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Preface

This thesis is the finalization of my EMBA studies at the University of Stavanger (UiS).

These last three years have been challenging, hard and educational.

First and most importantly I would like to thank my family for being patient and supportive through my study.

Secondly I would like to express gratitude to my employer for investing in my educational development.

Finally I would like to thank my supervisor at the University for guiding me in the right direction.

Stavanger 20.05.16

Helene Dahl

Abstract

Kaizen is a Japanese word translated to Good Change, but the meaning behind the word is continuous improvement. Kaizen events are a part of the Lean philosophy and developed by Toyota. The event typically takes place during 4-5 days and aims to make significant change by identifying possibilities for improvement.

This thesis is a study of one Kaizen event that took place in an American oil-service company in Sandnes, Norway.

A case study has been used to compose a detailed description of the Kaizen event. A holistic approach is used to achieve a detailed understanding of the process.

The scope for the event was:

From Order to Deployment (Cash)

The thesis aims to identify if the Kaizen approach is an effective way of making improvements.

The event contributed to detailed understanding of the chosen scope as a multi-functional team was chosen to participate. Data was gathered through discussions, interviews, observations and documentation.

The theoretical framework for this case study has been the extensive Lean theory together with relevant traditional theory.

After analyzing the Kaizen event, the following results were observed:

- Increased understanding of the process as a whole and an awareness of the connection between the different process steps and departments.
- Increased dedication and ownership by team members.
- Increased team-spirit and communication across departments.
- Increased knowledge of Lean concepts and benefits, a new mindset focusing on improvements.
- Financial results hard to identify due to the market situation.

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1.0 Introduction

There is a constant drive for improving your business to stay competitive, and there are several different methods to follow. Lean is one of these, showing great success in certain companies and failure in other.

Lean can be explained as “creating more value for customers with fewer resources”. Behind this statement you will find an extensive philosophy developed over years by individuals in Toyota and with a strong foundation in the Japanese culture.

This thesis will focus on one of these tools: The Kaizen Approach.

1.2 Background

The implementation of the Toyota Production System was conducted in Toyota in the 1950s in the middle of the great crisis, pushed through by Taiichi Ohno: “Great lean leaps are made during though economic crises”. (Shook, 2009).

Today, the oil industry is experiencing challenges in connection with the reduced oil price, and focus on costs and efficiencies have increased.

Through Kaizen events, a culture of continuous improvement will be created. Focus will be on eliminating waste from non-value added activities. This will save costs and highlight the activities that are value-adding to the customers.

The oil service company in this study has been exposed to rapid growth the last years before experiencing the sudden drop in activity. Focus used to be to deliver what the customer requested at any cost, creating a customer-focused culture with highly skilled employees working rather independently from each other and management.

The current situation is different. Cost has become the main decision point and therefore forcing the company to adapt.

1.1 Problem formulation

The main goal of this thesis is to explore whether the Kaizen event is an effective way of improving processes in the company. The intervention will be short and intense, forcing a group of people to find opportunities and solution during 4 dedicated days.

Research questions:

1. Will the Kaizen Event contribute to identify relevant errors and opportunities in the value stream, making the organization more effective without sacrificing quality?
2. Will Kaizen provide the correct actions for issues identified during the event?
3. Will the implemented solutions reduce errors?
4. Will Kaizen contribute to a culture of continuous improvement?

2 Theory

This chapter will describe the theoretical framework used in this thesis.

The history and background of Lean and TPS will be described, explained and connected to relevant theory.

2.1 Lean

Lean can be described as a set of management practices applied to eliminate waste and to increase value to the customer. (Womack & Jones, 1996).

Lean was first introduced as a concept by John Krafcik in the article “Triumph of the Lean Production System” in 1988 (Krafcik, 1988) and was based on his experience as a quality engineer at Toyota-GM NUMMI joint venture in California. What he was describing, was the Toyota Production System in action.

2.2 TPS – Toyota Production System

The tools and philosophy develop in Toyota throughout the years is extensive and dating back to 1926. (Liker, 2004).

Figure 2.2 Toyota House illustrates the widespread concepts of TPS.



Figure 1 Toyota House

This chapter will give an overview of the background, the Toyoda family and history, with focus on the tools used in the thesis.

2.2.1 Background

Car industry post-World War II: Henry Ford had successfully moved from craftsmanship to mass production in the 1930s, being able to reduce production costs and increase efficiency, taking advantage of economies of scale and building high inventory.

Japan, hit hard by the war, lacked cash, raw material and warehouse space. Debt was eight times its total capital value. (Reingold, 1999).

For Toyota to take up competition with the US car manufacturers on the same terms would be close to impossible. This forced the development of Lean production. (Plenert, 2006).

2.2.2 The Toyoda Family

The concepts in Lean and TPS cannot be fully understood without an introduction to the ideals and values of the Toyoda family.

Sakichi Toyoda was the son of weavers. Inspired by the hard work made by his parents, he developed several weaving devices and established Toyoda Automatic Loom Works in 1926. Later this company moved into the automobile industry and became what we know as Toyota today. Sakichi, often referred to as the father of the Japanese industrial revolution, developed 3 concepts used today in Lean philosophy:

Jidoka – Automation with a human touch: As an innovator, he had a strong believe in automation and included the concept of Jidoka to his innovations: The machine would stop working if an error occurred, requiring a person to fix the problem before production could continue. Jidoka is an essential part of the Lean philosophy today, empowering workers to stop production when an error occurs.

Genchi genbutsu – Go see for yourself: As an entrepreneur, Sakichi understood the importance of getting his hands dirty and go to where the work is done to thoroughly understand a problem. You will find that Lean managers to a higher degree spend their time on the work floor.

5 Whys – Find the root cause of the problem: Asking why until you understand the underlying problem so that the correct solution can be put in place.

Kiichiro Toyoda was the son of Sakichi. He moved the company from weaving to automobile establishing Toyota Motor Corporation in 1937.

Kiichiro had several trips to the US, trying to learn the mobile industry from Ford.

It was during a trip made by **Taiichi Ohno**, the shop floor supervisor a Toyota, that the

concept of **Just In Time** was invented. Taiichi was inspired by the US supermarket shelves: never empty and never overflowing. The items were replaced shortly after consumers had pulled them out of the shelves, leading to the thought of **Pull** versus Push production: to produce the right quantity of goods at the right place at the right time. This way, production will be triggered by customer demand and not by keeping up production to keep price per item low.

Eiji Toyoda was the nephew of Sakichi and became head of Toyota in 1957. Together with **Taiichi Ohno**, he continued to develop concepts later known as “The Toyota Way”. The **Kanban** concept, building on the principle of Just In Time, is a method of controlling available items in the production line. **Kaizen** events were also fine-tuned at this stage.

2.3 The 14 Principles and Theoretical Framework

The Lean concepts include both a philosophical aspect with guiding principles, and an operational view with tools and techniques. (Shah & Ward, 2007).

