as engineering documentation edges over the finish line, the next phase of making ready and delivering work packages offshore starts. The installation work that needs to be done offshore is detailed in the installation package, which is produced by the DRE by gathering relevant documentation and formulating the information through an established set of guidelines. These installation packages are available in template format for all departments, although with minor differences in respect to the different priorities in the departments.

Talking with a DRE (Stordahl, 2016) on the matter of starting up on installation packages, He articulated that the work on installation package has already started by the time the primary documentation is approved for AS-BUILT. Once the kickoff for installation packages is issued, time consume is gradually lessened and narrowed down to an approximate of maximum 1.5 weeks. By breaking down the process of creating the installation package, we find a basic layout that shows us the progress, step by step.

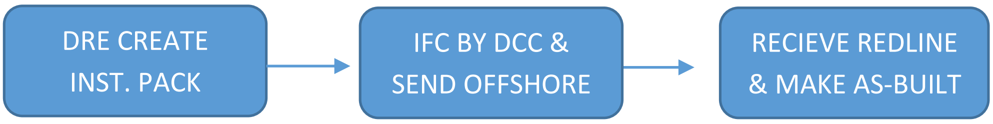

Figure 3: Basic overview of installation package flow

As the DRE rounds up the installation pack for “Issue for Construction”, the document takes a loop through the different departments for feedback until it eventually hits green light. On regular basis, a high percentage of IFCs are rejected in the first round thanks to errors. As for Document Control Center, their work compromises of organizing, storing, printing and scanning documents. In this case, DCC prints two copies of the package, one labeled original and the other “copy”. These are sent to the offshore platform by boat.

Immediately upon arrival, the offshore engineers start working on the site. If the work proves to be simple and straight forward, the onshore team plans 2 x 12hr maximum work period. Consequently, the offshore engineers write down changes with a red marker and send the package back onshore by boat, hence the name “redline”. The package is received by DCC onshore who upholds the flow by scanning it and sending the activity to the responsible engineer. The redline is implemented into an AS-BUILT according to the changes in the red mark-up. At last, the only documents that are required by the client are uploaded and stored on the clients SAP.

2.2 Aibel

Aibel has been in the oil industry for a long time, dating back to its humble beginnings as "Haugesund Mekaniske Verksted" (HMV) in 1900. HMV was later bought by ABB in 1987, which was the starting phase of their full commitment to offshore and EPC activity. The name Aibel was founded in 2007. Over 100 years of experience has refined the solid project execution and simultaneously reinforced their approach to newer organizational management system hand in hand with the growing spotlight on the oil industry. As of today, it is one of the biggest oil service companies in Norway in respect to possessing the experience and knowledge for instigating EPCI contracts.

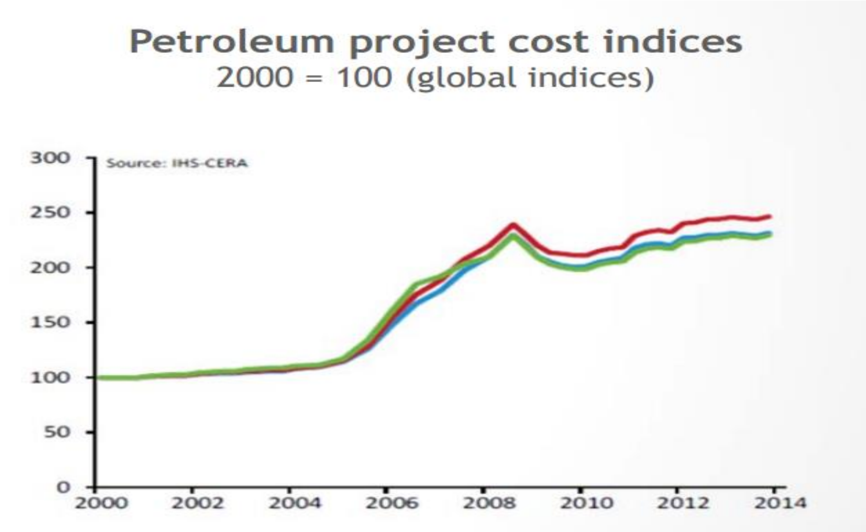

Figure 4: Project cost increase over the past decade

The continuous declining trend in the petroleum and offshore industry has an impact on service providers such as Aibel, for instance, the cumulative drop in oil price from 2014 has forced several other service providers on the brink of bankruptcy (Dolphin files for bankruptcy, 2015). In troubling times like these, the company's ability to change is vital to its survival, albeit the transformation requires a fundamental organizational system that is flexible and open for change.

At Aibel's operational level, a project based organization structure is employed. To best cater resources to the different projects in the form of;

1. Collocated employees with strong communication channels
2. Strong workforce directly working with project, although low innovation rate

The most important characteristic of project based work environment is the rapid reaction time to problems or issues that might arise (University of Stavanger, 2015:7). Thus, theoretically, Aibel is able to perform internal changes quite well in regards to the changes in the petroleum industry.

2.2.1 The response to falling oil prices

Aibel's ability to change and take decisions quickly is the reason for the recent layoffs, after successfully evaluating the current state of the company; some specific changes are done since the start of the oil crisis. These are:

1. 2300 employees have been laid off since early 2014
2. Board changes
3. Organizational changes

By definition, change is an action in order to make or become different (Oxford Dictionary), in times of trouble, the correct changes at the right time and place are critical. By cutting the work force and removing some of the core knowledge, Aibel is treading on risky grounds. Still, the forecast of the future depicts further layoffs and it is important that Aibel have the courage to take a stand. These changes are what ultimately saves Aibel.

2.2.2 Greater Ekofisk Modifications Contract

Aibel has carried out maintenance and modification in the Ekofisk-area for Conoco Phillips since 2002 (http://aibel.com/no/projects/gem) under the contract called GEM, additionally the contract was renewed in 2011 as GEMC with five years project period and infringement options of three plus three years. It was an implication and a sign of satisfactory performance on Aibel's half, even though the possible time and cost improvements were significant in Conoco Phillips projects such as Norway Capitol Projects, as

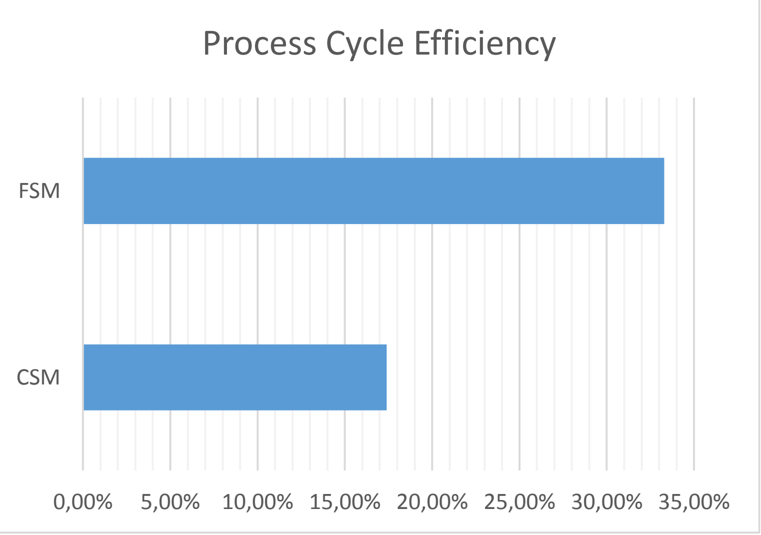

Figure 5: Results of earlier improvements in Aibel through VSM

seen from “A study of improvement in Aibel’s valve requisition process” (Chaudry, 2013:14, 32).

In the same style as I addressed the potential shortcomings and their solutions, this thesis will determine on a similar case study, but considerably larger in depth, by using LEAN methods for improving quality while eliminating wastes and paving the way for reduced time and costs.

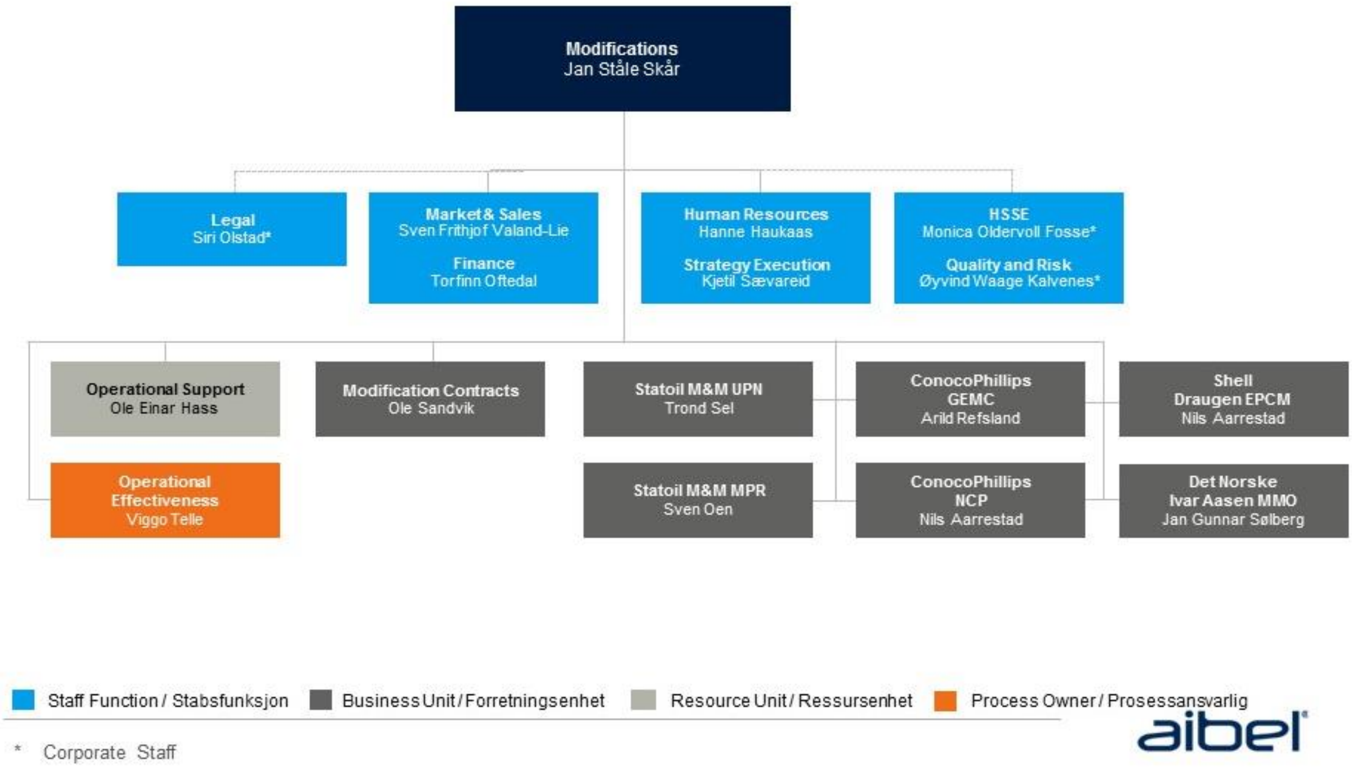

Figure 6: Aibel MMO & Modifications organisation chart 2016

In February 2016, Conoco Phillips gave the GEMC to Aker Solution; consequently, the whole GEMC department, which at its height employed up to 400 people, will eventually end by handover time between August and December 2016. This mark a change in Aibel’s portray of projects and will have a huge impact on future forecasted workload as well as investment.

2.2.3 My standpoint

My contact with Aibel was maintained after handing in the bachelor thesis. With the increasing decline in the oil market between the periods 2014-2015, my expectations for a LEAN based master thesis rose out of necessity and a wish to help a company which gave me it's trust from 2012 and onwards, once as a summer employee and afterwards as a DRE for Valves in a 50% position. After some quick events and email exchanges with the Section Manager for mechanical & maintenance, Betty Lystad, I was given a green light and we quickly set up a meeting with relevant onshore personnel, specifically in conjunction with Joffre Jatem, project execution processes, and Gunnar Haavik, construction manager for GEMC.

The purpose of the meeting was to clarify what Aibel wanted to achieve with the study. The discovery made by the construction department so far gave a rough idea of the possible improvement areas. Håvik explained the situation: as documentation reaches a point where it is deemed acceptable, it is sent offshore for installation. When the documentation returns the onshore engineer works with the markups and finalize the documentation for handing over to the client. In between the lines of these intricate processes, the construction manager feared that huge amounts of time and cost consuming activities called "*muda*" (waste) could lay hidden. The idea of this thesis is therefore to counteract and eliminate the wastes both in processes as well as in content, in order for Aibel to not only learn from this experience but also implement some of the idealistic and drastic changes into all current and future projects, thus saving money.

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3. Problem description

3.1 Research problem

To single out, analyze and determine efforts that can be taken in order to reduce the possible amount of waste such as time, cost and overproduction in the process of creating, managing and distributing a technical installation package for the Structural department in GEMC.

3.2 Main and sub-objectives

The main objective of this thesis is to be able to identify wastes in the GEMC project along with ideas that should raise the necessity for LEAN thinking. In terms of waste itself, such as time and cost, we are looking towards understanding the concept of avoiding wastes, rather than fixing them. This thesis ought to convey result oriented conclusions, specific to each of the main and sub objectives. That implies on the two constitutional pillars of the study:

1. Research on identifying and analyzing wastes in the process of technical installation package for the Structural department.
2. Identify, establish and review innovative solutions in order to reduce waste in the process of technical installation package for the Structural department.

The sub objectives encompass a study of the relationship between the DRE, DCC and offshore personnel; map their functional perimeters as well as communication barriers. Secondly, to dive into the content of the technical installation package for a closer look on the setup, form and composition. Another intention is to amass valuable data for analysis that may prove important for Aibel and further studies of improvement.

By processing the formative work of scope for the structural department, I should be able to gather knowledge of the steps that make up the intricate web of processes, and in hindsight create a Value Stream Map for surveying the overall flow. The VSM will focus on two primary sources of installation packages, the structural department and the EIT – Electro, instrument and telecom department. Being in the presence of the structural department and seeing the improvements led by Gunnar Haavik, I was assured that the results were already much better in this department compared to the other departments. I was right.

The reason why I chose two installation packages from two different departments is in order to, firstly, pinpoint improvements in an already improved installation package: the structural installation package. Secondly, the EIT installation package has scarcely any improvements; actually, it serves more as a stage for demonstrating the full potential of the LEAN improvements. Thus, the latter will also serve as a good example for the rest of the departments, as well as in other projects.

4. Theoretical Framework

LEAN is positively perceived worldwide by its width spectre of different tools that are available. The scalability makes it great for both big and small organizations. The theoretical framework of the study revolves around applying correct tools for the appropriate work; hence, the framework is subjected to definite applicability.

4.1 Lean Basics

John Krafcik introduced Lean in an article from his M.Sc. study at Massachusetts Institute of Technology (MIT) Sloan School of Management in 1988. The article was featured at the International Motor Vehicle Program (IMVP), organized by the MIT. Later, it went on to become the fundamental piece in Womack's bestselling book "The Machine that Changed the World" (1990), co-authored with Ross and Jones. The book draws its inspiration from the Japanese work environment, specifically the Toyota Production System.

Lean is an approach towards improving quality and eliminating waste. This definition resembles Shah and Ward (2007:785-805) and Plenert (2010:146) who adds a detailed suggestion on the definition of Lean:

> *"Lean is a systematic approach that focuses the entire enterprise on continuously improving quality, cost, delivery and safety by seeking to eliminate waste, create flow, and increase the velocity of the system's ability to meet customer demand."*

Improving quality and eliminating waste is done through a selection of different tools and methodologies, which in the end are customized for the specific Lean process. Some Lean experts in their approach to defining Lean challenge this viewpoint, as it indirectly opposes and deprioritizes the psychological part, management thinking (Rother 2009:6). Thus, one should be inclined to following a middle path and focus on both practices, principles and tools as well as the hidden management thinking and routines.

4.1.1 Defining Waste

There are at least seven types of wastes in Lean, which do not add value. These are commonly referred to as "*muda*". There are other candidates, for instance the non-utilized creativity. Practically every waste in the process can fall in one of these categories:

- Overproduction
- Inventory
- Transportation
- Motion
- Waiting
- Defects
- Over processing

In the process of eliminating *muda*, it is important to know the different categories of processes that *muda* can pass into,

1. Processes that are necessary, but do not contain *muda*
2. Processes that are necessary, and contain *muda*
3. Processes that are not necessary, but contain *muda*

Wastes are undesirable in any kind of process when they neglect to add value to a product, or in any way prevent value to be added. These are crucial to investigate in order to identify and encounter possible time and cost bottlenecks. Priority should be given towards 2. Processes that are necessary and contain muda, because of their necessity in which we need to find new solutions to counter the wastes.