It is argued that few companies experience the continuous improvements described in the literature when implementing Lean. (Marvel & Standridge, 2009).

It is suggested that a holistic approach to Lean is needed to experience full effect of the tools and concepts. (Crute, Ward, & Brown, 2003).

This chapter will describe the 14 principles of Lean as identified by Dr. Jeffrey Liker who believed that this knowledge is necessary to understand how the Lean tools works (Liker, 2004). The principles will be categorized under 4 levels and a conceptual association to relevant theoretical framework will be established.

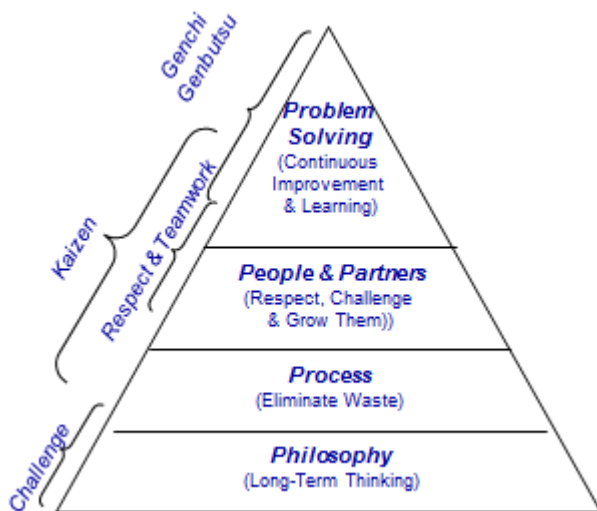


Figure 2 Toyota Production Systems (Liker, 2004).

2.4 Philosophy

Principle 1:

Base your management decisions on a long-term philosophy, even at the expense of short-term financial goals.

Theoretical framework:

Studies show that meaningful work triggers ownership and commitment, which again triggers motivation. Making the right decisions for the company as a whole, its employees, the customers and the society will help building a healthy organization. (Keller & Price, 2011).

2.5 Process

Principle 2:

Create continuous process flow to bring problems to the surface.

Principle 3:

Use “pull” systems to avoid overproduction.

Principle 4:

HEIJUNKA – Level out the workload.

Principle 5:

JIDOKA - Build a culture of stopping to fix problems, to get quality right the first time.

Principle 6:

Standardized tasks are the foundation for continuous improvement and employee empowerment.

Principle 7:

Use visual control so no problems are hidden

Principle 8:

Use only reliable, thoroughly tested technology that serves your people and processes.

Theoretical framework:

McGregor’s Theory X and Y describe two different views on the average worker and how this view will decide what kind of management style is chosen. (McGregor, 2006).

Theory X triggers a top-down management approach. The assumption is that the average worker has little to no self-motivation and needs to be managed through supervision, intimidation and punishment. **Theory Y** takes the opposite approach and assumes the average

worker is driven from internal motivation and takes ownership and responsibility of their tasks triggering a management style with less control and more freedom.

McGregor concluded that a mix of these approaches was necessary to achieve the most efficient production.

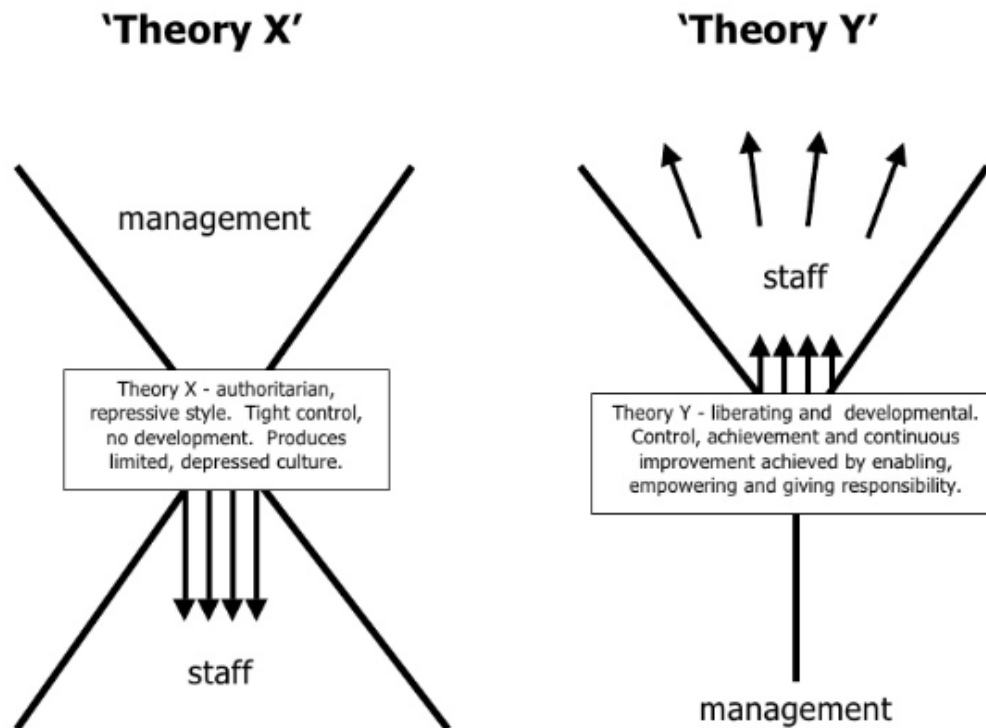


Figure 3 Theory X and Y.

Principles 2-8 describing the processes reflects detailed and standardized procedures to follow, which is related to theory X. At the same time, involvement from the worker is both expected and valued in Lean. It is the operator who is the expert, who writes the procedure, who comes up with suggestions and who has the power to stop production if an error is detected, supporting theory Y.

Toyota defines their leaders in the model below, showing largest focus on Bottom-Up In-Depth understanding. The typical Toyota leader has been with the company from a young age, starting at the bottom and developing upwards through commitment and knowledge.

The model also visualizes the value in standardized tasks and procedures through Task Master and Bureaucratic Manager, and last the Group Facilitator impact empowering the worker to suggest improvements and to take ownership at work. (Daniels, 1995).

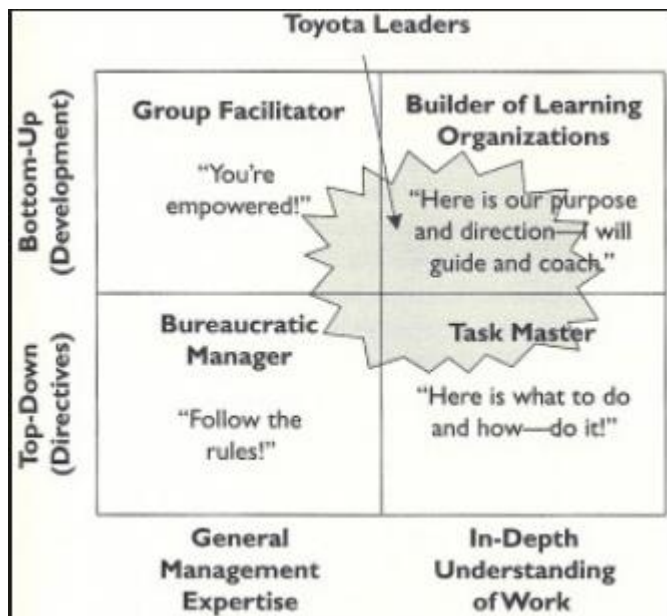


Figure 4 Toyota Leadership Model (Liker, 2004).