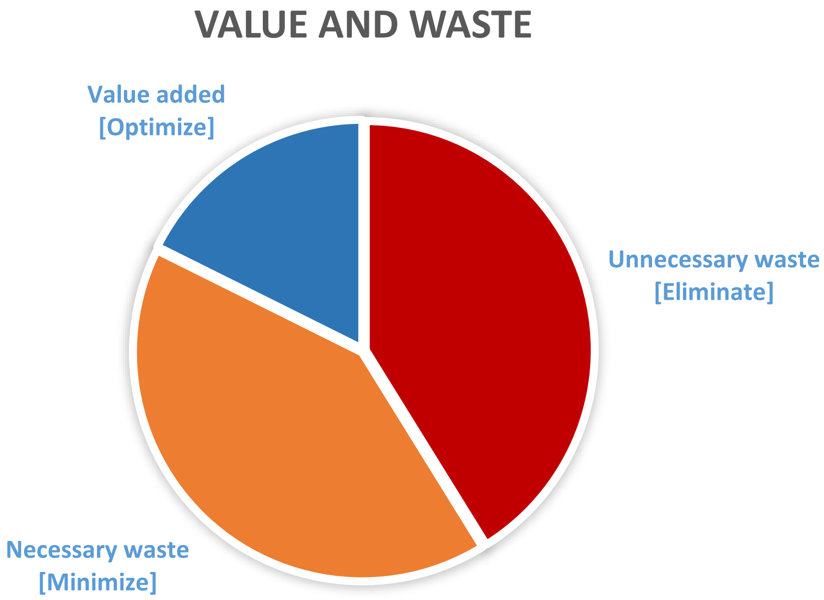


Figure 7: The three different kind of processes in regards to muda (waste)

The value added part is generally the smallest, while the unnecessary and necessary wastes are relatively similar, albeit the necessary waste is a tad more dynamically lenient. Our goal is to optimize the value added activity, minimize the non-value-added activity that is necessary, and eliminate the non-value-added activity that is unnecessary and purely waste.

4.1.2 Principles of Lean

In recent times, companies and organizations are competing with each other in order to implement Lean methodologies, mostly because of the negative impact the oil prices have had on the industry. The will to increase productivity while reducing costs and time has forced a great deal of unbalance in the implementation of Lean. Stories of incredible savings and miraculous endeavours by the use of Lean tools has left managers and leaders with a sour taste of dismay by implementing isolated, single or thoughtless methodologies on top of our existing management thinking without adjusting an appropriate approach.

By looking at Womack & Jones (2003:10) undertaking of intertwining the different lean tools and methodologies, we find a strong optimism in their pursuit of creating a better solution for organizations and alike to implement lean tools and methods by:

1. Specify value by specific product
2. Identify value stream for each product
3. Make value flow stream without interruptions
4. Let the customer pull value from the producer
5. Pursue perfection

Womack & Jones suggest these principles to be studied, and put together for constructing a steady course for the lean implementation of tools and techniques. Chaudry (2014:17) describes each point in detail:

Table 1: Lean principles for lean thinking

THE 5 LEAN PRINCIPLES

1. Specify value. A process or product with value should be designed to fill the needs of customers, rather than what the company or internal reflections might suggest.
2. Identify the value stream. The specific activities required to design, order, and provide a specific product, from concept to launch, order to delivery, and raw materials into the hands of the customer.
3. Flow. The progressive achievement of tasks along the value stream so that a product proceeds from design to launch, order to delivery, and raw materials into the hands of the customer with no stoppages, scrap, or backflows.
4. Pull. A system of cascading production and delivery instructions from downstream to upstream activities, which practically allows upstream to produce only at the demand from downstream, such as from a final customer or from an internal customer.
5. Perfection. If the above principles are achieved, the possibility of perfection is very high. Perfection means zero waste.

These five principles combined leads to a perfect system, which is practically hard to achieve. Nevertheless, the principles are neatly integrated with each other, and supply an ideal situation firms or organizations should strive to implement.

In a similar fashion, if we incorporate Rothers suggestion about management thinking, a rough corporal view of Lean thinking can be outlined with the addition of some extra inputs:

1. Management thinking
2. Routines

These basics build upon the principles Womack & Jones mentioned earlier. By expanding our view from tool and technique based work to forming the ideal psychological ground for understanding lean thinking, a harmonic path seems to appear. It introduces the idea of combining a methodological way through a management that has the right approach towards lean improvement. A detailed description of the two added principals are listed below:

1. Management thinking. The replacement of traditional financial-result-driven management is a change in the direction of favouring "managing by means", in contrast to "managing by results" (Johnson & Broms, 2000:12). In relevance to Lean thinking, the way we think and attack problems is different from what has been a usual occurrence in the Japanese industry for decades.

   Personally, I have experienced this in my two visits to japan, first in 2013 and afterwards in 2015. I studied the general behaviour and work ethics of everyday Japanese, as well as inspect the surroundings of construction sites, engineers, and working class citizens. What I found mesmerizing was the people's view of dignity and honour; every job and activity had its rightful esteem in the society. The Japanese take pride in the work they do, for instance, a washing lady will work as hard and diligent as an office worker, both respecting each other's prestigious work. This garnishes each member of the society in his or her rightful place without tarnishing his or her reputation in any way. Secondly, the Japanese workers are intent to achieve goals with quality and execution in mind. In contrast to the Norwegian standard of 7.5 hour working days which on regular basis Norwegians strictly follow even if the workload is overflowing, the Japanese tend to ignore the limitations of working hours in favour of doing a throughout job by evaluating their own progress and crucial deadlines. This serves as a basis for upon which the Japanese try to improve processes in order to become more efficient and reduce time and wastes.

2. Routines. At any given point of time, the ideal organizations collection of practices, ethics and principles is a result that comes forth from the routines of thinking and behaviour, emanated by the members. Each organizations competitiveness, culture and the ability to adapt emerge from the routines and habits by which the members of the organization conduct themselves on every day basis. This is called *Kata*.

Thus, we come to realize that Toyota's decent results derive more from routines of continuous improvement by experimenting, rather than from the tools and techniques that are listed in every major Lean book. Steven Spear, in his doctoral dissertation for Harvard Business School, describes the relation between routines and tools by pointing out that a big part of the tools and techniques are, actually, preventive remedies developed out of Toyota's continuous improvement routines, and not the other way around (Spear, 1999).

4.2 Tools and techniques

This chapter will present the different methods that will be used in this thesis. Initially, the focus will be on using the Value Stream Map to identify, analyse and implement solutions. In spite of the VSMs efficiency in quickly mapping the processes, it cannot do much more than identifying the value streams, hence the need for a specific tool e.g., 5S, which suits perfectly for analysing the content of the parts VSM pinpoints. Ultimately, the potential solutions that spring from the VSM and 5S will use the PDSA method of implementation.

Processes are prone to changes over years as they become more and more complicated, unless improvement programs are continuously applied, the practices fall into a waste filled pattern. Given that, most contracts between client and supplier in the oil industry tend to span over several years, the natural habit of relaxing into a specific practice is quite levering. Changes are hard to undergo, as people tend to have a certain amount of acrimony towards changes.

4.2.1 Value Stream Mapping

To create a Value Stream Map, one must systematically specify each step starting with the lowest department and working towards the top. By detailing and specifying load, work and time on every step in the process, the Stream can be standardized into the Value Stream Map. In short, the VSM's goals (George, 2002) are:

A. Visualizing multiple process levels
B. Highlighting waste and its sources
C. Making "hidden" decision points apparent

The map is a pencil-and-paper sketch of the process that shows the information and material flow, as well as the steps that are taken in progression to fulfil it. There are generally three steps in creating a VSM, the first being a Current State Map.

1. Current State Map. A flow chart that shows the progression of a process from start to finish, as it practically happens every single day. In order to work with the Future State Map, the CSM serves as a base for sketching down wasteful areas and suggest improvements.
2. Ideal State Map. A flow chart that shows the end product of the improvements, an ideal Value Stream Map where the goal is to have minimum wastes, and create value. It is advised to make the Ideal State Map highly optimistic, even though a process can never be perfect, asserting efforts and always striving towards a common goal can bring about wonders.
3. Future State Map. The final map shows the flow of information that is practically possible after passing out improvements from CSM, finding solutions and eliminating wastes. The FSM needs regular updates as it plays an important role in setting deadlines and sub-goals.

4.2.2 Value Stream Analysis

The main prospective of the VSM analysis is to feature lean tools that take advantage of the mapping. Granted that the CSM is drawn, the next step is to review each activity with a series of questions. George gives his opinion on the content of the questions (2002:52), listed below,

A. Customer Value-Added (CVA) Questions:
    i. Does the task add a form or feature to the product or service?
B. Business Value-Added (BVA) Questions:

In addition to customer value-added activities, the business may require you to perform some functions that add no value from the customer's perspective:

i. Does law or regulation require the task?
ii. If the task is removed, will the process break down?

Recognize that these activities are non-value-added, but one is currently forced to execute them. It is important to eliminate or reduce the waste.

C. Non-Value-Added (NVA) Questions:

i. Does the task carry any of the following activities: counting, handling, inspecting, transporting, moving, delaying, storing, all rework loops, expediting, and multiple signatures?
ii. With faster lead times, how many distribution centres can be eliminated?

Waste is discoverable by applying these questions, which is the most important job of the VSM. As a rule of thumb, we consider the manufacturing industry's 80/20 rule for waste reductions when performing VSM. The 80% of delay caused in a process is considered to be from 20% activities. It cannot directly be translated into the transactional process in this study, but it should give a rough approximate of the possible results. Thus, we are looking at a minimum 20% performance improvement using VSM, through the calculation of processing time (T_p) and lead-time (LT) shown in the equation 1, below:

$$T_P = \sum_{i=1}^{n} T_{A_i} + \sum_{i=1}^{m} l_P + T_{AR_j} \qquad (1)$$

Where,

T_p – Processing time

T_A – The time one activity takes to be performed

n – The number of activities

T_{AR} – The time taken to perform the repeated activity

l_P – The number of repetitions

m – the number of loops

In conjunction with the calculation of the processing time, is the total lead-time, which can be summarized in the same manner as shown in the equation 2, below:

(2)

$$LT = T_P + \sum_{i=1}^{n} T_{W_i} + \sum_{i=1}^{m} l_P + T_{WR_j}$$

Where,

LT – Lead time

T_p – Processing time

T_W – Waiting time

n – The number of waiting actions

T_{WR} – The waiting time between the repeated activities

l_P – The number of repetitions

m – the number of loops

The processing time and the lead-time are both valuable assets that serve as input to the Lean metric; Cycle efficiency (George, 2002:36), as shown in the formula below,

$$Process\ Cycle\ Efficiency = \frac{Value\text{−}Added\ Time}{Total\ Lead\ Time} \quad (3)$$

To calculate Process Cycle Efficiency for management and organizations is a hassle as it conduces to considering far more factors, as opposed to a machining plant production facility. That is solely a consequence of the risk we accept when approaching the dilemma: humans versus machines. By normal standards, the productivity level in organizations that deal with producing technical documentation is quite variable, compared to production facilities that machine parts. On the other hand, the technical documentations complexity level is far above what any machine can fully reflect upon and reproduce. Hence, in our situation concerning technical documentation, a minimum of 25% cycle efficiency must exist for it to be called a Lean process (George, 2002:37). An optimum 50% cycle efficiency should be achieved in reality because the research involves transactional work. The study will concentrate on attaining the latter.

The Value-Added Time refers to the time that adds value to the process in any kind of way; it is what the customer regards as important. Conversely, the Total Lead time presents the total amount of time of the process, from start to finish.

In their simple approach to create a VSM for a Business Process Analysis, Stadnicka & Chandima (2015:4) add two additional indicators along with the PCE. The indicators are developed in order to further clarify the improvements, as the current Total Lead Time and Value-Added Time are proportional, which causes the results to show discrepant improvements. The first indicator specifies the total time improvement as a result of 'value added activities' (VAI).

$$VAI = \frac{T_{VCS} - T_{VFS}}{T_{VCS}} * 100\% \quad (4)$$

Where,

T_{VCS} – Total time of value added activities from the CSM

T_{VFS} – Total time of value added activities from the FSM

Similarly, the Non-Value Added Improvement (NVAI) shows the total time improvement by comparing the non-value added activities from the CSM and the FSM.

$$NVAI = \frac{T_{NCS} - T_{NFS}}{T_{NCS}} * 100\% \quad (5)$$

Where,

T_{NCS} – Total time of non-value added activities from the CSM

T_{NFS} – Total time of non-value added activities from the FSM

A practical example of the calculation of Process Cycle Efficiency can be found from the CSM results of my earlier research on Aibels valve requisition process (Chaudry, 2013:34):

Value-Added Time = 8 Days

Total Lead Time = (3+5+2+14+2+14+1+5) = 46 Days

Process Cycle Efficiency = 8 / 46 = 17.4%

Lean process (25%) > 17.4%

The analysis was made for the CSM, and showed a slightly below minimum cycle efficiency.

In spite of the flexibility that VSM gives in our approach to obtaining a good mapping system, Rother presents a distinctive approach that simplifies the operation (Rother & Shook, 1999):

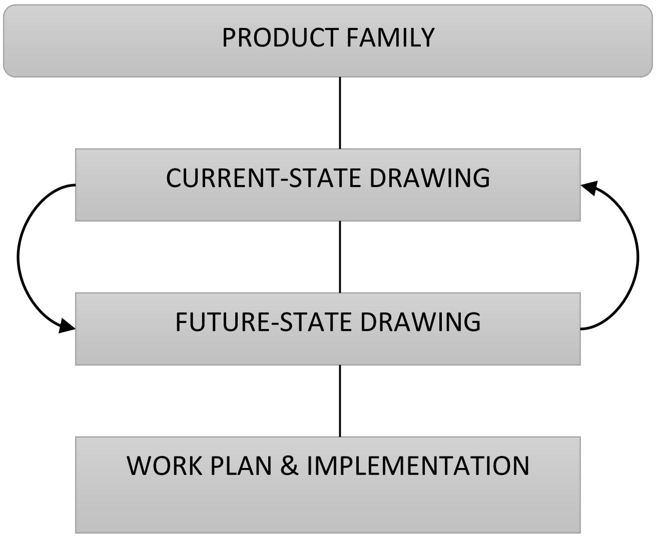


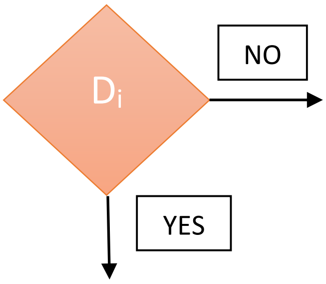
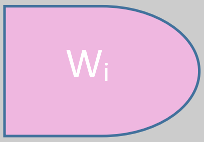
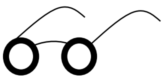
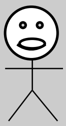
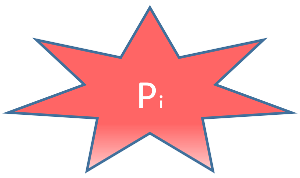
Figure 8: General steps for Value Stream Mapping

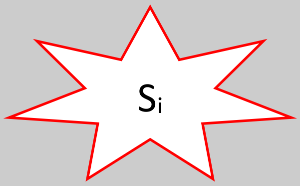
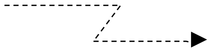
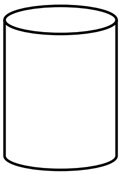
Continuous improvements are imperative to gaining success, which is why the loop made in Figure 8: General steps for Value Stream Mapping relies on the fact that work which is confined to be done in future-state must be aggressively demonstrated in the current-state, and contrariwise the future-state can create instability that was not discernible before. Prior to the improvement loop, the "Product Family" is any type of action or process. On the opposite end is the "Work Plan & Implementation", these are means on how to actually achieve the future-state that we have drawn.

The best practice for plotting down the CSM is to perform a "*gemba walk*" throughout the process. A *gemba* walk can be considered as taking a stroll on the bottom floor with the ground engineers and people who actually do the work, people who add types of value or non-value. As a direct witness to the process one might learn, observe, and consequently discover hidden wastes that cannot be found in reports and documents. For the process to be readable by everyone, simple adjustments are made to the plotting design, as shown in table.

Table 2: Symbols that are used in the VSM

Symbol	Meaning	Explanation

	Activity (A_i)	An activity which is performed in the process
	Decision (D_i)	A decision point where an action or a document need corrections, if yes it will have to be corrected by another activity, if no then it will continue through the process
	Waiting (W_i)	Waiting time is caused when the next activity in line must wait for this action
	Inspection (I_i)	When a closer inspection of the activities in the process is needed
	Gemba (G_i)	The gemba walk is the place where value is created, in practice it means to follow the process from start to finish while being on site.
	Problem (P_i)	Problems that are identified in the process, usually displayed in the CSM

	Solution (S_i)	Solutions to the identified problem, usually displayed in the FSM.
	Electronic Information Flow	The flow of electronic information such as drawings, documents, communication.
	Process Flow	An arrow which connects the activities in a flow
	Documentation Data Storage	ProArc data storage from where documents, drawings and other relevant information is extracted.

4.2.3 5S

The Five S' is a very famous tool that has been widely adopted from the set of Lean techniques. In contrast to VSM, the 5S is based on evaluating the content of one activity at a time. The main objective of the 5S is to systematically shape up and create a clean environment, along with an orderly system. The 5S is ideal for organizations that are at the starting phase of implementing lean methodologies, because of several factors such as low complexity, straightforwardness and the fact that it handles exposed wastes very efficiently. In addition, it gains further momentum by helping establish the framework and work upon standardizing. In this study, we are resorting to limiting the 5S to 3S; it will address the specified goal effectively.

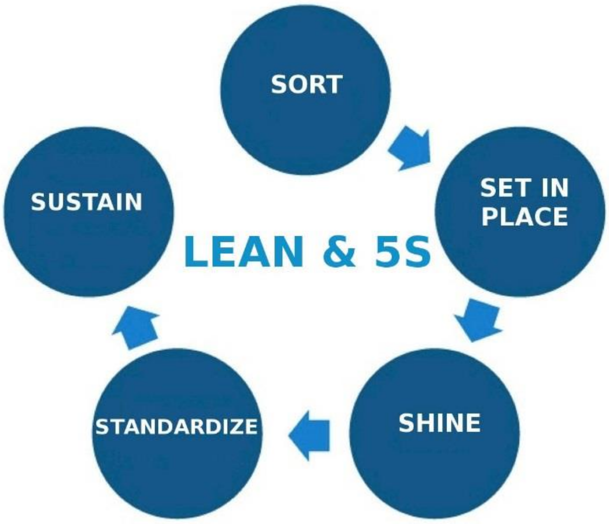


Figure 9: The steps in 5S

The 5S comes from five Japanese words: seiri, seiton, seiso, seiketsu, and shitsuke. It is obvious that the reason for the peculiar name, 5S, come from the fact that all the Japanese words start with the letter “S”. The theoretical framework for the 5S can be adjusted depending on how, where and in what situation the organization is in, thus it can be built to the desired level in order to fulfil its purpose.

4.2.3.1 Seiri (Sort)

Seiri is the first step in the 5S methodology, and it enables organizing and eliminating unnecessary parts. It gains a certain amount of inspiration from Toyota’s “Just-In-Time” (JIT), in the sense that acquiring just what is needed, in the right quantity, at the right time. As mentioned, generally there are three questions asked in this section, they encompass the necessity, amount and the location of the activity.

4.2.3.2 Seiton (Set In Order)

Seiton means to put the necessary actions in order so that anyone can easily find them. The Seiton is often described as being a place for everything and everything in its place. A practical example can be found when visiting a car mechanic. In his garage, you may find that all the tools are ordered in a way that makes it efficient, productive and clean.

4.2.3.3 Seiso (Shine)

Seiso is about following up on Seiton, as the objective is to maintain all the actions that are put in order. That includes keeping the work space clean and in good condition, may it be a physically or by within an eco-system. Concurrent to Lean thinking in organization and management level, the Seiso reckons with maintaining implementation of improvements, responsibilities, methods of incorporating systematic cleaning, throughout all levels of organization.

4.2.3.4 Seiketsu (standardize)

Seiketsu is a state of condition made from the maintenance of the first 3S. In itself, the seiketsu is an imperative part of the 5S. The sole purpose is to set a standardization for the cleanliness, a direct outcome of the Seiso. We ensure that the best practices are standardized and followed.

4.2.3.5 Shitsuke (Sustain)

In the end, it is important to make a habit of maintaining the correct procedures and standards. A vital part of Shitsuke is to establish a good knowledge and information flow between all levels of the organizations. These can be achieved by using graphical posters, mentor training, and by focusing on processes while respecting your co-workers.

4.2.4 Plan-Do-Study-Act

The scientific method of finding a path by experimenting is called the Plan-Do-Study-Act. Originally made by Shewhart (1939:45) as a three-step cycle containing specification, production and inspection, whereas W. Edwards Deming evolved it further in 1950 to include the fourth step: Redesign through marketing research (Deming, 1950). Eventually the cycle was termed the PDCA cycle in the west, which Deming thought of as a misunderstanding as He finalized his version in 1993, and called it the “Shewhart Cycle for learning and improvement”. In regards to the word “Check” in PDCA, Deming feared that the word might emphasize inspection over analysis and study. This has resulted into two versions, the PDCA and PDSA, which are only related through the scientific method.

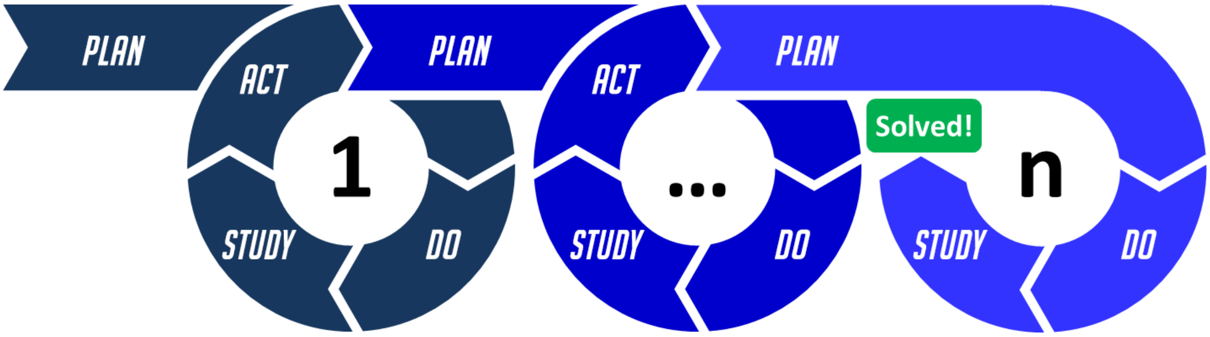


Figure 10: The Plan-Do-Check-Act cycle in a loop until solved

In short, the PDSA method consists of formulating a hypothesis and then testing it with the collected information e.g. Gemba Walk. Rother (2009:133) summarizes these steps in the cycle:

1. Plan. Define what you expect to do and to happen. This is the hypothesis or prediction
2. Do (or Try Out). Test the hypothesis, that is, try to run the process according to plan. This is often done on a small scale initially. Observe closely
3. Check (or Study). Compare the actual outcome with the expected outcome.
4. Act (What is next?). Standardize and stabilize what works, or begin the PDCA cycle again.

Rother (2009:136) reminds us repeatedly to concentrate on Toyota's way of thinking, instead of having a go at the techniques. Another point raised is the ability to experiment and adapt, which is vital for improving. Along with a heavy focus on "go and see", as it recommends managers and leaders to not trust reports and talking, but go themselves and witness the situation at site with their own eyes. At last, but not least, the elementary essence of Lean is to respect people by focusing on the process instead of blaming the people. Toyota cultivate a no-blame focus on processes as they assume that (Rother, 2009:141):

- People are honestly doing their best
- A problem is a system problem, and if we were the other person, the same problem would still have occurred.
- There is a reason for everything, and we can work together to understand the reason for a problem.

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5 Research Methodology

This chapter introduces the methodological viewpoint of the research method. Here, we will look at research approach and strategy, along with the method for collecting data and understanding non-probability sampling.

5.1 Research Approach

There are mainly two research approaches, which encompass a set of guidelines for conducting the research. In some cases, we are certain of a theory from which a hypothesis is deduced. The data is collected based on the hypothesis, and a choice of approval or rejection is given. If neither, then a revision of the theory is recommended (Bryman & Bell, 2007:11). This is called the Deductive Research Approach. On the other hand, the research we are following in this thesis is Inductive Research Approach as we are focusing on gathering data through the means of experience, actions and experiments. The empirical data analysis leads to the research hypothesis, which in turn is completed with theory (Bryman & Bell, 2007:14). This follows in line with our approach of bottom-up analysis, interviews and workshops in order to establish a Lean view.

5.2 Research Strategy

Research strategies are important in theoretical works. The two different research selections are the qualitative and quantitative research. The latter's approach desires the use of statistical tools, such as calculating towards an accurate answer by having defined steps compiled in advance. A short example of a quantitative research can be an imaginary survey, which concludes that the average patient has to wait thirty minutes in the waiting room for his or her doctor before being called in. Qualitative research relies more on analysis based on deeper understanding and discovery with the use of words instead of churning numbers. It reflects the methods of inductive research in order to generate a theory. The main perspective of this approach is to gather answers from the analysis of human behaviour.

5.3 Data collection

The empirical data collection in a qualitative research setting can be found through methods

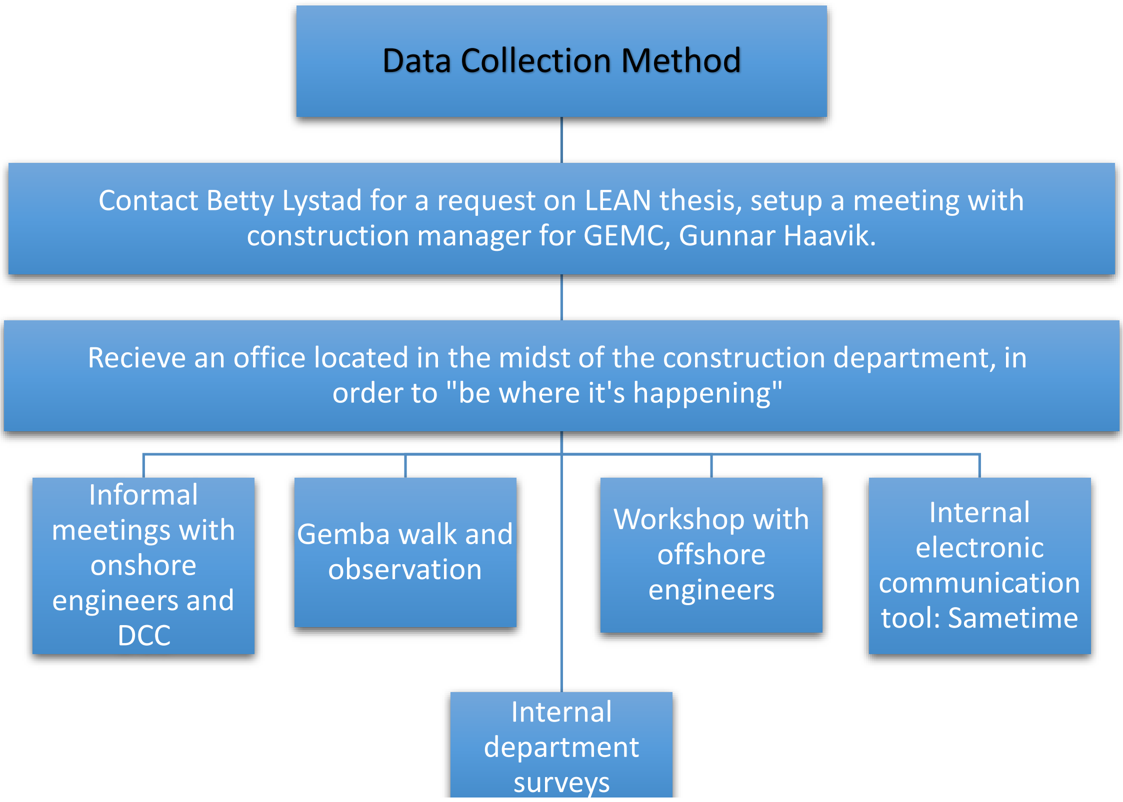

Figure 11: The data collection method

such as surveys, interviews, questionnaires and observation. Figure 11: The data collection method highlights the data collection method used in this study. Because of decent office placement, connecting with the department engineers was relatively easy. By then, the knowledge of having the appropriate people in regards to the study was apparently obvious, and with the help of the construction manager, most of the department was introduced to the study in their weekly follow-up meeting. The engineers had a positive mindset on improving the lead times, and engaged in expressing their concerns for the flow of unnecessary information to offshore.

5.3.1 Sampling method

In the field of selecting units from a population that we might be interested in, the use of non-probability methods are essential and generally preferred. The fundamentally distinctive feature of the non-probability method is that samples are selected based on the subjective judgement of the researcher, instead of a random selection (i.e., probabilistic methods). If the research is qualitative designed, then the non-probability method is often recommended, as it often provides researchers with strong theoretical reasons for selection of units to be joining the sample. In exploratory research, as is our aim in discovering if problems exist or not, this research method excels by being quick and inexpensive. It is also a quite easy and agile procedure in regards to setting up the samples, hence the ultimate choice for students (Laerd Dissertion, n.d.). There are up to five different non-probability methods.

Quota Sampling. To create a sample where the groups that are being studied are proportional to the population that is being studied.

Convenience Sampling. To choose the units for the samples based on how convenient and easily accessible they are.

Purposive Sampling. A sampling technique that uses judgemental, selective or subjective style of approach when discerning units to include in the sampling.

Self-selection sampling. To give access to individuals or organizations who wish to take part in the research by their own accord.

Snowball sampling. Applicable on population that is hard to get in contact with, or hidden. The idea is to identify individual people, and use them to find more people and increase the sample size until it reaches the desired amount.

In this research, quota, convenience and snowball samples were used. The quota sampling was used in order to reflect the differences in the two departments, Structural and EIT, as the number of engineers differed, along with the number of survey answers. On the other hand, convenience sampling was an outstanding and valuable method given the location wise advantage; it was convenient to get in contact with the closest engineers only mere feet away from the office. Finally, the snowball sampling was used for offshore engineers, as they rarely stayed in Aibel on normal days except Tuesdays. The offshore engineers' rotation list specifies the people that are required to join the weekly meetings at Aibel, before they depart for offshore the next day.

5.3.2 Survey

The survey was initially configured to play a supportive role, which would reflect the onshore engineers' sense of attitude towards the specific project improvements, which the offshore engineers proposed. Additionally, the survey should serve as background data in order to support and *approve* forthcomings in the study. The forms for the survey were made in Aibels internal web survey solution (http://forms.aibel.com), by the recommendation of GEMC IT Manager, Kjersti Cudderforth. At the beginning, a rough structure of the survey was divided into three parts.

Part 1. Identification of the engineer with name, job position, job location, onshore and offshore experience.

Part 2. Challenging the onshore engineers on their perception of each point in the installation package, considering its relevance to what is necessary information that the offshore engineers need, instead of habitual repetition.

Part 3. Present possible solutions for document handling by introducing electronic document transportation with the use of EX-certified tablets offshore, and as a result, determine the onshore engineers' responsiveness to the matter.

Part 4. Get engineers' feedback on three different software, which are in use constantly.

Part 1 made it possible to arrange the units into at least two or more groups, creating categories such as seniority, position, and if the engineer had offshore experience or only onshore experience. In this way, the qualitative research gained a stronger foothold by being coincidentally accordant to the purposive sampling technique. The second part became a breathing ground for the 5S study, as each of the chapters in the installation package were examined in a chronological order. The offshore engineers were exempted from this survey, since they had a separate setup with workshops and informal meetings instead. The third part was mostly set up in contemplation of grasping the overall opinion on electronic package transportation. The fourth part was an additional bonus, as some engineers expressed their concerns over the questionable ease of use with Aibel's software.

The respondents were contacted via the Aibel's internal mailing system with the help of the construction manager, Gunnar Haavik. In some cases, the internal chat program, Sametime, had to be used in order to urge the engineers to participate in the survey. It took roughly two weeks to prepare the survey, and the respondents were contacted 6th of April 2016. The survey was online for approximately 2 weeks until 19th April 2016. In total, 15 out of 29 people responded in the EIT department, and 8 out of 19 responded in the Structure department. That is a 42% participation in the structural department, and a 52% participation in the EIT department, which is satisfactory.

5.3.3 Making of 3S

In the course of the first few months in Aibel, there was a steady flow of offshore engineers on Tuesdays, which made it easier to get in contact with them. In addition, the GEMC Survey Coordinator Katherine A. Courtney set up an hour at my disposal in the offshore engineers' timetable. One may differ on how effective that was, as the offshore engineers were still hard to come by, or had other more important meetings to attend. Nonetheless, it paved the way for a workshop with offshore engineers in February, and several informal meetings from March until the end of April. The workshop was held in a meeting room on the 9th of February 2016, and it was constructed for a smaller kaizen burst, where three offshore engineers participated. The engineers were told to think outside the box, while a gemba walk was given across the full process of installation packages. Afterwards, as the bottlenecks of the process became visible, they were sorted out and saved for further inspection. A list was made for the content in the installation package template, from which the Appendix C originates. The feedback was jotted down by pen, and it was later included in the making of the Lean method.

Table 3: List of offshore personnel for the study

Initial of Name	Position	Method of communication
R.K.	Field Eng.	Workshop / Meeting / Email
R.J.	Field Eng.	Meeting / Chat
K.S.O.	Field Eng.	Workshop / Chat
M.M.	Field Mech.	Email
A.H.	Completion	Workshop

5.4 References

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Aibel Survey maker (http://forms.aibel.com)
[*Accessed 15.03.2016*]

6 Findings and Discussion

This chapter will examine the data gathered from the different data collection methods, such as workshops and meetings. The results of these findings are provided using VSM, along with a logical explanation of the steps towards achieving it. We will have a look at the opening steps of the PDSA, the planning, in which we investigate and study the current situation. Further study will take the form of value stream mapping, 5S and in conclusion the method of actually implementing the ideas into the organization and making it a reality. Thus, the chapter is divided into two sections. The first section presents a detailed view of the steps taken in the CSM, the identification of wastes, and finally the implementation of Lean techniques. The second part discusses the challenges, risks and benefits of implementing Lean in Aibel.

6.1 Current State Map

The current state map presents an overview of the processes that take place from the time when work on the installation package starts, until the work is done and the As-Built is delivered. Our main goal is to decipher the CSM and select the parts that ultimately fall into the respective categories of waste. The appendix A1 in attachments presents the CSM, while the analysis of the stages are explained throughout chapter 6.1.x.

6.1.1 First Stage: The making of Installation Package

The GEMC projects run different smaller sub objectives in parallel for the sake of efficiency and in pursuance of meeting deadlines. The engineering work, which invokes the senior engineer, project leads and the study group, is initially started once the study phase is over. After attaining a clear supervision of the task from the study phase, floor engineers such as the DRE in cooperation with the senior construction engineers produce engineering documentation e.g. drawings, calculations and technical documentation. Several different stages in the structural document progression enable quality control and evaluate in respect to the desired production level. The most important stages are the *IDC*, *IFR*/*IFA*, *IFC* and the *AB*. When the responsible engineer obtain approval from the client, Conoco Phillips, and the AB is finished, the work on the installation package starts.