2.6 People & Partners

Principle 9:

Grow leaders who thoroughly understand the work, live the philosophy, and teach it to others.

Principle 10:

Develop exceptional people and teams who follow your company's philosophy.

Principle 11:

Respect your extended network of partners and suppliers by challenging them and helping them improve.

Theoretical framework:

Development of people and partners in TPA is based on the internal motivational theories from Maslow and Herzberg. (Liker, 2004).

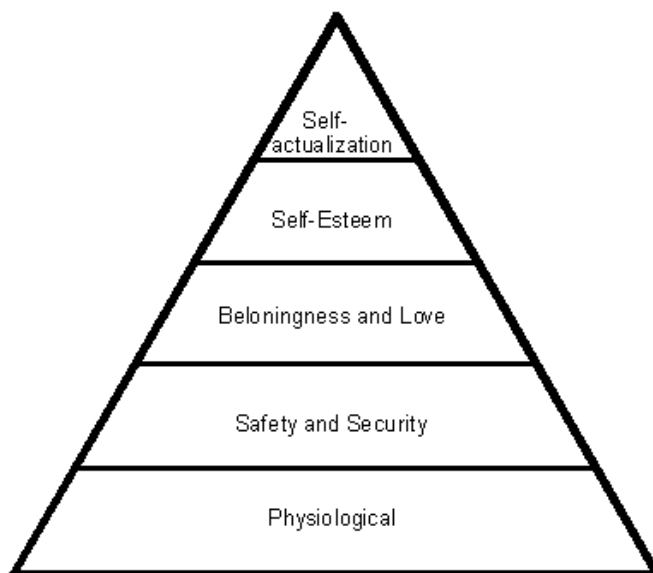


Figure 5 Marslow's Need Hierachy.

The lower levels of Maslow's Need Hierarchy is completed by job security, fair pay and safe work conditions, while the top section is fulfilled by the culture of investing in the employees and supporting a continuous growth toward self-actualization. (Liker, 2004).

The same theory is used with external partners and suppliers. The foundation has to be fair and honest, for the relationship to move upwards in the hierarchy and finally be a Learning Enterprise.

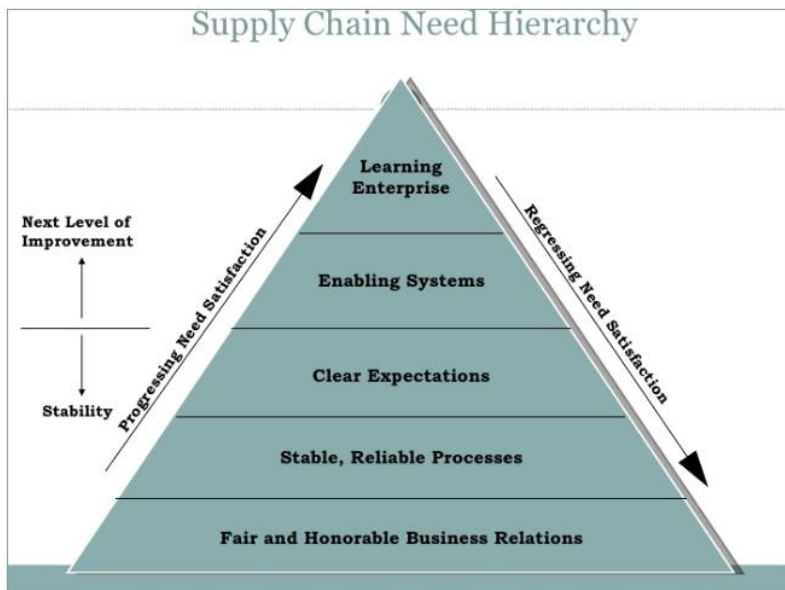


Figure 6 Supply Chain Need Hierarchy.

Herzberg's findings revealed that certain job characteristics lead to job satisfaction (motivational factors), while other lead to job dissatisfaction (hygiene factors). He concluded that the motivational factors and hygiene factors are not opposites, making both sides relevant for job satisfaction.

Several of the Lean tools contribute to the elimination of hygiene factors. 5S is one of the tools used to remove the dissatisfiers from the workplace.

Motivational factors include the same as for the upper part of Maslow's Need Hierarchy. (Liker, 2004).



Figure 7 Herzberg's Job Enrichment Theory.

2.7 Problem Solving

Principle 12:

GENCHI GENBUTSU – go see for yourself to thoroughly understand the situation.

Principle 13:

Make decisions slowly by consensus, thoroughly considering all options; implement decision rapidly.

Principle 14:

Become a learning organization through relentless reflection – HANSEI – and continuous improvement – KAIZEN

Theoretical framework:

The last 3 principles describing problem solving brings us to the top of figure 2.2.3. Comparing to Maslow's Need Hierarchy, problem solving with continuous improvement and learning is only possible after the philosophy is manifested in the organization, the processes are in place and people & partners are respected and challenged.

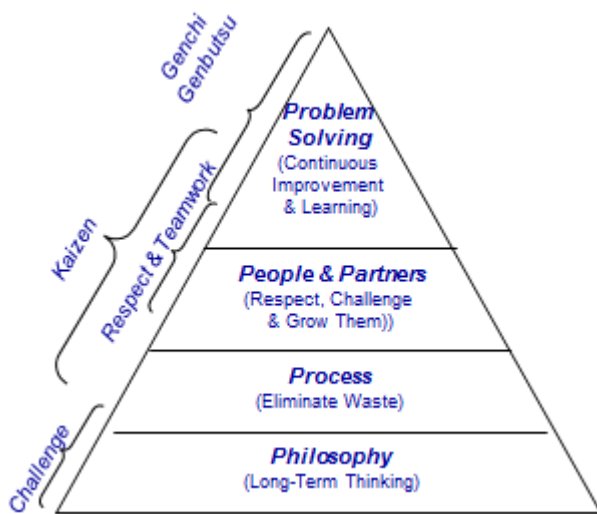


Figure 8 Toyota Production Systems (Liker, 2004).

2.8 The Tools and Concepts

The following will give a detailed description of Lean tools and concepts used in this thesis.

2.8.1 DMAIC

DMAIC is a management method combining elements from Lean with Six Sigma.

While Lean focus on waste elimination, standard work, flow and pull production, Six Sigma addresses reduction of variations in production, rework and scrap elimination and process control. (George, Maxey, Rowlands, & Price, 2004).

Lean contribution will improve process speed and reduce lead time, and Six Sigma will bring the process under statistical control.