The DRE picks up the relevant information from the finished AB engineering work and inserts it into the installation package. All relevant documents can be seen in Appendix A1, these are extracted from the document system ProArc. Usually, the DRE starts on the installation package the moment most of the drawings are finished. Until all necessary technical documentation is ready, a reasonable amount of the installation package might be ready. If that is the case, then the DRE uses only up to 1.5 week to produce the package, readying it for the *IFC*.

By engaging the DRE's and performing a gemba walk, the appropriate awareness regarding the start-up can be understood and incorporated into the mapping. Installation Package templates are made for each respective department and are available in ProArc for the DREs to download and use. The basic setup of these templates are often similar, although some chapters are added or subtracted, which depends on the level of relevance it may have towards the offshore work. These templates have been around for quite some time, and apart from the structural installation package, most have scarcely had any feedback in terms of improvement. The installation package was, content wise, early on pointed out to be fairly susceptible of being in the vicinity of waste. Thus, a content analysis termed 5S was decided in cooperation with the offshore engineers. Given that the whole idea of this improvement project is to do a bottom-up analysis through the offshore engineer's needs, the feedback and engagement from the offshore engineers was both positive and important!

On finishing, the installation package is uploaded to ProArc and distributed by Document Control Centre to all relevant parties, such as the project departments, project leads and key engineers. There are no decisive rules on how long the IFC-round may take, even if the 5-day rule of thumb is a good indication, the actual ground floor inspection shows that the IFC round in many cases ended up taking 7 days. In some cases, the installation package is refused and have to undergo correction by the DRE before being approved. When the IFC is approved, the documentation is made ready for the next step: Transportation.

6.1.2 Second Stage: Transportation

Once the IFC has been approved, the installation packages resumes its journey to offshore. Before that happens, the DCC has to prepare it. A general installation package has in the past years had a tendency to exceeded 100 pages in total, thus the work required by the DCC would amount to several hours when they have to print two copies, prepare the folder and the cover, administer the ProArc flow and correct small but frequent errors in the progress. One of the two copies is an original, and has to be treated carefully, while the second one is a copy for the offshore engineer to make notes on.

The transportation of the installation package is usually carried out in this way: a vehicle drives the package to the shoreline, drops it on to a boat, which carries it to the offshore platform, and the offshore personnel picks up the package. This process takes, in average to worst case, up to 4 days. In case the installation package is a priority, a helicopter is used for transporting instead of the boat, ultimately causing a rapid increase in expenses. A rough estimate of 5-6% of packages have been delivered by helicopter since 2014, according to DCC (Undheim, 2016).

The offshore installation work has not been included in the calculation of lead-time, processing time and other general improvement estimates. An explanation of the choice is given below:

The work provided in the installation package can differ in complexity, which makes the offshore installation work a difficult part to include in the VSM. There are other reasons too, for instance, the goal of the study is to reduce wastes onshore, and consequently the VSM study presents that the problems are occurring onshore, and the construction manager further supports this claim. He pinpoints that the improvement potential lies onshore, and not offshore, as they are often practical and efficient. Even if the outcome of the offshore work may cause changes in the final build, and additionally increasing the amount of rework onshore, it still does not qualify as value added or non-value added factor in regards to producing installation package onshore. It is also evident that a gemba walk offshore was both impractical and unattainable for me, leading to a knowledge gap in how the offshore engineers may perform the work.

When the installation is complete, the package is updated with the relevant information. Then, it is sent back to land, where a vehicle transports the package to Aibel's office at Forus. DCC receives the package, scans, organizes and distributes to the respective DREs and departments. The latter takes up almost half a day. The transportation part was another section of the CSM that fell directly into the category of waste, obviously by not adding any value while consuming time.

6.1.3 Third stage: As-Built

The DREs receive their red mark-up for rework, depending on what and how the installation was completed. In most cases, there is a limited change in scope, which gives the DRE a slightly better control at finalizing the As-Built versions within 1.5 weeks. As a result, the installation package is uploaded to the client's database and the work is finished.

6.2 Lean implementation

Studying the CSM work, it is apparent that there are specifically two main problem areas in the process. The further we investigate, the clearer it becomes that these parts need special attention, in the form of Lean techniques, which necessarily does not have to be the same.

6.2.1 3S

The 5S is a handy technique for cleaning mess or disorder, as well as being optimal for continuous improvement. Opting for such a tool creates a systematic approach to improvement, as seen in Appendix B. In order to suit the task at hand, the 5S was cut down to a 3S technique, which will be able to fulfil the exact purpose it was made for. The outcome of the 3S depended on the feedback from the qualitative research method, where every bit of information from the engineers, processes and the innovative ideas led to the making of the new setup.

The 3S was structured as a systematic analysis of each chapter, where the main goal was to determine an elements necessity, appropriate location and measures that must be taken granted that the former two goals are accounted for.

Table 4: A brief outtake from Appendix B illustrate how the 3S analysis is performed. The table shows 3S performed on the HSE chapter.

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	Obligatory for operating personnel to have HSE documentation available
If necessary, do you need this amount?	No	The rules and regulations both in Copnos TCD and www.regelhjelp.no do not relate any specific instructions as to the amount or place.
If necessary, must it be located here?	No	Excessive use of copy/paste

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	Yes	A standardized version always available to personnel offshore (operating staff). Move location from within installation package to a standalone offshore standard.
Step 2: Identifying the loc./surrounding	Yes	HSE information that is general for all work packages is better to standardize and change location to a place where it is easily available for the operating personnel.

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	No	Most of the information is general, and is unnecessary for installation package (experience from gemba walk).
Step 2: Determine improvement methods: what, where, who, when, how	Yes	Specific, new and relevant HSE information should be specified in the installation package - work description
Step 3: The final step is incorporating systematic work pack inspection.	No	Not needed

Next, for the 3S work to be of relevance, the results were incorporated into a new template, as can be seen from Appendix C. Presently, the CSM for the installation package content shows the chapters as they are used today, while the FSM reflects what the 3S proposes by cutting down and rearranging the chapters for further improvements. Since there are two different installation packages, with uneven amount of prior improvements, the results of 3S show potential for further development on both.

Table 5: Reduction of chapters by 3S for EIT and Structure templates

Implementation of 3S [Installation package template]	Amount of chapters EIT installation pack. *(subchapters)*	Amount of chapters Structure installation pack. *(subchapters)*
CSM	13 *(13)*	12 *(5)*
FSM	6 *(13)*	6 *(7)*

We are looking at an approximate 50% improvement chapter wise; however, there are changes on a deeper level that work as a constitution for the high improvement rate. The full overview of improvements can be seen in Appendix B, a reasonably big improvement is for instance:

- Remove HSE chapter in favour of placing it where it is needed: offshore. If important notices must be given, they should be included in the work description.

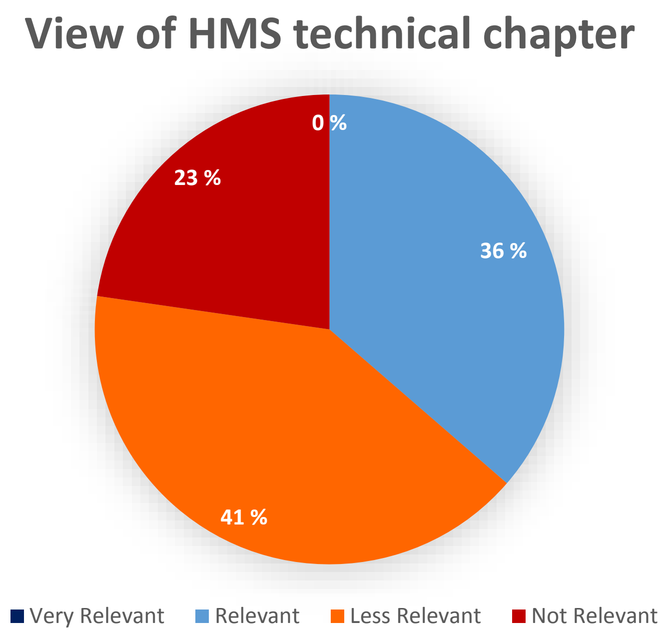


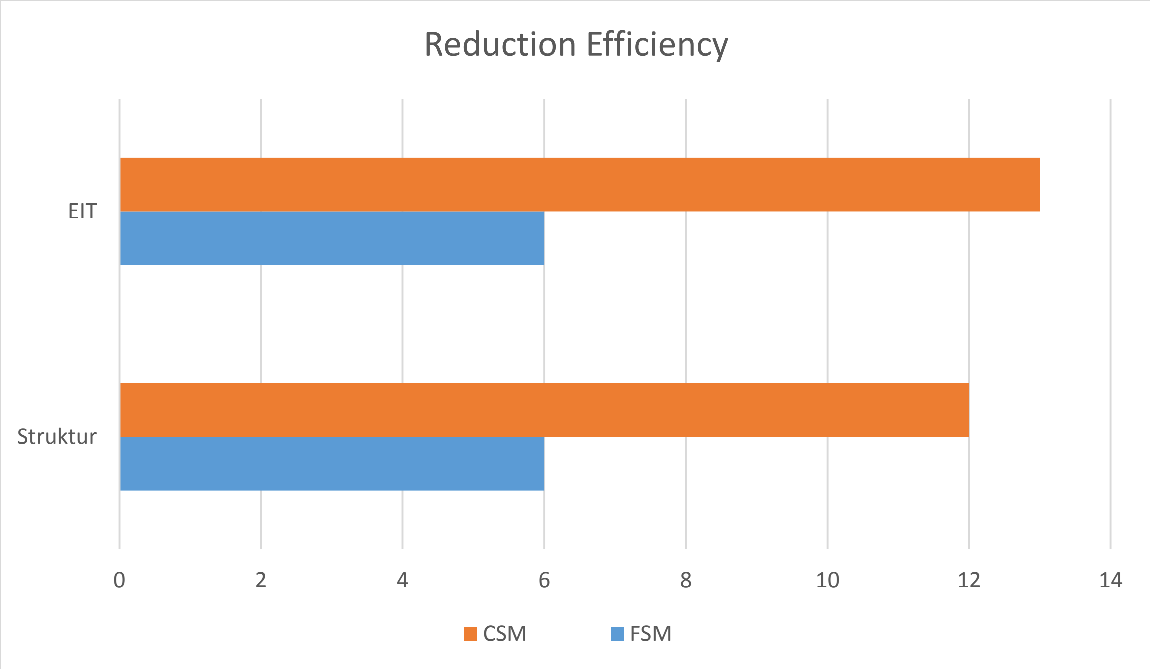
Figure 12: Shows the importance of the HMS technical chapter. Notice that 64% think it is either less relevant or not relevant at all [Survey]

Others are smaller, more specific and content focused, these are often included as feedback from the DRE:

- Add pre-made tables in chapters for "pulling of cables" and "termination of cables" for further efficiency.

Some of the chapters are deleted from the installation package because of non-consistency, which makes them constantly wasteful and unnecessary. Such as the HSE, welding and NDE-documentation. Furthermore, the second change is about reorganizing the chapters into subchapters; these are selected on the criteria to match the content they carry, as well as how often the chapters are filled out. In practice, they are often smaller and irregular segments in the installation package, such as the deviations and vendor documentation chapters. A third change is the addition of a new subchapter in order to gather all referencing information at one place. Another similar change is the making of extra subchapters for the work description chapter, with the means of gaining a better overview of the content.

Table 6: Reduction of chapters in the work package. Lower is better.



It is important to have awareness of what and where the current improvements are being implemented, as mentioned, this changes the installation package template, and hence the improvements may differ regarding the actual work package. Given that the past iterations of work packages used to contain over 100 pages, some have recently become prone to cuts resulting in an average of around 50 pages. Our starting priority is to cut down the work package further until it reaches around 30 pages, a move towards implementing limits for the number of pages.

Some of the chapter reviews in Appendix B address the DREs by giving a stern message on using good sense when adding documentation. A good example is the chapter "documentation for information", where offshore engineers are oftentimes perplexed by the amount of information included. They wish to see a declining trend on quantitative information, in favour of a qualitative approach by the onshore engineers. By continuously improving the installation package, along with the template, these changes can quickly be implemented. Judging by the structure department's frequency of updates to the template, we find potential for advancement through systematic and fixed updates.

Table 7: Confirmed and approved updates to the work package templates since 2010

No. of updates to the Installation package template	Structure	EIT
#08	NA	02.05.2016
#07	17.12.2015	17.12.2015
#06	25.03.2014	25.03.2014
#05	03.09.2013	23.10.2013
#04	29.11.2011	21.11.2011
#03	21.06.2011	21.06.2011
#02	08.03.2011	08.03.2011
#01	10.12.2010	10.12.2010

In Appendix B, the last part of the 3S recommends a rough timeline of when to update, ranging from 3 months to a maximum half year. The ultimate period for a new revision is at around 4 months, or up to three times a year. One possible method of continuing the improvement is through keeping a log, which is updated after every successful installation package. The log is for the DREs to report the progress on either a physical document, or an online software. Thus, the statistics of how the installation package develops will be available for the Lean responsible person, and adjustments can be done for achieving the best result.

6.2.2 Electronic Work Package

Aibel is a thriving company that does not shy away from changes; a shift in the way of doing things can bring about a greater experience. A fine example of that is the recent implementation of Outlook and Skype, parting ways with the old Lotus Notes and Sametime, a chatting software. The feedback this far has been positive, as it shows that embracing new technology is not necessarily a bad idea, quite the opposite, we must learn that in this industry, once technology rise above a certain threshold of acceptable risk in regards to offshore activity, it should become a focus area for implementation. Similarly, the construction manager has been aware of the possibilities of contextualizing new technological ideas into the processes, given the looming cost and time consumption issues related to DCC – overwork, printing costs and transportation of installation packages.

The CSM shown in Appendix A1 has two main problems outlined by a red mark-up. The first problem was the prolonged waste in the installation package, discussed in chapter 5.1.1 with study results in chapter 5.2.1. The second problem, substantially more complex, is the transportation of the installation packages. The investments made into transporting the installation packages on a boat can be directed towards finding a solution that incorporates technology with faster lead times, and efficient execution. This is where the notion of continuous innovation comes alight, by expanding on current technological infrastructure with new additional assets.

Aibel's internal structure of document handling is handled by an electronic system called ProArc, which acts as a storage and distribution centre for all documentation inside Aibel. Even the installation package is produced on computers, but at the last point, it is printed out and sent offshore in a physical copy. The breakthrough will be to expand and fully apply electronic storage, distribution and transportation throughout the progress. In order to do that, we have to identify the potential risks and discover whether it is practically applicable.

6.2.2.1 The Electronic Process

The general opinion on proper electronic work packages has always been a bit gloomy, even dating all the way back to when the Norwegian oil adventure began. Furthermore, the current method of transportation has been the same for the past several decades. The oil sector has relished their moments of lavish spending under the peak period up until the moment the oil crisis hit. A system that was accustomed to high earnings and higher costs, with only a half-hearted shot at maximizing profits by increasing efficiency. Moreover, Lean was for the most part unheard of in the oil industry. This changed quite drastically under the recent oil crisis, when panic ensued on realizing the enormous costs related to being a part of the oil industry. The Norwegian oil industry is known for its conservative stance on these matters, but when dire times approach, companies try to respond by cultivating new ideas. It seems, finally, to have occurred a positive transition.

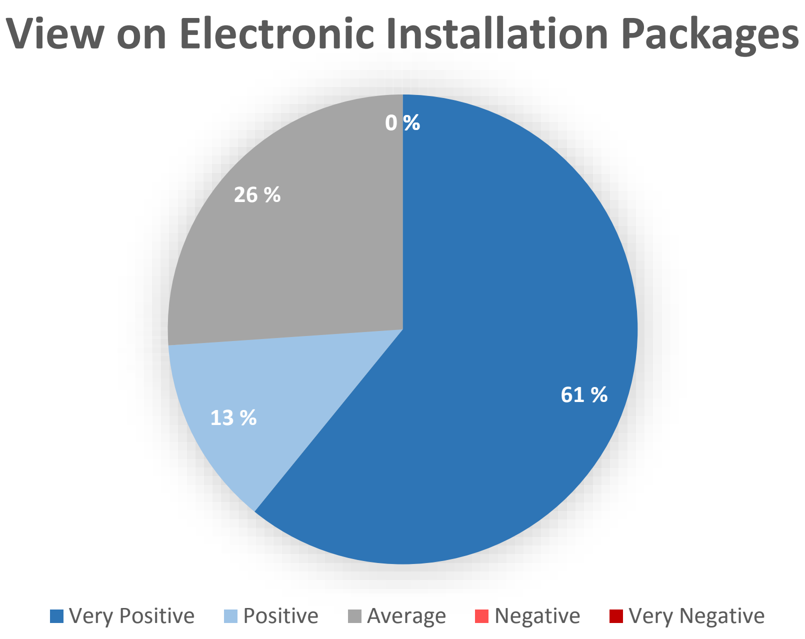


Figure 13: Onshore engineers view on electronic installation packages [Survey]

On land, it will not require any substantial changes from the DREs, however, the relevant personnel at the offshore location will be able to work through an EX certified Windows Tablet, rugged and safe for use in even the most hazardous environments. This type of tablet is available in the market today, with specifications that match the technological advancements of computing, and in combination with Zone 1 certification for use in hazardous areas.

The DCC will now be able to relocate their efforts, because printing, transporting and organizing physical work packages will become irrelevant. With a docking station for the Tablet, the experience of using the Tablet will be similar to a normal laptop. Thus, the offshore engineer will be able to receive the work package, create an offline copy, walk out into the field and evaluate the work, perform a red mark-up with the additional pen, walk back in to office, insert the Tablet into the docking station and upload the files to the ProArc system.

The onshore personnel have been positively inclined towards the use of electronic information and tablet.

6.2.2.2 Risk Analysis

With every new aspect of change comes a risk. The general rule of risk is given by,

Total Risk = Consequence x Probability (Likelihood)

As a qualitative research, this is a classical risk analysis method by doing a risk matrix approach. The matrix has rows that represent the increasing severity of consequences by hazardous elements, while the columns display the increasing probability of these consequences to happen. The matrix has been modified in order to show the two possible receivers of the possible consequences, the people and the assets. The Risk Criteria Matrix, in

Table 9: Risk matrix Criteria, presents acceptable risks highlighted by green, likewise are the yellow and orange region risks that need to be as low as reasonably possible (ALARP), and finally the red region exhibits the intolerable risks. The green risks are acceptable, and may exist daily such as bumping into someone or something. The ALARP region is accustomed to receiving higher frequency of serious damages. If some risks happen to fall into this category, they must be lowered as reasonably possible. The red region presents risks that cannot be accepted in any way, and need a solution that can change the risk rating. In this case, the people are showcased as the engineers on the offshore platform, while the assets are the tablets in use.

Table 8: List of possible risks with consequence and likelihood

No.	Cat.	Risk action	Consequence	Likelihood	Total Risk
1	Asset	Halt in installation because of system malfunction in (all) available tablets or software	3	2	6
2	Asset	Damaged tablet which is beyond repair	2	2	4
3	People	Operating personnel with a serious accident while using tablet, for instance tripping by using tablet while in motion	3	1	3
4	Asset	Dropping tablet and causing damage	2	2	4
5	People	Operating personnel refuses to use tablet, favouring conventional methods	2	1	2
6	People	Learning and unlearning problems, lack of proficiency	2	2	4
7	Asset	Security of electronic information	3	1	3
8	Asset	Losing or dropping a tablet pen	1	3	3

Analysing the possible risks, we find that human related risks are not life threatening, although may cause some minor injury by accident. In terms of human safety, the conditions are met by low probability for injuries to happen. Equivalently, the asset damage is also of lesser concern as the tablets are relatively cheap to replace, cost savings considered. However, there exists a concern about the offshore industries conservative approach to implementing newer technology, in fact, this affects the offshore personnel as well, and in turn the outlook on practicing work on a tablet rather than paper causes dismay for the older generation. Thus, we find that the learning curve can be steep for offshore personnel that cannot use electronic equipment, resulting in delayed installation work. This can only be countered with proper training sessions, follow-ups and appropriate support. The process of performing the work must also be intuitive and easy to comprehend, as the offshore personnel will do quick mark-ups on site. Moreover, the full work can be done in the office by utilizing the many features of the tablet, such as a docking station that transforms the tablet into a portable computer. Table 8 demonstrate that there is one risk that falls in the yellow category of producing major costs if the tablets have a malfunctioning. Given that there exists personal computers and printers on the offshore facility, quick thinking can turn down such costs.

Table 9: Risk matrix Criteria

Consequence >

How severe could the outcomes be if the risk event occurred?

Likelihood > What is the chance of the risk occurring?		1	2	3	4	5
	People >	Minor injury	Loss time accident	Single or few injuries	Single or few fatalities	Many fatalities
	Assets >	Minor damage /cost	Significant damage / cost	Severe damage / cost	Major damage / cost	Catastrophic damage / cost
Almost certain	5 (10)	5 Medium	10 High	15 Very High	20 Extreme	25 Extreme
Likely	4 (10^{-1})	4 Medium	8 Medium	12 High	16 Very High	20 Extreme
Moderate	3 (10^{-3})	3 Low	6 Medium	9 Medium	12 High	15 Very High
Unlikely	2 (10^{-5})	2 Very Low	4 Low	6 Medium	8 Medium	10 High
Rare	1 (10^{-7})	1 Very Low	2 Very Low	3 Low	4 Medium	5 Medium

Conclusively, the highest risk from Table 8 amounts to a low probability of occurrence with major costs as a possible consequence. The applicable risk levels follow NORSOK recommendations for safety, which mentions that all risks related to accidental loads and general platform conceptual risks must be less than 10^{-4} (NORSOK, 2001:34). The only risk that exceeds the 10-4 limit is risk No. 8: dropping a pen. It can be neglected given that it has minor consequences. The remainder risks are all less than 10^{-4} and at most, with severe damage or costs as consequences such as risk No. 1, which should decline over a period until it becomes a rare occurrence (10^{-7}), because of an increased knowledge on deploying electronic equipment and software services. The risks of dropping the tablet is minimized by certain offshore rules that specify that equipment must be attached to the person. Therefore, the tablet is handled just as a normal package would be handled. Ultimately, electronic packages with the use of tablets are mostly safe to implement, and if in case there is an obstacle, it would definitely be the mentality and mind set of the people involved. That is showcased in the survey discussed in chapter 5.3.2, where eighteen out of twenty-four onshore engineers from both EIT and Structure department expressed their opinion on the possible obstacles in regards to implementing electronic work packages.

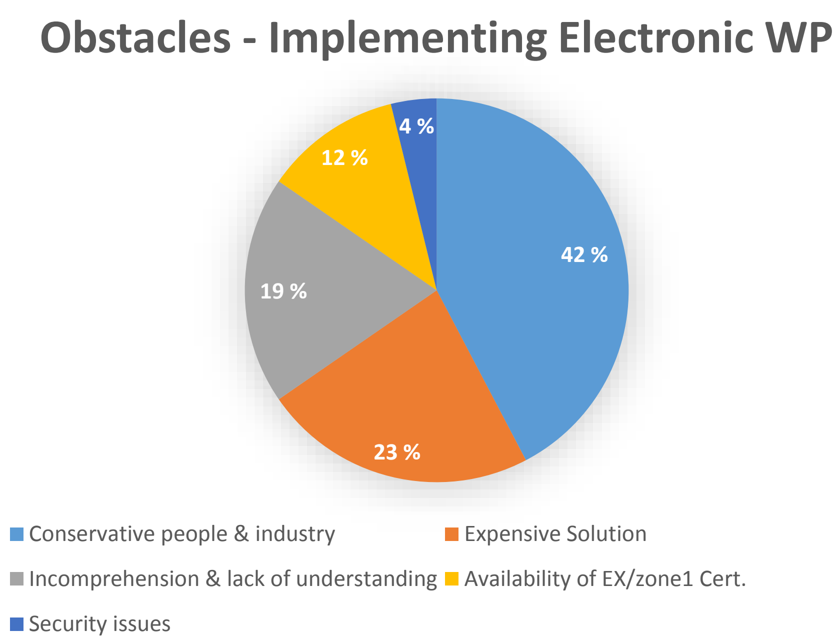


Figure 14: Representation of what hinders the implementation of electronic WP, from the survey discussed in chapter 5.3.2

6.2.2.4 Cost improvements

Small cost improvements can be gained by optimizing for less printing. There are roughly about 300 work- and installation packages, along with additional supporting documents that are made each year by the structure department. Again, these are often printed out several times by the DREs and at least two till three times by the DCC. The gemba walk has shown a very relaxed appeal towards printing, with low awareness of printing costs in general.

The cost per paper for the Xerox WorkCentre printers can go up to 0.70 NOK/page. By printing a random 100-page installation package, we are looking at a single time cost of up to 70 NOK per installation package. This is a theoretically worst-case scenario, and the real average cost is around 50-70 NOK.

Object	Price [NOK]	Pages [A4]	Worst case cost per page [NOK]
Ink (back & colour)	5940,36	50 000	0,12
Paper A3	170,00	500	0,34
Paper A4	90,00	500	0,18
Belt Cleaner	2542,93	160 000	0,02
Transfer Roller	2478,20	200 000	0,01
Printing Cassette	3470,40	131 000	0,03

Table 10: Cost breakdown of printing

It is worth nothing that the A4 and A3 papers, the maintenance and replacement of waste toner containers, transfer belts and transfer rolls are all taken into consideration, which would increase the overall cost per page compared to the single 0.12 NOK cost per paper of the ink. Thus, a representation of cost per page by 0.70 NOK is a humble one. By reducing the technical documentation in the installation package, at least to a 50-page limit. We may cut the costs of printing by half, and further reduction to 30 pages is our goal, which would achieve up to 70% reduction in printing costs as well.

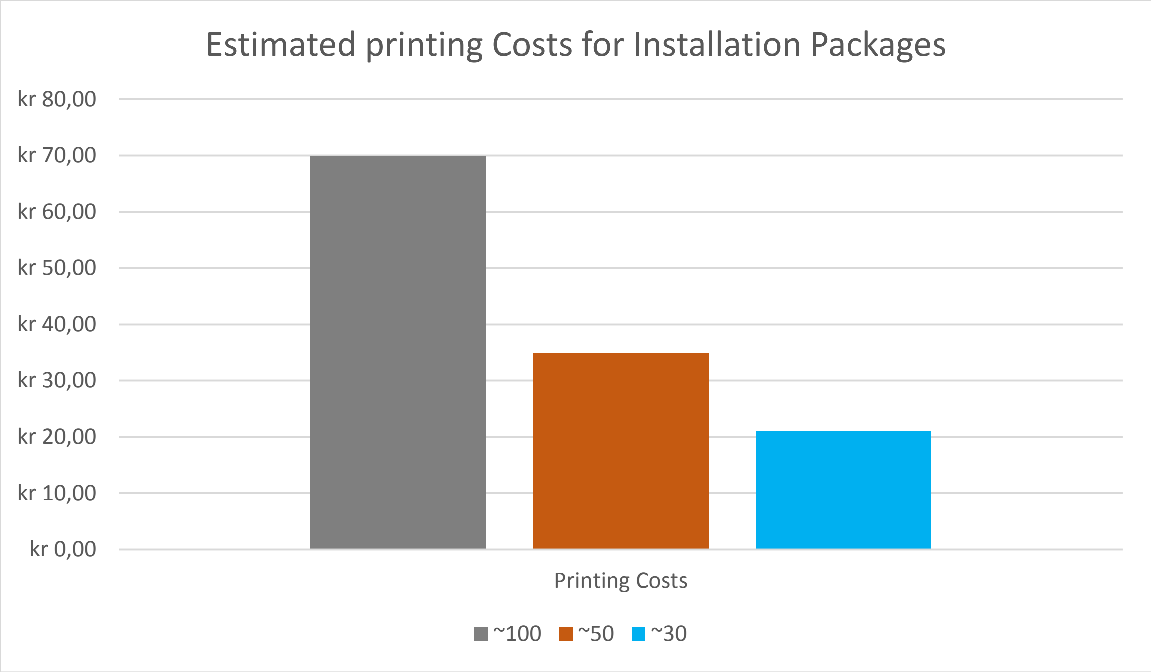


Figure 15: Estimated printing costs for an installation package of 100, 50 or 30 pages given a 0.70 NOK/CPP

According to Conoco Phillips, about 9 million A4 papers are printed out yearly (*Brochure*), which makes the cost exceed 6 million NOK. If the total process of creating work packages and installation packages turn electronic, there are huge amounts of savings that become possible. Additionally, as the reduction in the amount of information leads to reduced DCC work, the overloaded DCC personnel has a less stressful job to perform. Given that DCC can use up to between 4 and 7 hours on printing, organizing, distributing installation packages both when they are to be sent offshore, and when they return, only to be scanned each page at a time, saved and distributed. This is a plausible action, in which Aibel might even reduce the DCC department to match the available work.

Other cost improvements are less printer maintenance and no transportation costs for boat. In terms of helicopter costs, the cheapest solutions cannot be used because of the harsh north sea climate, thus, the costs are usually up to 40 000 NOK/hour for transporting the installation package (http://heliwing.no/no/home/helicopter-questions-and-answers).

6.3 Future-State Map - I

Succeeding the CSM is a proper future-state map, which shows the solved problems with their new lead times. This section presents the results of improvements over two stages, the first FSM and the second FSM, in order to approach the final destination of our improvement project, it is only possible to achieve by striving towards it, a single step at a time.

6.3.1 First stage: The making of Installation Package

Embracing Toyota's ideology of avoiding problems rather than fixing them is a path taken into developing the FSM. This serves as an explanation for the change in lead-time in the first activity on the FSM, presented in Appendix A2. As installation package is made, the stress and fast-paced working environment can force errors to happen. By giving extra time to the DRE, the installation package gains a quality boost, as well as a reduction in the risk of receiving errors in the IFC-round, thereupon minimizing the possibility of having to redo the package. Another action that lowers the risk of redoing the package is to include the offshore personnel as early as possible, and somehow giving the offshore engineers a view of the installation package before it goes into the IFC round. As there are no specific limits for the IFC round and it tends to take up to 7 days, a recommended limit of 5 days has been given, in which relevant personnel should be able to review the installation package.

From earlier results, the installation package has been reduced quite significantly. For a normal complexity work task, the DRE is recommended to practice the 30-page limitation as reasonably possible. There is no doubt that the size of the installation package is often proportional to the complexity of the work task, hence it is only a recommendation and not a rule. Benefitting from these improvements, the overall making of the installation package will cause shorter lead-time, less uncertainty, lower costs and higher quality.

6.3.2 Second stage: Transportation

The first FSM focuses on the initial stages of the installation package and produces great improvements. However, the second stage does not undergo the same procedure, as there are few changes in the process apart from a small but significant detail. The improvement from the last stage caused a reduction in the installation package, and consequently a reduction for the DCC work related to printing and organizing.

6.3.3 Third stage: AS-Built

The last stage fuses together the red mark-up as an update to the final documentation, and term it AS-Built. Further improvements are not identified.

6.4 Future-State Map - II

Building upon the first iteration of the FSM, the second revision puts forward the outcome of implementing new solutions. The FSM – II can be seen in Appendix A3.

6.4.1 First Stage: The Making of Installation Package

There are no explicit changes in the initial composition of the installation package from earlier. Actions from the first revision are implemented and feedback should be apparent.

6.4.2 Second Stage: Transportation

By utilising tablets that are ATEX certified with Zone 1 capabilities, given that they run Windows Operative System, has docking facilities and work seamlessly with available software, offshore invested companies can set the stage for efficient documentation handling, such as the EXOC 1 tablet (http://www.exloc.co.uk/isis-ex-specialist-hazardous-area-computing/xplore-technologies-ruggedised-pcs-and-laptops).

With electronic information flow, the DCC has reduced their amount of work until the point where it can be considered as a part of the IFC round, and the offshore engineers receive the installation package instantly. This is the most time saving action in terms of lead-time.

6.4.3 Third Stage: AS – Built

Akin to the third stage in the first FSM, there are no specific improvements except some small efficiency gained by the fact that the DREs now have an easier and faster way of communicating and sharing information with the offshore personnel.

6.5 Improvements

This subchapter presents the results from improvement calculations for the VSM. Since there are two Future-State Maps, both are subjected to a complementary study. The total lead-time along with the processing time, also known as value-added time, are shown in the table below for all the three State Maps. The terms 'approved' and 'not approved' refer to the decision point in the VSM; it is a review of the installation package where all relevant departments have to give their approval. If the installation package is not approved on the first try, it has to be corrected, resulting in a loop. Seeing that the Lean basics mention to register the longest time consuming activity of the two, one must take into consideration that approximately up to 10% of the installation packages are not approved, while 90% are approved.

Table 11: The total lead-time and processing time for 'approved and 'not approved' installation packages

State	Total Lead Time (approved)	Total Lead Time (not approved)	Processing Time (approved)	Processing Time (not approved)
CSM	37.7 days	51.7 days	95.8 hr	132.5 hr
FSM–I	36 days	46 days	102 hr	128.3 hr
FSM-II	25.7 days	35.7 days	102 hr	128.3 hr

To counter it, the study suggest to give the DREs increased time, involving offshore engineers early in the process of making the installation package, and the general impact from the 3S results should reduce the possibility of refused installation packages in the IFC round by a minimum of 3%. To represent both ‘approved’ and ‘not approved’ was a deliberate choice made in order to highlight the different instances. A brief look at the lead-times and processing times shows a smaller improvement from CSM to FSM-I, as the total lead-times are reduced by 1.7 days for approved and 5.7 days for not approved. A different outlook can be seen on the processing times, where the processing time actually increases in the ‘approved’ section, but decreases in the ‘not approved’ section. This indicates that the DREs spend more time to polish the installation package and increase the overall quality, while the decline in the ‘not approved’ part confirms that earlier actions reduce both the time and risk for re-doing the installation package.

The substantial change in Table 11 comes from the lead times on FSM-II, yet the process timings are much on par with the FSM-I. Moving on to the Process Cycle Efficiency, Value-added activities and Non Value-Added activities, some interesting values are presented.