The method always starts with **Defining** the problem before deciding on a current state used for **Measuring** improvement. Next step is identifying defects and **Analyze** the root cause before moving over to **Improvement** and a better future state. Finally **Control** needs to be put in place to verify if the changes made have been successful.

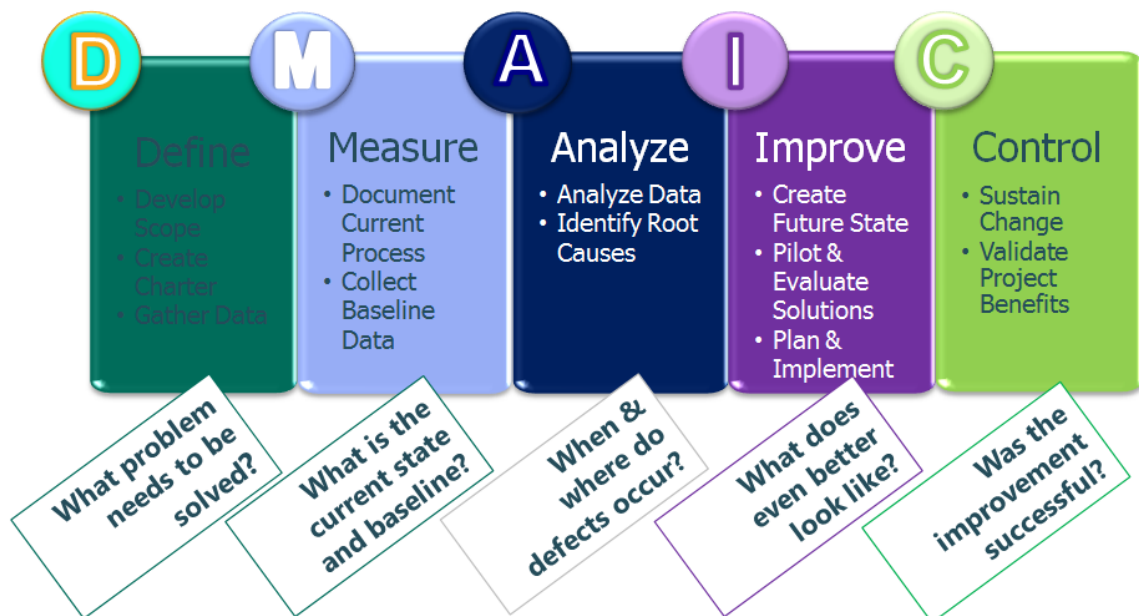


Figure 9 DMAIC.

2.8.2 Root Cause Analysis

Root Cause Analysis is a method of making sure that the real cause of a problem is being addressed and corrected. The alternative is to waste resources treating symptoms that will keep occurring because the actual problem has not been addressed and solved.

The 5 Whys technique was developed by Sakichi Toyoda. Confronted with an issue, he found that asking why 5 times often will lead you to understand the underlying problem(s). (Liker, 2004).

Root Cause Analysis Process

A **Problem Definition** should be the first step in this process, identifying the owners of the issue. Next, a **Root Cause Analysis** will be carried out identifying the underlying problem and receive validation from the owner(s) of the issue that we are on the right path.

Based on this information, a **Corrective Action Plan** is created stating cause(s) of the problem, describing the corrective action to solve the problem, identifying Action Owner and due date, and finally document the Corrective Action Evidence. All documentation is gathered in a **Root Cause Analysis Summary** highlighting the Problem Statement, Analysis Summary, Root Cause(s) and Recommended Corrective Action.

2.8.3 Waste Definition and Identification

Elimination of waste is one of the most effective ways of increasing profitability and an important concept in Lean Management.

Waste in Lean is defined as “Deviation from optimal allocation of resources” and categorized as Muda, Mura and Muri.

Mura is the waste of unevenness and Muri is the waste of overburden.(Liker, 2004).

For this thesis, Muda is the waste that has been addressed and will be further described.

There are two types of Muda: **Type One Muda** is non-value adding activities that are unavoidable and therefore cannot be eliminated. **Type Two Muda** creates no value and should be immediately eliminated. (Womack & Jones, 1996).

TPS identified 7 groups of Muda (Liker, 2004):

Transportation

Moving material from one location to another.

Inventory

Any material that is not being transformed into something the customer wants.

Motion

The unnecessary movement of people: walking, searching, correcting errors.

Waiting

People or material waiting for information, equipment, approvals, parts, etc.

Over-processing

Unneeded steps when completing a process.

Over-production

Manufacturing an item before it is acquired.

Defects

Anything that doesn't conform to the correct specifications.

The purpose of waste identification is to reduce or eliminate the waste identified in the Non-Value Adding activities.

2.8.3 Value Added vs Non-Value Added Activities

A Value Adding activity is defined as a process step that transforms or shapes a product or service which the customer is willing to pay for. Opposite, Non-Value Adding activities is defined as those process steps that take time, resources, space, or labor, but do not add value to the product or service.

Understanding this difference is important to understand what value means to the customer.

Non-Value added activities increase lead times, add costs, create opportunities for defects, increase inventories, and inhibit continuous flow.

The concept is to focus on the non-value adding activities in a process as this is where the potential for improvement is: Reducing or eliminating waste from these activities frees up resources to be used in a more effective way

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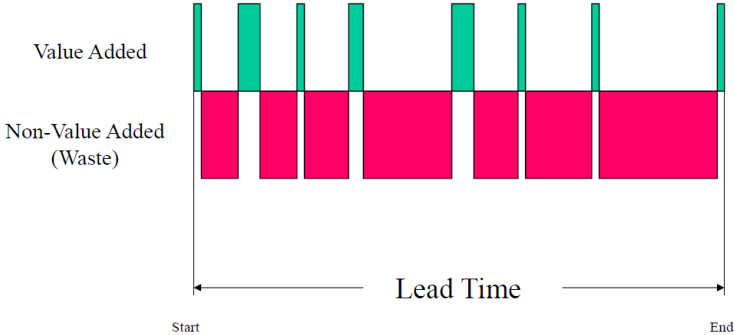


Figure 10 VAa 1.

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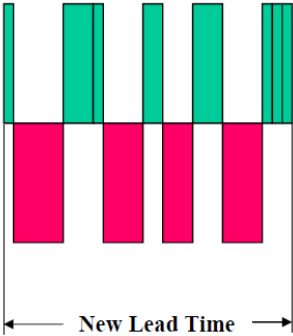


Figure 11 VAa 2.

2.8.4 Value Stream Mapping

“All we are doing is looking at the time line from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that timeline by removing the non-value-added wastes.” (Ohno, 1988)

Creating the Value Stream Map is a method of analyzing the current state and designing an improved future state. (Rother & Shook, 2003).

In an organization, most employees will have an idea of the different steps in a value stream. Very few will know in detail how the process runs.

Building a Value Stream Map will help visualize the flow of materials and communication, in addition to understand the relationship between each step of the process. The exercise will also highlight problems when going through each step in the value stream. (Rother & Shook, 1999). It is used as a tool for identifying waste and opportunities, and a baseline data to compare improvements over time.

The description below is one way of creating the map.

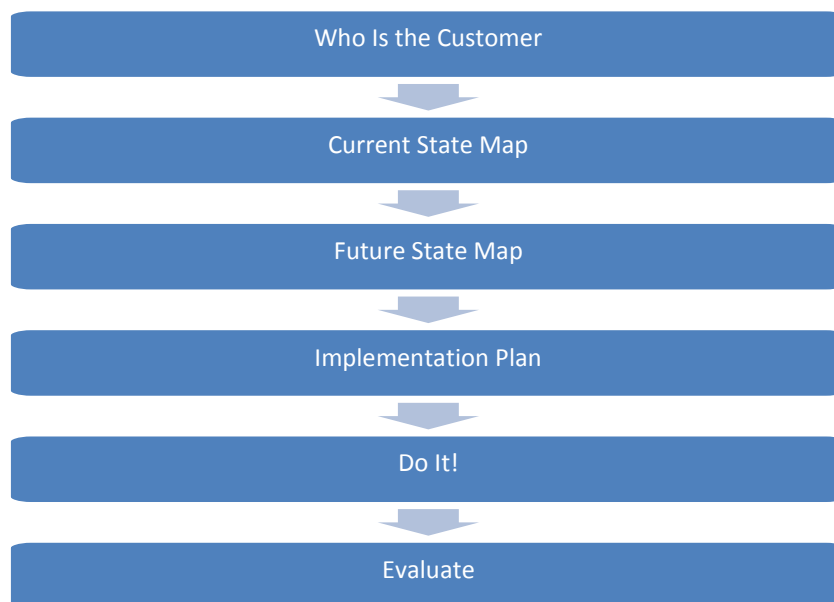


Figure 12 Value Stream Mapping.

2.8.5 5S and Visual Management

The concept: A place for everything, and everything in its place, clean and ready for use.

5S is one of the basic Lean tools aiming on reducing waste and keeping quality on top. The concept is applicable everywhere, from workshop to office.

When implementing 5S, the following steps should be followed: (Imai, 2012)

Sort: Clearly distinguishing between what is necessary and what is unnecessary and disposing of the unnecessary.

Straighten: Organizing the necessary items so that they can be used and returned easily. Making tools easy to find and making obvious when a tool is missing.

Scrub: Clean floors, equipment, and furniture in all areas of the workplace. This will prevent things from becoming unclean and unsafe.

Stabilize: Maintaining and improving the standards of the first 3 S's. Making sure procedures are in place to ensure no backsliding.

Sustain: Achieving the discipline or habit of properly maintaining the correct 5S procedures.



Figure 13 5 X S.

This is not a method used once for cleaning up: 5S should be a continuous process, moving from step 1-5 and then continuing with step number one again.

2.8.5 Continuous Flow

Traditionally production takes place in functional departments based on specialty. Each department produces a number of items before sending the complete batch of items over to the next step. This method causes increased lead time between departments waiting for the batches, and errors might be detected too late causing production of defect items. Ownership and communication is also challenged in this method as focus is more on doing your part of the process and less focus on the final product.

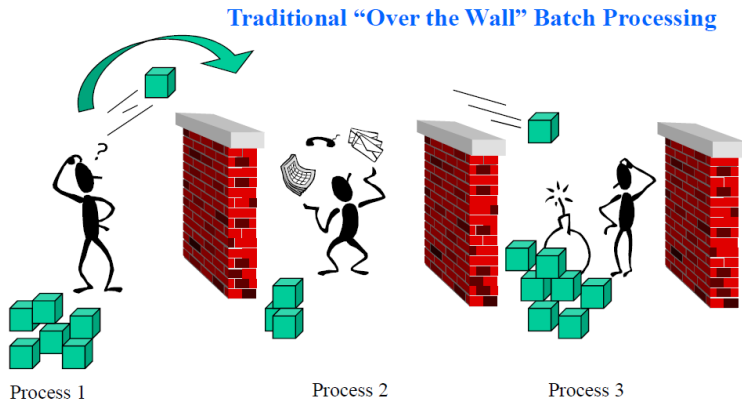


Figure 14 Batch Processing.

The Lean concept of Continuous Flow is creating One-piece Flow where the produced item is pulled through all steps in one flow. This method will **improve quality** as problem solving will be forced whenever there is an error (principle two and five), and avoid further production of items with errors. **Learning and thinking will increase** (principle 12 and 14) for each problem emerging and **communication will improve** working closer together and being more dependent on each other. Work In Progress will be reduced as will inventory (waste), and the process will be more open for adjustments and changes.(Liker, 2004).

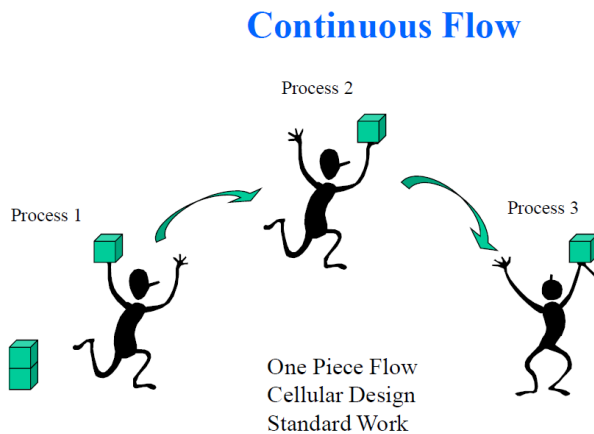


Figure 15 Continues Flow.

2.9 The Kaizen Approach

Kaizen is a Japanese word translated to Good Change, but the meaning and philosophy behind the word is **continuous improvement**. The intention is to create a company culture continuously working towards improving, and small incremental steps are just as important as major improvements.

The Kaizen Event dates back to the 1970s in Japan and became an integrated part of Lean in the 1990s. The event has a structured and disciplined path for problem solving and can be used in almost any situation.

The foundation of the Kaizen method consists of five fundamental elements:

Teamwork, personal discipline, improved morale, quality circles and suggestions for improvement. It demands 100% focus and 100% commitment from all participants to be successful. (Imai, 1986).

In this chapter, a step-by-step description of the Kaizen Event will be presented, together with the tools and concepts used during the event.