The PCE ends on around 34% for both revisions on the CSM, which paints the picture of a

Table 12: Process Cycle Efficiency for approved and not approved installation packages

State	Process Cycle Efficiency (approved)	Process Cycle Efficiency (not approved)
CSM	33.9%	34.2%
FSM–I	37.8%	37.2%
FSM-II	52.9%	47.9%

moderately Lean process. This being the lowest, it is safe to say that our goal of a minimum 20% PCE is achievable already. Further inspections shows a slight increase from CSM to FSM-I, because of the optimizations implemented into the process. The reasons for the FSM-I being a tad more efficient than the CSM has to do with the implementation of 3S, which on a micro level improves the efficiency, however it is the financially advantageous reasons that make it shine.

The real momentous advancement comes from the FSM-II scoring just above 50% cycle efficiency when the process goes smooth, and just a bit less when the package needs revising. This is primarily achieved by cutting down the lead times that occurred because of transportation, since the Value-Added Time stayed the same.

Table 13: Value-Added Activity Improvement (VAI) calculated in order to compare value differences from CSM to FSM I/II

State	Value-Added Activities (approved)	Value-Added Activities (not approved)
CSM to FSM–I	- 6.5%	3.2%
CSM to FSM–II	- 6.5 %	3.2 %

The Value-Added Activities have no differences compared to the CSM. The negative percentage stands for increased Value-Added Time for the end state, which is caused by increasing the standard time given to the DRE for issuing the installation package, as seen from Table 11. The CSM to FSM-II experiences the same.

Table 14: NON-Value-Added Activity Improvement (NVAI) calculated in order to compare value differences from CSM to FSM I/II

State	NON Value-Added Activity improvement (approved)	NON Value-Added Activity Improvement (not approved)
CSM to FSM–I	4.5%	11.0%
CSM to FSM–II	31.8%	30.9%

Second to the Process Cycle Efficiency, Table 14 displays the most promising results. A 4.5% and 11% decrease in the total lead-time after implementing the first improvement plan is a great way to lay the fundamental for further improvement. The CSM to FSM-II shows an astounding 31.8% and 30.9% lead-time reduction compared to the CSM. This originates from moving all technical documentation towards an electronic system.

6.6 PDSA

The managers should implement the Plan-Do-Study-Act program in unison with their co-workers and floor engineers. The theoretical framework is explained in chapter 4 with details that are designed to be utilized continuously. The two important tools to insert into the daily operation is the VSM and 3S. When the questionnaires are answered, and the managers grasp a rough idea of the situation, at that moment the 'Do' must be initiated. It is worth indicating that the activities do not change drastically in the VSM, they are on the same spot in CSM as well as in FSM-II. The changes are done by 3S and the study of electronic installation packages, which begs the question. Where do we start?

The 'Do' is an experiment just like testing a hypothesis as we have studied and concluded, the 3S should decrease the amount of paper as well as content, until all that is left is the minimum relevant information needed in the installation package.

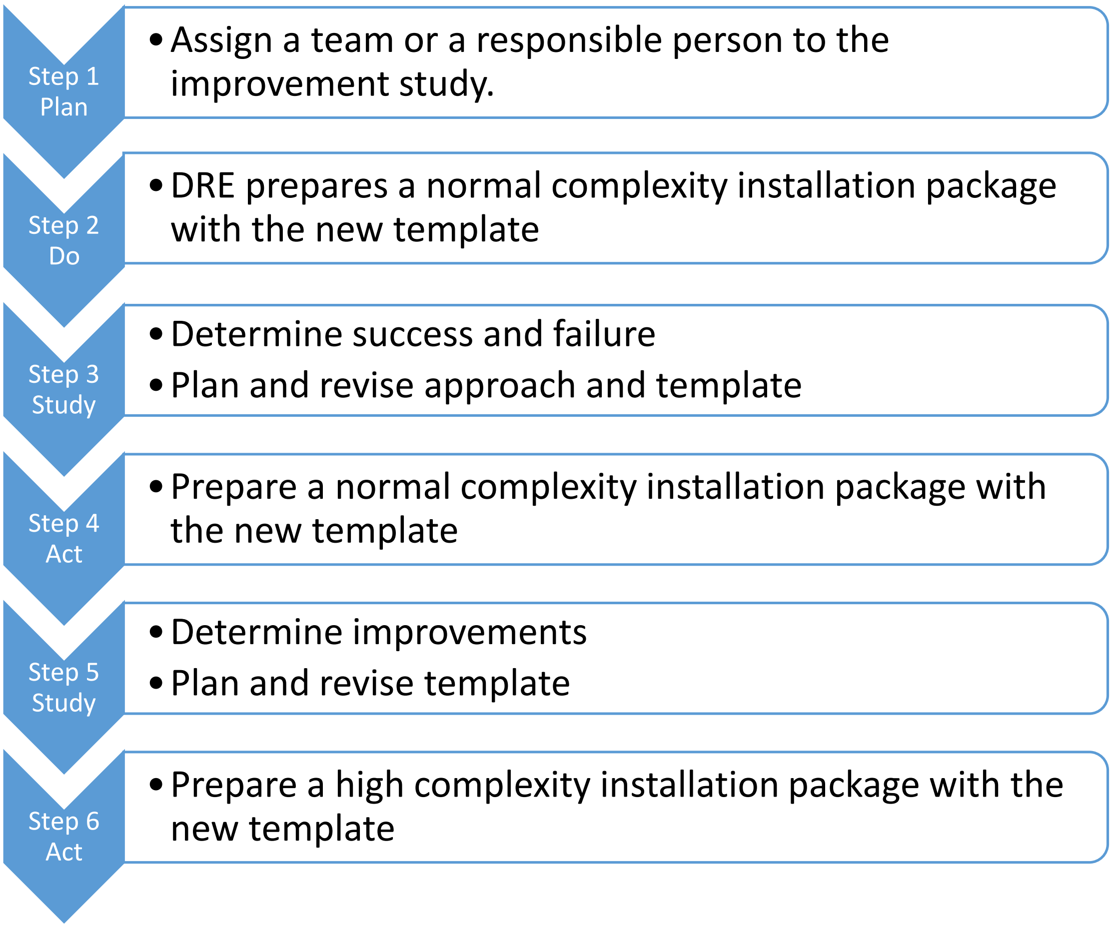


Figure 16: Steps taken in the PDSA for implementing the 3S solution

The steps taken are specific for the implementation of the 3S. The process is of the iteration type, adjustments are done after every test. The same effort is devoted to creating the VSM profile, and continuously updating it. As the groundwork for the VSM is detailed in this thesis, the responsible person can work on improving it.

The final improvement focus is the electronic installation packages. First, the managers and relevant personnel must decide to form a team that will take the responsibility to do the preparations. Then, a new study of available technology must be in order because of the rapid change in the computer industry. The optimal method of trying out the solution as cheap and fast as possible is to get in contact with the respective tablet producers, ask them to provide an ATEX Zone 1 certified tablet for offshore use, with a full Windows 8.1 Industry operating system, and a docking system. Thus, we are able to install ProArc, PDF and other relevant software. The tablet will first be tested on land by reconstructing a possible offshore case study, depending on feedback, successes and failures, the choice of testing the solution in the same manner offshore will be taken. If the onshore testing is approved, the tablet will go to the operating field engineers at the offshore platform to test the solution, without interrupting the normal installation package procedures, in order to have a backup in case the tablet system malfunctions. The iteration process of discovering success and failure continuous at the offshore location, the findings are reported and implemented until a decent working solution is arranged.

6.7 References

Digital

Heliwing costs
http://heliwing.no/no/home/helicopter-questions-and-answers [*Accessed 05.06.2016*]

NORSOK Standard Z-013N (2001)
http://www.standard.no/pagefiles/954/z-013-n.pdf [*Accessed 05.06.2016*]

Communication

Undheim, M. (27th January 2016)
Personal interview

7 Conclusion

The process of producing installation packages is an elaboration of collecting all relevant technical data, adding work description and work requirements in regards to the offshore field engineer's needs. In the long run, advising the operator at the offshore location in terms of how they are supposed to be doing their jobs is borderland naive. Which brings us to the core of the study, how can we prevent wastes such as excessive documentation to find its way offshore, while cost-reducing operations are commencing everywhere else in the organization.

As Aibel is trying to continue improving, there is an underlying rationality change in progress that has already led to increased Lean thinking and challenges the conservative ways of operation. What fuels this ongoing change is the decline in oil prices, and as a consequence, the drop in revenues. The general opinion on the organization floor seems to have felt the pressing concerns in abundant, which may also be the reason that more engineers and managers now perceive the activities through a different view, consequently being able to identify wastes. Hence, a new effective way of performing activities by using Lean tools is the path forward. There are cases where improvements from this study are present at this moment, but without being standardized. An example of that is the updates to the installation package template that mostly happens when the managers "feel the need" to improve on something, instead of a systematic pursuit of improvements. Involving the PDSA early is the key to create change, along with the Value Stream Mapping. The importance of identifying the right problems in the Value Stream is crucial for the study.

The qualitative research method is an excellent way of dealing with case studies, and grants a possibility to work directly with people for gathering data. The survey builds upon it with a respectively 42% and 52% representation of the two departments, Structure and EIT. The data is thereafter used as background knowledge in cases where the general opinion affects the outcome of the particular situation, or as an approval of the incoming changes. A direct consequence from the feedback was the focus on improving the HSE chapters, where 64% of the participants felt that the chapter had little to no relevance to the installation package. Along with the 3S' systematic approach of defining the final installation package template, a 50% percent documentation reduction is theoretically possible.

The reduction in documentation is a step in the right direction, but can further improve by encompassing the process into an electronic based system of document production, handling and distribution. The setup has no ALARP risks and one might easily test the PDSA approach. The question is not ‘if’ it will happen, but rather ‘when’ it will become a reality. The gains by moving the process to the electronic system are satisfying.

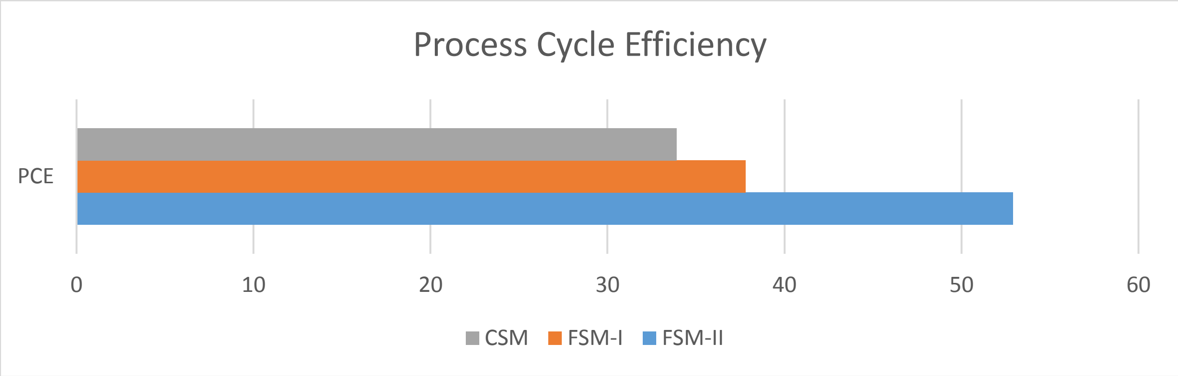


Figure 17: The Process Cycle Efficiency diagram shows Value-Added time divided by the Total Lead time within a process. Above 50% PCE is seen as a Lean process. Higher is better.

A solid 19% increase in efficiency pushes it over the 50% mark and thus fulfils our depictions about a 50% optimal PCE state. The FSM-II also accomplishes a satisfactory result in the total lead-time, with a 31.8% reduction as opposed to the FSM-I that only results in a 4.5% reduction.

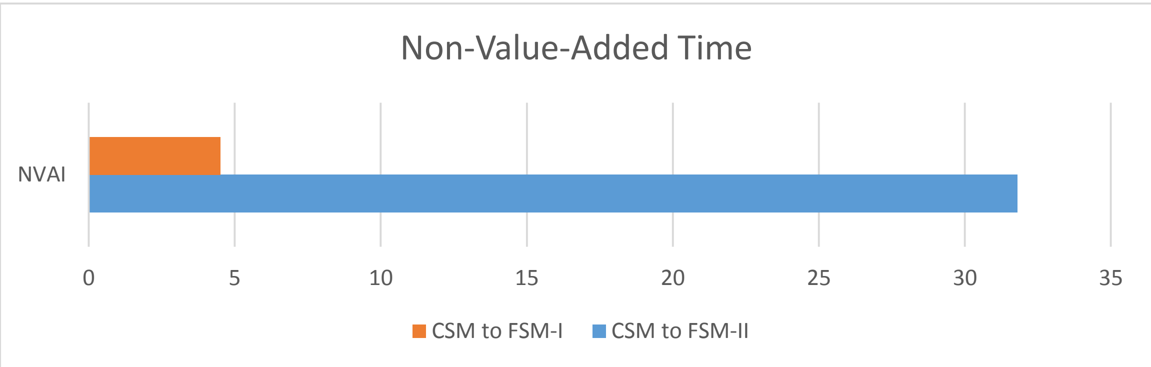


Figure 18: The Non-Value-Added Time shows the reduction of Lead Time made from CSM to FSM-I and FSM-II. Higher is better.

There are, however, challenges that needs to be addressed in order for the study to be of help to the Aibel system. First, the freshly made Lean team must increase the awareness and capability of Lean thinking to managers and floor engineers. Only by achieving an understanding of Toyota’s norms and routines can the tools and techniques gain substantial success. The second challenge is for the managers to assign teams that control usage of Lean tools and techniques systematically. The fundamental study in this thesis may serve, as inspiration for similar improvement projects in Aibel's other contracts. Finally, the last challenging aspect for the future is that managers must give greater responsibility and confidence to the floor engineers and in cooperation be able to further improve processes. The managers are not supposed to do the job, but to teach the engineers on how to do the job.

8 Last Words

A vital part of the advancement process is to improve your surroundings. To respect the human beings and create a thriving environment for all colleges and managers to enjoy. Lean promotes exactly that, but there are instances that do not conform to the principles of Lean. At often times, the bottom floor engineers find the managers lack of understanding a concurrent problem in their relationship to the workplace. This was evident in the gemba walks I performed in 2013 through the NCP and GEMC departments. In contrast, the construction department led by Gunnar Haavik is an excellent role model for the rest of the departments. My Gemba walks show and confirm that Haavik not only performs Lean, but also incorporates Lean thinking in his way of living. His natural instincts lead him to spend more times 'at site' than his office, and his solution oriented mind breaks barriers between engineers and managers. If there are possibilities of implementing the Lean solutions in any department, then the highest chances of success are in the construction department.

In Toyota's Own Words

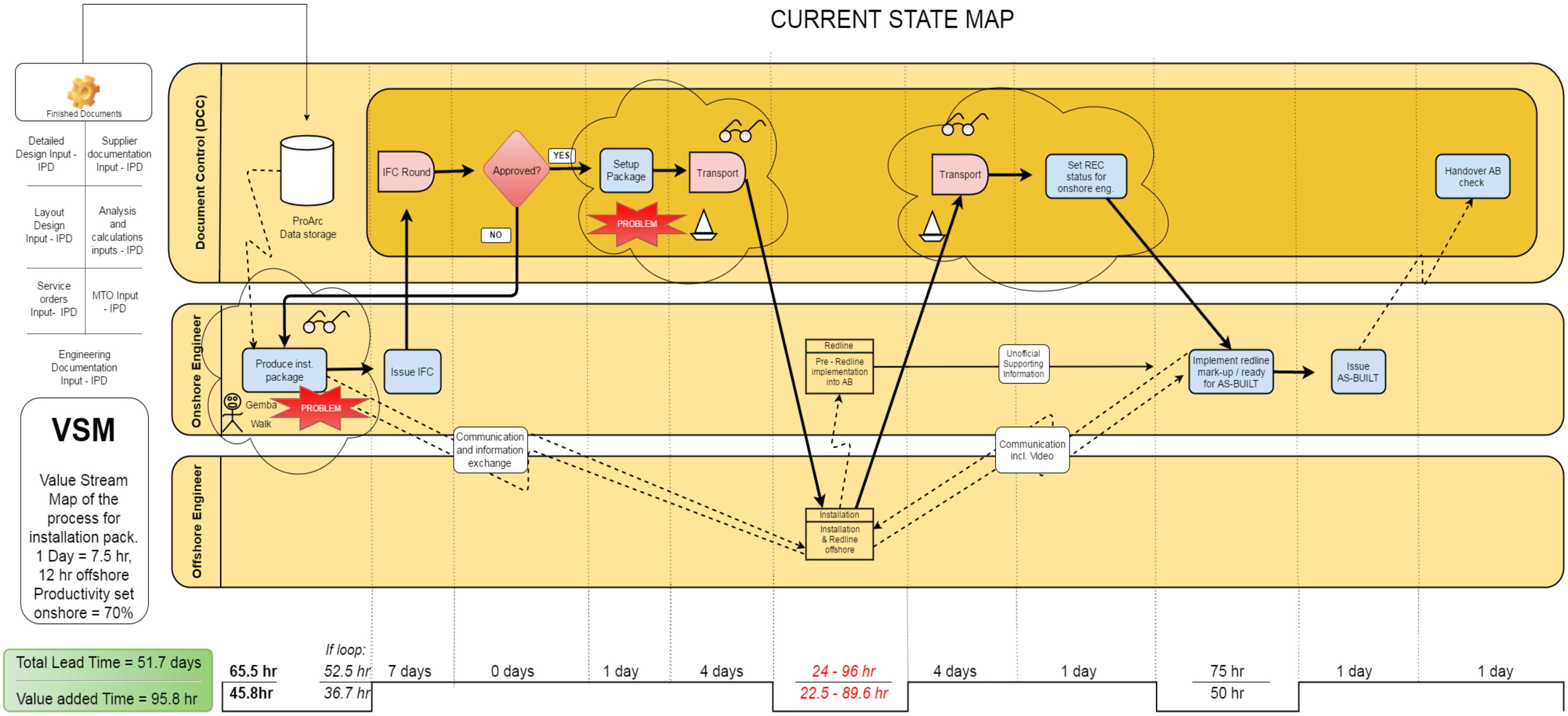
Toyota has a unique corporate culture that places emphasis on problem solving and preventative measures, such as making decisions based on the actual situation on the ground and highlighting problems by immediately flagging and sharing them. Toyota's management team and employees conduct operations and make decisions founded on that common system of checks and balances and on high ethical standards.