2.9.1 The Kaizen Event

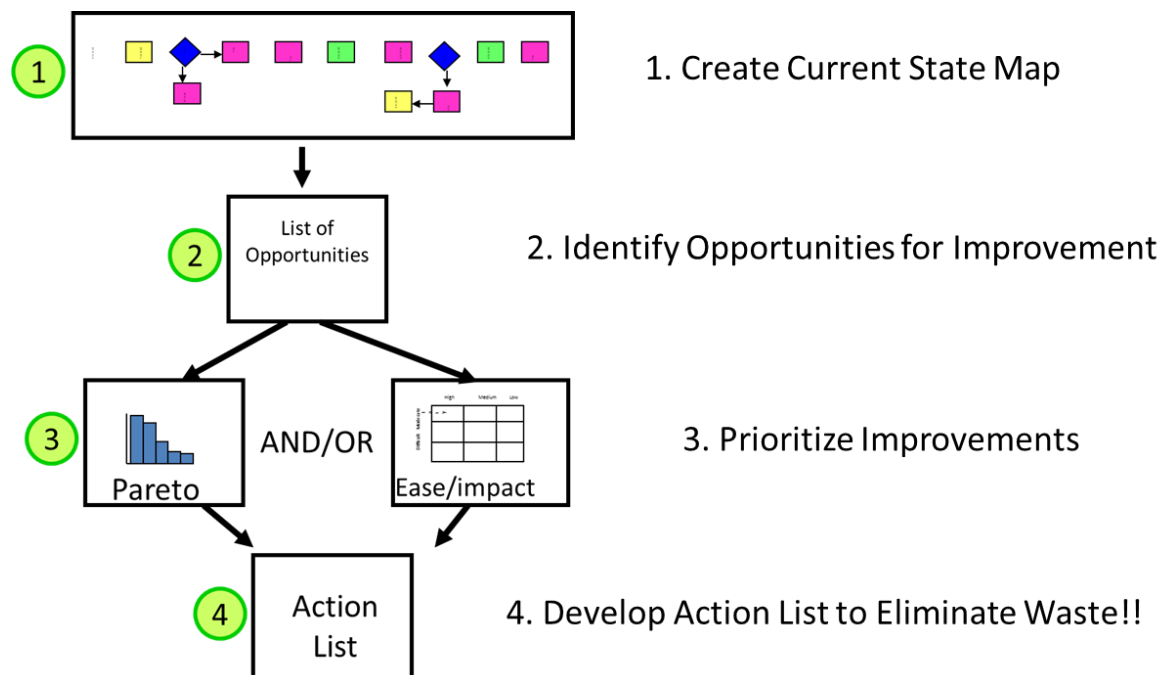


Figure 16 Kaizen Approach.

Before the Kaizen Event

Describe the problem statement and decide scope.

Choose a multi-functional team representing all departments involved in the chosen scope.

Choose a facilitator who will carry the team through all the necessary steps to complete the event.

Choose Executive Champion and Value Stream Owner: These participants are chosen from management and will not participate in the event. Management involvement is one of the success factors in this event, and successful implementation is dependent on participation from the whole organization. All participants are equal, there is no rank in the team and all gets their hands dirty (Laraia, Moody, & Hall, 1999) (Tozawa, 1995). Management must be fully committed and ready to lead the process.

Introducing the Kaizen Event

Why are we doing this event? This has to be specifically explained to the team to establish a common understanding of the challenge. After clarifying the scope for the event, the team discusses and decides on measurable objectives and goals.

Introducing Lean philosophy and tools

The Kaizen event is one step in implementing Lean philosophy to the organization. A thorough description of main Lean tools will be presented, together with examples making it visible to the team members.

The Kaizen Event

1. Creating the Current State Map

At this step, the team understands the scope and objectives for the event.

A wall covered in paper will be used to create the Value Stream, identifying first step and last step of the scope chosen for the event.

The team members are chosen for their role in the scope and together will represent the complete Value Stream. The exercise of creating the Value Stream collectively leads to a deep understanding of the process and triggers questions and discussions. The material flow and information flow is made visible and helps the team understand the complete process and the challenges faced in different departments. The result is a detailed overview of the process in scope.

Each activity and decision point is made visual by using post-it notes of different colors.

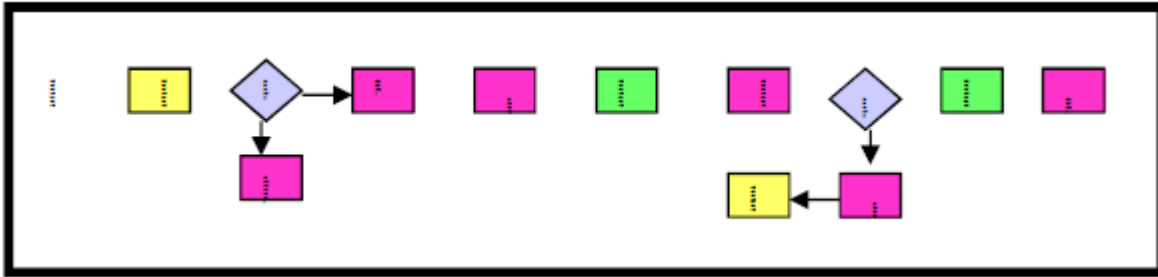


Figure 17 Value Stream Map.

After completing the Value Stream, start from the beginning and work through each step drawing communication lines whenever applicable. This will help the team verify if the process is complete before continuing to the next step, and also visualize necessary/unnecessary communication.

Next step is to categorize each activity into **Value Added or Non-Value Added**.

Who is the customer in this process? And what activities is the customer willing to pay for?

Further focus on improvement will only be made on the Non-Value Adding activities.

Next, an estimate of resource use will be identified for each activity step and made visual by post-it notes below the activity:

- Task Time; time spent completing the activity.
- Lead Time; time spent waiting between activities.
- Number of Employees involved in each activity.
- Error rate for each activity.

The complete Value Stream Map will be used as a baseline data throughout the Kaizen Event.

2. Identify Opportunities for Improvement

The focus for improvement will be on the Non-Value Adding activities and should address at least one of the seven wastes identified as Muda.

Each team member will be asked to hand in at least 3-4 suggestions for improvement on post-it notes. For efficiency reasons, this process has to be completed in 10 minutes. Each suggestion is posted on the Value Stream together with the activity it addresses.

This exercise is an effective way of identifying problem areas as the suggestions will pile up around certain activities in the Value Stream.

3. Prioritize Improvements

| | | | |
|---------------|------|-------------------------------|-------------|
| Impact | High | Kaizen Event / Project | Just Do It! |
| | Low | Drop | Consider |
| | | Low | High |
| | | Ease of Implementation | |

Figure 18 Ease/Impact Model.

Each suggestion for improvement is reviewed and discussed by the team, before categorizing in an Ease/Impact model.

4. Develop Action List to Eliminate Waste

The Action List generated from the event is a detailed overview of all actions composed from the improvement suggestions and the categorization in the Ease/Impact model. It describes Action Step necessary for improvement, Action Owner, Action Event (Kaizen, Just Do It, Project), date of completion and finally the benefits achieved after completion.

The team now returns to the original Value Stream, includes all the changes manifested in the Action List and creates a new Future Value Stream.

After the event

Presentation to management and lessons learned

A complete presentation is prepared for management, and all team members will participate in the presentation. A personal Lessons Learned from all participants will be registered.

Action List

The event is not completed until all action items have been completed.

Continuous Improvement

It is essential to monitor and control Lean implementation. Failing to do so will result in not succeeding. (Kumar & Phrommathed, 2006). It is advisable to create a Lean expert team in the organization that can be responsible for carrying through the implementation. (Womack & Jones, 2003).

3.0 Methodology

3.1 Methodology

This paper aims to provide an in-depth description of a Kaizen Event to understand if the approach is an effective way of improving processes.

Four objectives were developed to answer the problem statement:

1. Will the Kaizen Event contribute to identify relevant errors and opportunities in the value stream, making the organization more effective without sacrificing quality?
2. Will Kaizen provide the correct actions for issues identified during the event?
3. Will the implemented solutions reduce errors?
4. Will Kaizen contribute to a culture of continuous improvement?

The methodological approach includes conventional social science methods collecting data through reviewing documents, interviews and discussions and finally observations. This will be further explained in this chapter.

During the literature review, the extensive theory behind Lean and TPS was studied in detail to understand how the philosophy and the tools and concepts have been developed to what it is today. This included knowledge about the Japanese culture, the Toyoda family background and the financial and political situation Japan was in when Toyota succeeded.

To further understand Lean from a western civilization view, American Lean practitioners were studied in detail. (Liker, 2004).

During the literature review, connections were made to manifest the Lean principles with established theory.

3.1.1 Data Collection

To be able to analyze the value stream in scope, qualitative data was first collected through document review of Standard Operational Procedures (SOPs). These were later challenged in the event when further data was collected through interviews and detailed discussions when creating the value stream. Each activity in the process was described, and Task time, Lead time, error rate and number of employees involved was estimated. Data from the Quality Department and Finance Department was used for verifying the estimated variables. Finally observation was performed, a physical walk-through of the value stream to verify that the detailed data obtained were correct and complete.

Suggestions for improvement were collected using post-it notes.

Each step in the Kaizen event was documented as presented in the next chapter, providing a detailed overview of how a Kaizen event should be conducted.

In addition, the Kaizen event was documented in detail and finalized with a complete Action List.

4.0 Design

The Kaizen Event takes the form of a Case Study using a qualitative descriptive research orientation. The group studied will consist of 8 participants and the conclusion drawn will only reflect this specific group in this specific setting and cannot be used for generalizations.

The event takes place in a natural setting and a holistic interpretation of the situation is required. A conclusion will be based on the complete case.

Multiple methods of data collection will be used to establish an in-depth knowledge of the case. The data collected will be qualitative.

5.0 Analysis

This chapter will present an overview of the findings in this study.

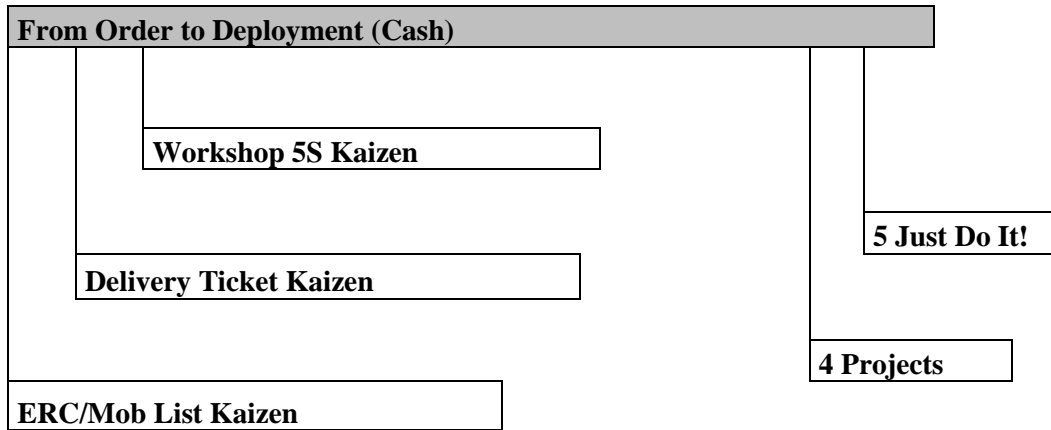


Figure 19 Kaizen Findings.

5.1 The Kaizen Approach

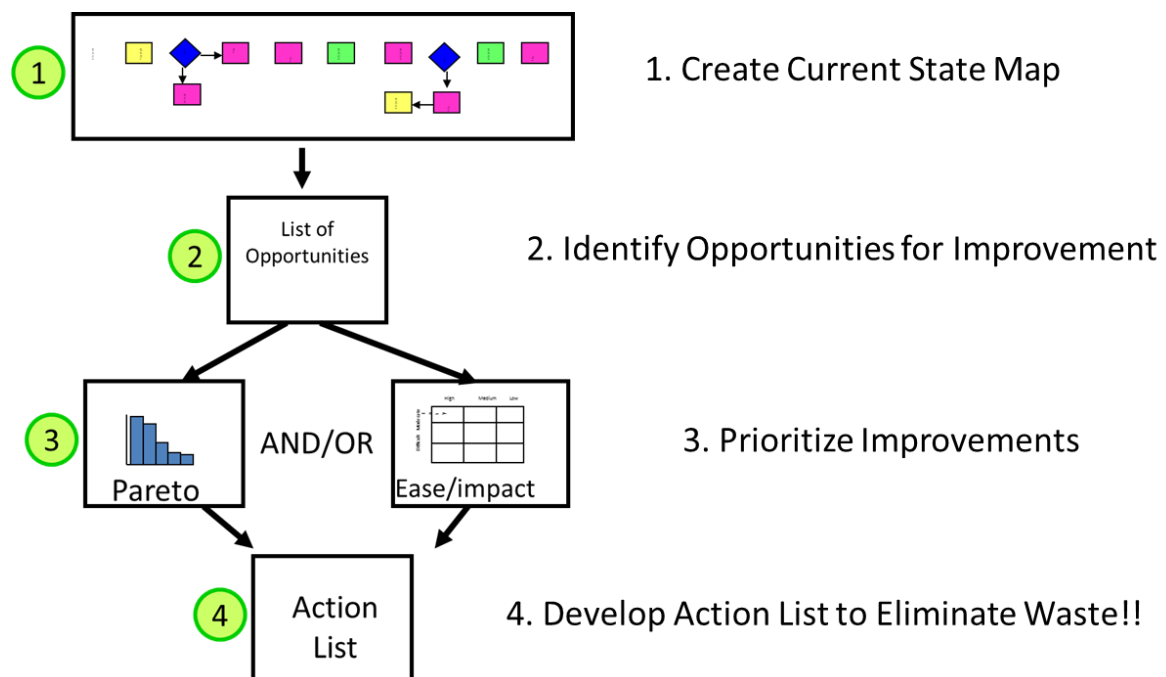


Figure 20 Kaizen Approach.

5.2 Kaizen Event: From Order to Deployment (Cash)

The Value Stream “From Order to Deployment (Cash)” was chosen for this first Kaizen event. Scope starting when receiving an order from a client, to the moment payment is received (Cash). The scope is holistic and the intention is to identify waste and errors in the value stream to improve the process.