A distinctive feature of Toyota's system is that senior managing directors do not focus exclusively on management. As the highest authorities in their areas of supervision, they also act as links between management and on-site operations. Retaining an emphasis on developments on the ground—one of Toyota's perennial strengths—helps closely coordinate decision making with actual operations. Management decisions can be swiftly reflected in operations, while overall management strategy is able to readily incorporate feedback from frontline operations.

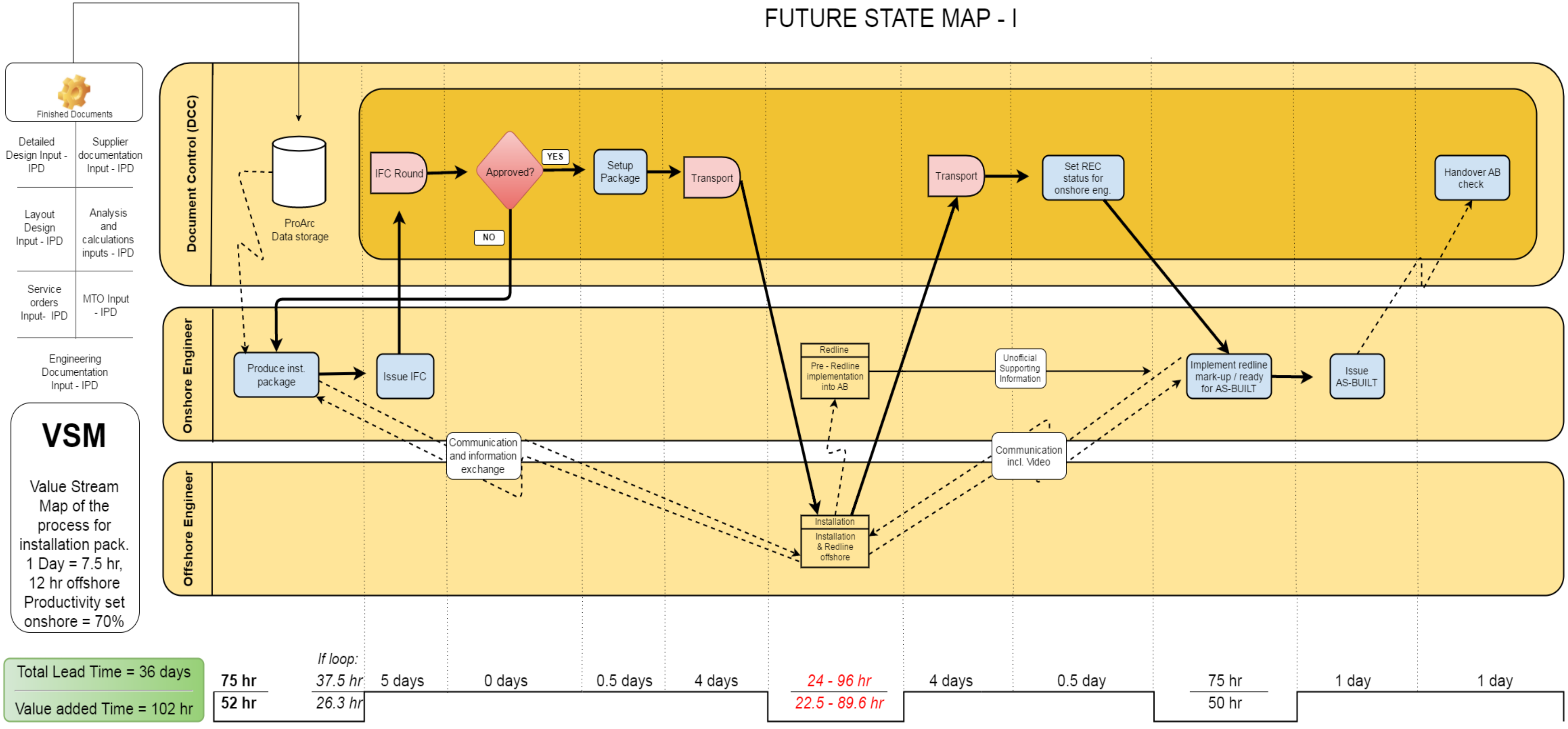
—Toyota 2004 Annual Report, page 16

Appendices

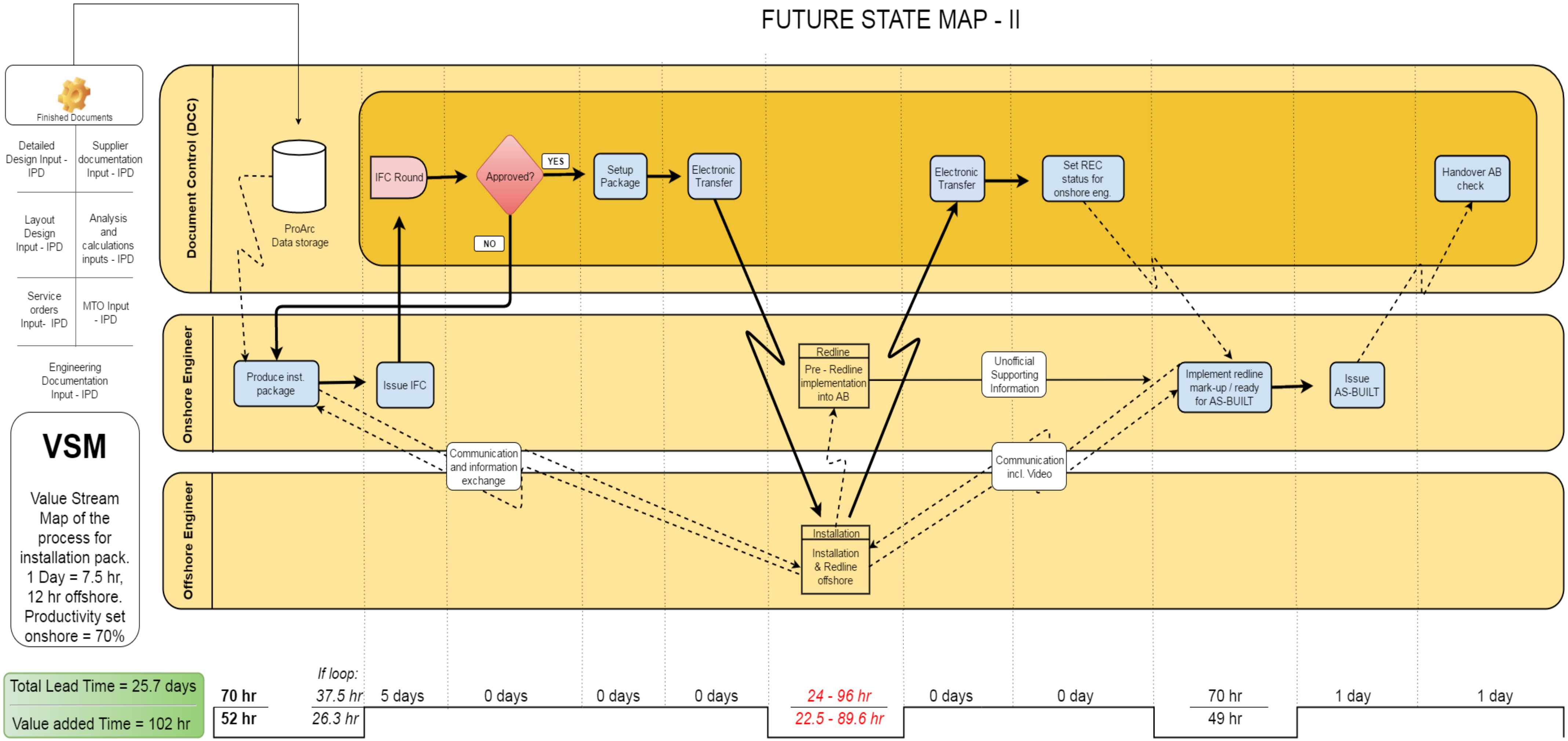
Appendix A1 – Current State Map



Appendix A2 – Future State Map - I



Appendix A3 – Future State Map - II



Appendix B1 – 3S of Structure Department's installation package

1. Checklist

1. Seiri (SORT)	Answer	Details / description
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	Answer	Details / description
Step 1: determining appropriate loc.	No	Don't need to
Step 2: Identifying the loc./surrounding	No	Don't need to

3. Seiso (Shine)	Answer	Details / description
Step 1: Determine if every part is applicable to current work	Yes	
Step 2: Determine improvement methods:what, where, who, when, how	No	If field engineer find standardized work that is not included in the check list, he/she should report it as improvement.
Step 3: The final step is incorporating systematic work pack inspection.	Yes	When content updates - Manual

2. Work Description

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	No	Don't need to
Step 2: Identifying the loc./surrounding	No	Don't need to

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	Work description is ultimately one of the most important parts of the work pack
Step 2: Determine improvement methods:what, where, who, when, how	No	More efficient description by PRE in direct talks with offshore Operator/eng. Use of pictures, and numbering titles in order to improve standardization.
Step 3: The final step is incorporating systematic work pack inspection.	No	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews - every third month.

3 HSE

1. Seiri (SORT)	Answer	Details / description
Is this element necessary?	Yes	Obligatory for operating personnel to have HSE documentation available
If necessary, do you need this amount?	No	The rules and regulations both in Copnos TCD and www.regelhjelp.no don't relate any specific instructions as to the amount or place.
If necessary, must it be located here?	No	Excessive use of copy/paste

2. Seiton (Set In Order)	Answer	Details / description
Step 1: determining appropriate loc.	Yes	A standardized version always available to personnel offshore (operating staff). Move location from within installation package to a standalone offshore standard.
Step 2: Identifying the loc./surrounding	Yes	HSE information that is general for all work packages is better to standardize and change location to a place where it's easier available for the operating personnel.

3. Seiso (Shine)	Answer	Details / description
Step 1: Determine if every part is applicable to current work	No	Most of the information is general, and is unnecessary for installation pack (experience from genba walk).
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Specific, new and relevant HSE information should be specified in the installation package - work description
Step 3: The final step is incorporating systematic work pack inspection.	No	Not needed

3.1 Technical HSE

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	Same as 4. HSE
If necessary, do you need this amount?	No	Same as 4. HSE
If necessary, must it be located here?	No	Same as 4. HSE

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	No	Same as 4. HSE
Step 2: Identifying the loc./surrounding	No	Same as 4. HSE

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	No	Same as 4. HSE
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Same as 4. HSE
Step 3: The final step is incorporating systematic work pack inspection.	No	Not needed

3.2 HSE Installation

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	Same as 4. HSE
If necessary, do you need this amount?	No	Same as 4. HSE
If necessary, must it be located here?	No	Same as 4. HSE

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	No	Same as 4. HSE
Step 2: Identifying the loc./surrounding	No	Same as 4. HSE

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	No	Same as 4. HSE
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Same as 4. HSE
Step 3: The final step is incorporating systematic work pack inspection.	No	Not needed

3.3 Operational risks

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	Same as 4. HSE
If necessary, do you need this amount?	No	Same as 4. HSE
If necessary, must it be located here?	No	Same as 4. HSE

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	No	Same as 4. HSE
Step 2: Identifying the loc./surrounding	No	Same as 4. HSE

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	No	Same as 4. HSE
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Same as 4. HSE
Step 3: The final step is incorporating systematic work pack inspection.	No	Not needed

4. Deliveries

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	No	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	Yes	Use referencing instead of actual papers
Step 2: Identifying the loc./surrounding	Yes	Use ProArc for referenced documents

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	No	Depends on priority, but mostly the documents are inserted for the offshore engineer to be able to find them easier. DRE in contact with offshore personnel should decide if MTO / SAP printout is needed.
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Use references instead of papers given priority from offshore engineers.
Step 3: The final step is incorporating systematic work pack inspection.	No	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews – every second month.

5. Weight input

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	No	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	Yes	Use electronic copy in ProArc instead of paper if necessary
Step 2: Identifying the loc./surrounding	Yes	The cost / weight input is contract dependent. Instead of one copy in each WP, collect all information into one excel document in ProArc

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	No	
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Use referenceing instead of papers, work will be done by offshore personnel in ProArc if need arises.
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews – every third month.

6. Vendor documentation

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	No	
If necessary, must it be located here?	No	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	Yes	Use electronic copy instead of paper
Step 2: Identifying the loc./surrounding	Yes	The vendor documentation is not used regularly and depends on the WP/job. Thus, if the offshore engineer specifically need it, then insert into WP, if not prioritized then use referencing: the document can be fetched from ProArc.

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	Depends on the need of the offshore engineers, the balance between work, print and DCC work onshore vs. offshore electronic paperwork (ProArc input)
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Use references instead of papers, work will be done by offshore personnel in ProArc if need arises
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews – every third month.

7. MC Mechanical completion certificates

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	No	Important document which should stay in the package.
Step 2: Identifying the loc./surrounding	No	

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	
Step 2: Determine improvement methods:what, where, who, when, how	No	
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews – every third month.

8. Deviations / exception

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	No	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	Yes	Feedback from offshore engineers show that the deviations/exceptions should be placed earlier and more visible for the offshore personnel.
Step 2: Identifying the loc./surrounding	No	The appropriate surrounding should be under work description, where the deviation is more relevant and easier to be seen.

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Implement important parts from HSE as well as general deviations or exceptions.
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews – every second month.

9. Welding- and NDE-documentation

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	Necessary approx. every 3rd year: in case of production stop and welding is needed
If necessary, do you need this amount?	No	
If necessary, must it be located here?	No	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	Yes	**Reference the documents to ProArc**
Step 2: Identifying the loc./surrounding	Yes	The doc. Is needed in case of production stop resulting in welding, happens approx. every 3rd year. If offshore personnel need the document, it can be found in ProArc

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Use of referencing table, and in case of necessity insert the documentation upon priority message from offshore.
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews – every third month.

10. Bolt working / work copy

1. Seiri (SORT)	Answer	Details / description
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	The information relevant to bolting work is scarce but essential if offshore engineer find a need for it: bolt work table with torque moments and an ISO work copy.
If necessary, must it be located here?	No	

2. Seiton (Set In Order)	Answer	Details / description
Step 1: determining appropriate loc.	Yes	Depending on job specific priority report / Offshore engineers; reference the ISO drawing to ProArc.
Step 2: Identifying the loc./surrounding	Yes	If offshore personnel find a need for the document, it is possible to fetch it from ProArc.

3. Seiso (Shine)	Answer	Details / description
Step 1: Determine if every part is applicable to current work	Yes	
Step 2: Determine improvement methods:what, where, who, when, how	Yes	First rev: use current setup. Next rev: reference ISO doc to ProArc
Step 3: The final step is incorporating systematic work pack inspection.	Yes	Check workflow and feedback from both onshore and offshore engineers and decide to move on the phase two of improvement (move ISO to ProArc).

11. Documents for information

1. Seiri (SORT)	Answer	Details / description
Is this element necessary?	Yes	
If necessary, do you need this amount?	No	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	Answer	Details / description
Step 1: determining appropriate loc.	Yes	Use referencing to ProArc instead of actual papers
Step 2: Identifying the loc./surrounding	Yes	Use ProArc for referenced documents

3. Seiso (Shine)	Answer	Details / description
Step 1: Determine if every part is applicable to current work	No	Depends on priority, but mostly the documents are inserted for the offshore engineer to get a bigger picture of the work. A lot of this information is not relevant.
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Feedback from offshore engineers is that onshore engineers need to take bigger responsibility concerning matters of what to include, as well as communicating extensively with offshore engineers, in order to decide the amount of documents for information. Use less info and more referencing to ProArc.
Step 3: The final step is incorporating systematic work pack inspection.	Yes	This part is where we can utilize a big amount of cost saving by cutting unnecessary information. Incorporate a systematic review check after each installation pack.

12. Drawings (IFC original) (AS-Built)

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	No	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	No	
Step 2: Identifying the loc./surrounding	No	

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	One of the most important parts, also one which goes on to client as “AS-BUILT” and has to be included into installation pack.
Step 2: Determine improvement methods:what, where, who, when, how	No	
Step 3: The final step is incorporating systematic work pack inspection.	No	

13.1 Drawing index / drawings (IFC Original eng) (AS BUILT from offshore)

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	Yes	
Step 2: Identifying the loc./surrounding	No	

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Insert Taglist on same page as §12 and §12.1, thus making it a single page setup apart from the drawings.
Step 3: The final step is incorporating systematic work pack inspection.	No	Does not need a systematic inspection.

13.2 Taglist

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	Yes	
Step 2: Identifying the loc./surrounding	No	

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Insert Taglist on same page as §12 and §12.1, thus making it a single page setup apart from the drawings.
Step 3: The final step is incorporating systematic work pack inspection.	No	Does not need a systematic inspection.

Appendix B2 - 3S of EIT Department's installation package

1. Checklist

1. Seiri (SORT)	Answer	Details / description
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	Answer	Details / description
Step 1: determining appropriate loc.	No	Don't need to
Step 2: Identifying the loc./surrounding	No	Don't need to

3. Seiso (Shine)	Answer	Details / description
Step 1: Determine if every part is applicable to current work	Yes	
Step 2: Determine improvement methods:what, where, who, when, how	No	Updated when content changes
Step 3: The final step is incorporating systematic work pack inspection.	Yes	Will be done in next revision / an inspection should be done every month

2. Planning and risk analysis

1. Seiri (SORT)	Answer	Details / description
Is this element necessary?	No	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	Answer	Details / description
Step 1: determining appropriate loc.	No	Don't need to
Step 2: Identifying the loc./surrounding	No	Don't need to

3. Seiso (Shine)	Answer	Details / description
Step 1: Determine if every part is applicable to current work	No	It is rarely used when inspecting from Genba walk. Even if it might be useful in some cases, it should be covered in the HSE chapter.
Step 2: Determine improvement methods:what, where, who, when, how	No	
Step 3: The final step is incorporating systematic work pack inspection.	Yes	Will be done in next revision / inspection should be done every 3-6 months

3. Work Description (title only)

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	No	Don't need to
Step 2: Identifying the loc./surrounding	No	Don't need to

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	Work description is ultimately one of the most important parts of the work pack
Step 2: Determine improvement methods:what, where, who, when, how	No	
Step 3: The final step is incorporating systematic work pack inspection.	No	

3.1. Reference to other relevant work packages / assistant - activities

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	No	Don’t need to
Step 2: Identifying the loc./surrounding	No	Don’t need to

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	Work description is ultimately one of the most important parts of the work pack
Step 2: Determine improvement methods:what, where, who, when, how	Yes	More efficient description by PRE in direct talks with offshore Operator/eng.
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews - every month.

3.2 Work description with pictures and text

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	No	Excessive use of mapping

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	Yes	Move to 3. Work description
Step 2: Identifying the loc./surrounding	Yes	Increased productiveness if collocated with 3. Work description, reduces space usage and cost, while increasing time efficiency.

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	Work description is ultimately one of the most important parts of the work pack
Step 2: Determine improvement methods:what, where, who, when, how	Yes	More efficient description by PRE in direct talks with offshore Operator/eng.
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews - every month.

3.3 Block diagram demolition and installation / Installation of equipment

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	No	
Step 2: Identifying the loc./surrounding	No	

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	
Step 2: Determine improvement methods:what, where, who, when, how	No	
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews - every month.

3.4 Installation of cable / tubing (ladders, trays and penetrations)

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	No	
Step 2: Identifying the loc./surrounding	No	

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	
Step 2: Determine improvement methods:what, where, who, when, how	No	In next revision
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews - every month.

3.5 Pulling cable / installation of tubing

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	No	
Step 2: Identifying the loc./surrounding	No	

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	
Step 2: Determine improvement methods:what, where, who, when, how	Yes	This revision: Insert a table in template, it will create less work and become more effective for the engineer making the package.
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews - every month.

3.6 Termination of cables – from A end to B end

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	No	
Step 2: Identifying the loc./surrounding	No	

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	
Step 2: Determine improvement methods:what, where, who, when, how	No	This revision: Insert a table in template, it will create less work and become more effective for the engineer making the package.
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews - every month.

3.7 Testing

1. Seiri (SORT)	Answer	Details / description
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	Answer	Details / description
Step 1: determining appropriate loc.	No	
Step 2: Identifying the loc./surrounding	No	

3. Seiso (Shine)	Answer	Details / description
Step 1: Determine if every part is applicable to current work	No	Normally MC tests are enough. But in some special cases the testing refers to external docs like PCSS, commissioning pack or commissioning procedure. It's usually applicable for equipment which are tested up against a control system, or in any way has an interface interconnected with other systems. Then COPSAS personnel will assist.
Step 2: Determine improvement methods:what, where, who, when, how	Yes	This revision: Insert a table in template, it will create less work and become more effective for the engineer making the package.
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews - every month.

3.8 Settings of protection

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	Only for electro packages
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	No	
Step 2: Identifying the loc./surrounding	No	

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	No	It's mainly for electro packages. Aibel is usually not involved in working with motor controller and big dispatches from elect boards, but in case it is needed; then it should be possible to do.
Step 2: Determine improvement methods:what, where, who, when, how	Yes	This revision: Insert a table in template, it will create less work and become more effective for the engineer making the package.
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews - every month.

4 HMS

1. Seiri (SORT)	Answer	Details / description
Is this element necessary?	Yes	Obligatory for operating personnel to have HMS documentation available
If necessary, do you need this amount?	No	The rules and regulations both in Copnos TCD and www.regelhjelp.no don't relate any specific instructions as to the amount or place.
If necessary, must it be located here?	No	Excessive use of copy/paste

2. Seiton (Set In Order)	Answer	Details / description
Step 1: determining appropriate loc.	Yes	A standardized version always available to personnel offshore (operating staff). Move location from within installation package to a standalone offshore standard.
Step 2: Identifying the loc./surrounding	Yes	HMS information that is general for all work packages is better to standardize and change location to a place where it's easier available for the operating personnel.

3. Seiso (Shine)	Answer	Details / description
Step 1: Determine if every part is applicable to current work	No	Most of the information is general, and is unnecessary for installation pack (experience from genba walk).
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Specific, new and relevant HSE information should be specified in the installation package - work description
Step 3: The final step is incorporating systematic work pack inspection.	No	Not needed

4.1 Technical HMS

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	Same as 4. HSE
If necessary, do you need this amount?	No	Same as 4. HSE
If necessary, must it be located here?	No	Same as 4. HSE

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	No	Same as 4. HSE
Step 2: Identifying the loc./surrounding	No	Same as 4. HSE

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	No	Same as 4. HSE
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Same as 4. HSE
Step 3: The final step is incorporating systematic work pack inspection.	No	Not needed

4.2 HMS Installation

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	Same as 4. HSE
If necessary, do you need this amount?	No	Same as 4. HSE
If necessary, must it be located here?	No	Same as 4. HSE

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	No	Same as 4. HSE
Step 2: Identifying the loc./surrounding	No	Same as 4. HSE

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	No	Same as 4. HSE
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Same as 4. HSE
Step 3: The final step is incorporating systematic work pack inspection.	No	Not needed

4.3 Operational risks

1. Seiri (SORT)	Answer	Details / description
Is this element necessary?	Yes	Same as 4. HSE
If necessary, do you need this amount?	No	Same as 4. HSE
If necessary, must it be located here?	No	Same as 4. HSE

2. Seiton (Set In Order)	Answer	Details / description
Step 1: determining appropriate loc.	No	Same as 4. HSE
Step 2: Identifying the loc./surrounding	No	Same as 4. HSE

3. Seiso (Shine)	Answer	Details / description
Step 1: Determine if every part is applicable to current work	No	Same as 4. HSE
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Same as 4. HSE
Step 3: The final step is incorporating systematic work pack inspection.	No	Not needed

5. Deliveries

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	No	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	Yes	Use referencing instead of actual papers
Step 2: Identifying the loc./surrounding	Yes	Use ProArc for referenced documents

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	No	Depends on priority, but mostly the documents are inserted for the offshore engineer to be able to find them easier.
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Use references instead of papers given priority from offshore engineers.
Step 3: The final step is incorporating systematic work pack inspection.	No	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews – every second month.

6. Weight input

1. Seiri (SORT)	Answer	Details / description
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	No	

2. Seiton (Set In Order)	Answer	Details / description
Step 1: determining appropriate loc.	Yes	Use electronic copy instead of paper
Step 2: Identifying the loc./surrounding	Yes	The cost / weight input is used mainly in EIT packages and is useful for offshore personnel. But it can be done effectively in offshore office by field eng.

3. Seiso (Shine)	Answer	Details / description
Step 1: Determine if every part is applicable to current work	Yes	Depends on the balance between work, print and DCC work onshore vs. offshore electronic paperwork
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Use references instead of papers, work will be done by offshore personnel in ProArc if need arises
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews – every third month.

7. Vendor documentation

1. Seiri (SORT)	Answer	Details / description
Is this element necessary?	Yes	
If necessary, do you need this amount?	No	
If necessary, must it be located here?	No	

2. Seiton (Set In Order)	Answer	Details / description
Step 1: determining appropriate loc.	Yes	Use electronic copy instead of paper
Step 2: Identifying the loc./surrounding	Yes	The vendor documentation is not used regularly and depends on the WP/job. Thus, if the offshore engineer find a need for it: the document can be fetched from ProArc.

3. Seiso (Shine)	Answer	Details / description
Step 1: Determine if every part is applicable to current work	Yes	Depends on the balance between work, print and DCC work onshore vs. offshore electronic paperwork (ProArc input)
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Use references instead of papers, work will be done by offshore personnel in ProArc if need arises
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews – every third month.

8. MC Mechanical completion certificates

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	No	Important document which should stay in the package.
Step 2: Identifying the loc./surrounding	No	

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	
Step 2: Determine improvement methods:what, where, who, when, how	No	
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews – every third month.

9. Deviations / exception

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	No	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	Yes	Feedback from offshore engineers show that the deviations/exceptions should be placed earlier and more visible for the offshore personnel.
Step 2: Identifying the loc./surrounding	No	The appropriate surrounding should be under work description, where the deviation is more relevant and easier to be seen.

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Implement important parts from HSE as well as general deviations or exceptions
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews – every second month.

10. Job specific procedures / Notification of electrical installation / Declaration of conformity

1. Seiri (SORT)	Answer	Details / description
Is this element necessary?	Yes	
If necessary, do you need this amount?	No	
If necessary, must it be located here?	No	

2. Seiton (Set In Order)	Answer	Details / description
Step 1: determining appropriate loc.	Yes	Remove as a chapter, and insert a point in the check list
Step 2: Identifying the loc./surrounding	Yes	While instrument and telecom rarely use it, the electro dept. have been using it regularly. The solution with a point in the check list is a recommendation by Astad, K.P. and should be implemented

3. Seiso (Shine)	Answer	Details / description
Step 1: Determine if every part is applicable to current work	Yes	
Step 2: Determine improvement methods:what, where, who, when, how	Yes	
Step 3: The final step is incorporating systematic work pack inspection.	Yes	A review of WP after every finished WP. Inspection of WP and incorporate results/ solve problems from reviews – every second month.

11. EX Documentation / Datasheet / Reports / Calculations

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	No	
If necessary, must it be located here?	No	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	Yes	Located in ProArc where the document is also referenced in installation package
Step 2: Identifying the loc./surrounding	Yes	From offshore engineers perspective; the datasheets are the most relevant, while the rest of documents are less likely to be used.

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	No	Only the datasheets are of immediate use to offshore personnel onsite, and can be regarded as relevant. EX Documentation, reports and calculations are in case the offshore engineer would like to investigate further, and can thus be found in ProArc.
Step 2: Determine improvement methods:what, where, who, when, how	Yes	In first revision, cut down this part to only include Datasheets. In next revision move datasheets to ProArc.
Step 3: The final step is incorporating systematic work pack inspection.	Yes	Check workflow and feedback from both onshore and offshore engineers and decide to move on the phase two of improvement (move datasheets to ProArc).

12. Drawings / Documents for information

1. Seiri (SORT)	Answer	Details / description
Is this element necessary?	Yes	
If necessary, do you need this amount?	No	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	Answer	Details / description
Step 1: determining appropriate loc.	Yes	Use referencing to ProArc instead of actual papers
Step 2: Identifying the loc./surrounding	Yes	Use ProArc for referenced documents

3. Seiso (Shine)	Answer	Details / description
Step 1: Determine if every part is applicable to current work	No	Depends on priority, but mostly the documents are inserted for the offshore engineer to get a bigger picture of the work. A lot of this information is not relevant.
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Feedback from offshore engineers is that onshore engineers need to understand the importance of "using their head" as well as communicating extensively with offshore engineers, in order to decide the amount of documentation for information. Use less info and more referencing to ProArc.
Step 3: The final step is incorporating systematic work pack inspection.	Yes	This part is where we can utilize a big amount of cost saving by cutting unnecessary information. Incorporate a systematic review check after each installation pack.

13. Drawings (IFC original) (AS-Built)

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	No	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	No	
Step 2: Identifying the loc./surrounding	No	

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	One of the most important parts, also one which goes on to client as "AS-BUILT" and has to be included into installation pack.
Step 2: Determine improvement methods:what, where, who, when, how	No	
Step 3: The final step is incorporating systematic work pack inspection.	No	

13.2 Drawing index / drawings (IFC Original eng) (AS BUILT fra offshore)

1. Seiri (SORT)	Answer	Details / description
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	Answer	Details / description
Step 1: determining appropriate loc.	Yes	
Step 2: Identifying the loc./surrounding	No	

3. Seiso (Shine)	Answer	Details / description
Step 1: Determine if every part is applicable to current work	Yes	
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Insert Taglist on same page as §12 and §12.1, thus making it a single page setup apart from the drawings.
Step 3: The final step is incorporating systematic work pack inspection.	No	Does not need a systematic inspection.

13.2 Taglist

1. Seiri (SORT)	**Answer**	**Details / description**
Is this element necessary?	Yes	
If necessary, do you need this amount?	Yes	
If necessary, must it be located here?	Yes	

2. Seiton (Set In Order)	**Answer**	**Details / description**
Step 1: determining appropriate loc.	Yes	
Step 2: Identifying the loc./surrounding	No	

3. Seiso (Shine)	**Answer**	**Details / description**
Step 1: Determine if every part is applicable to current work	Yes	
Step 2: Determine improvement methods:what, where, who, when, how	Yes	Insert Taglist on same page as §12 and §12.1, thus making it a single page setup apart from the drawings.
Step 3: The final step is incorporating systematic work pack inspection.	No	Does not need a systematic inspection.

Appendix C1 – Installation Package EIT Department

Current state

1. Checklist

2. Planning and risk assessment

3. Work description
    - 3.1. References to other relevant workpackages / assistant - activities
    - 3.2. Work description with text and pictures
    - 3.3. Block diagram demolition and installation / Installation of equipment
    - 3.4. Installation of cable / tubing (ladders, trays and penetrations)
    - 3.5. Pulling cable / installation of tubing
    - 4.6 Termination of cables – from A end to B end
    - 3.6. Testing
    - 3.7. Settings of protection

4. HMS
    - 4.1. Technical HMS
    - 4.2. HMS installation
    - 4.3. Operational risks

5. Deliveries

6. Weight input

7. Vendor documentation

8. MC Mechanical completion certificates

9. Deviations / exception

10. Job specific procedures / Notification of electrical installation / Declaration of conformity

11. EX Documentation /Datasheets /Reports / Calculations

12. Drawings / Documents for information

13. Drawings (IFC original) (AS-Built)
    - 13.1. Drawing index / drawings (IFC Original eng) (AS BUILT from offshore)
    - 13.2. Taglist

Future state

1. Checklist

2. Work description
    2.1. References to other relevant work packages / assistant - activities
    2.2. Work description with text and pictures
    2.3. Block diagram demolition and installation / Installation of equipment
    2.4. Installation of cable / tubing (ladders, trays and penetrations)
    2.5. Pulling cable / installation of tubing
    4.7 Termination of cables – from A end to B end
    2.6. Testing
    2.7. Settings of protection
    2.8. Job specific HMS / "Fareskjema"
        2.8.1. Deviations / Exceptions

3. Deliveries

4. MC Mechanical completion certificates

5. Drawings / Documents for information
    5.1. Vendor documentation

6. Drawings (IFC original) (AS-Built)
    6.1. Drawing index / drawings (IFC Original eng.) (AS BUILT from offshore)
    6.2. Tag list

*use head/brain to determine the necessary information to include in work package.

Appendix C1 – Installation Package Structure Department

Current State

1. Checklist

2. Work Description

3. HMS
    3.1. Technical Safety
    3.2. HMS Installation
    3.3. Operational risk

4. Delieveries

5. Weight input

6. Vendor Documentation

7. MC Mechanical Completion Certificates

8. Deviations / Exceptions

9. Welding and NDE - Documentation

10. Bolt Tork Table / Working Copy

11. Documentation for information

12. Drawings (IFC original) (AS-Built)
    12.1. Tegningsindeks / tegninger (IFC Original eng) (AS BUILT fra offshore)
    12.2. Tagliste

Future state

1. Check list

2. Work Description
   2.1. Work description with text and pictures
   2.2. References to other relevant work packages / assistant – activitites
   2.3. Job specific HMS / Fareskjema
      2.3.1. Deviations / Exceptions

3. Deliveries

4. MC Mechanical Completion Certificates

5. Documentation for information (*)
   5.1. Vendor Documentation
   5.2. References

6. Drawings (IFC original) (AS-Built)
   6.1. Taglist

*use good sense to determine the necessary information to include in work package.