Before the Kaizen Event

Why are we doing this event? We want to analyze the value stream to find opportunities for improvement. Main focus will be on reducing lead time between activities to save costs.

The team chosen to participate in this event is a representation of the process as a whole. Together the team will have complete information of each step in the value stream.

A professional facilitator was chosen to lead the event.

Executive Champion and Value Stream Owner are chosen from upper management and represents dedication from top level in the organization.

Introducing the Kaizen Event

This first step of the introduction is made by the facilitator with the team present in addition to representatives from upper management.

After presenting the scope for the event, objectives were discussed and defined.

Objectives: Reduce lead time and waste in the Value Stream.

Introducing the Lean philosophy and tools

The presentation made by the facilitator focused on basic tools and concepts from Lean, but did not address the philosophy or the holistic approach of Lean. The presentation was a combination of lecture and practical tasks that the team had to solve, illustrating the difference between traditional methods and Lean and challenging the team to think outside the box.

The following Lean concepts were included in the presentation:

- Waste definition and identification
- Value-Added versus Non-Value Added activities
- Value Stream Mapping
- 5S and Visual Management

- Continuous Flow
- Pull Inventory Management

5.3 Value Stream Map

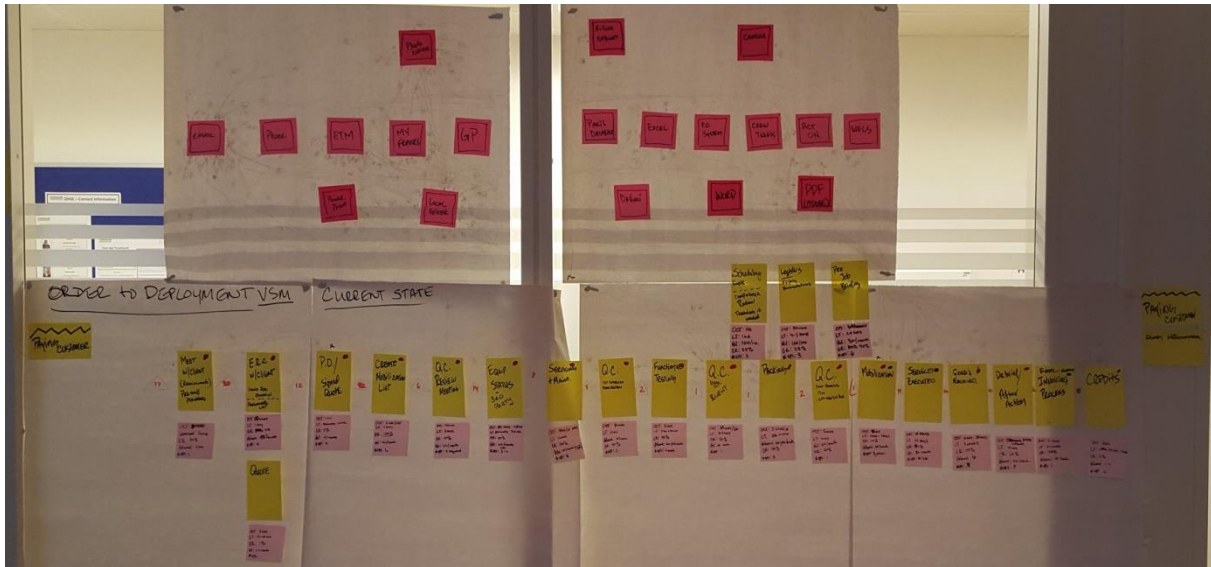


Figure 21 Value Stream Map.

After being introduced to the main Lean concepts, the team gathers to create the Value Stream Map for the scope chosen for the event: **From Order to Deployment (Cash)**. Each process is identified by a yellow post-it, while the pink shows the measurable variables for the activity: number of employees involved in the activity, task time (how long time it takes to perform the task), lead time (time spent waiting between each process) and finally the error rate for each process.

This was a challenging exercise for the team: each team member either had an accountable or responsible role in the value stream described, and being confronted with an estimate of lead time and error rate triggered heated discussions and frustration. The Root Cause Analysis was used in this process, helping the team to shift focus from blaming individuals for not doing a proper job, to discuss the process that allows defects to occur. This resulted in a much more productive discussion.

If the team did not agree on the measurable, the facilitator would cut through and force the team to make a decision.

When the value stream finally was completed, the team went through the process from start to finish verifying that all steps were included and that the value stream was complete. At the

same time a spaghetti chart was created visualizing all the communication points necessary to get from start to finish. The chart was an eye-opener to the team, illustrating both unnecessary communication and missing communication.

Creating the value stream made the team understand the complete process. Being confronted by the unpleasant truth of error rates and lead time triggered a feeling of responsibility and ownership. The team left the event that day being fully aware that things had to change for the better.

5.4 Waste Identification and Prioritization

The second day of the event was dedicated to waste identification and prioritization. With yesterday still fresh in mind, the team was eager to discuss possible improvements to the value stream.

First step was to categorize each activity as value adding or non-value adding. It took some time before the team understood the definition of a value adding activity: there has to be a transaction or creation, and the customer has to be willing to pay for the transaction or creation to happen.

Not much emphasis was made on Type One or Type Two Muda.

This value stream identified only two value adding activities of 22 in total, leaving 20 non-value adding activities to challenge.

5.4.1 Identification of Waste

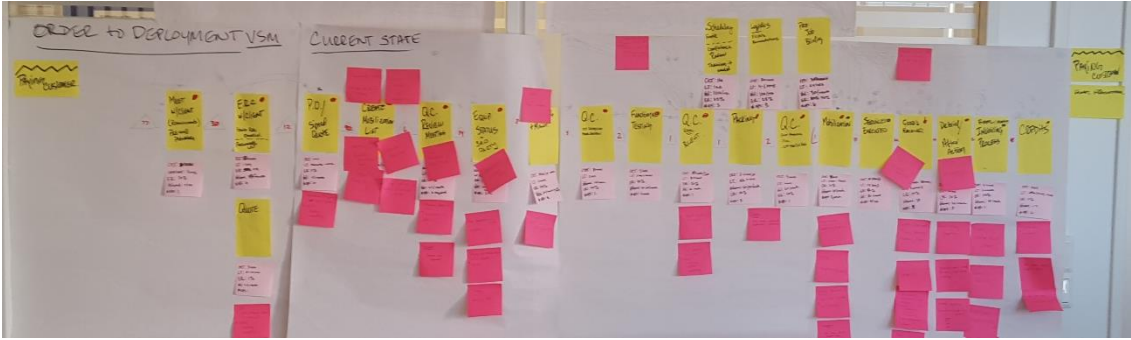


Figure 22 Waste Identification.

All team members were asked to come up with at least 3-4 suggestions for improvement written on dark pink post-it notes and stick the note where it belonged on the value stream. The team was given 10 minutes to complete this exercise, and it was immediately visible that the participants agreed where improvements had to be made. 44 wastes were identified in 21 categories,

5.4.2 Prioritization

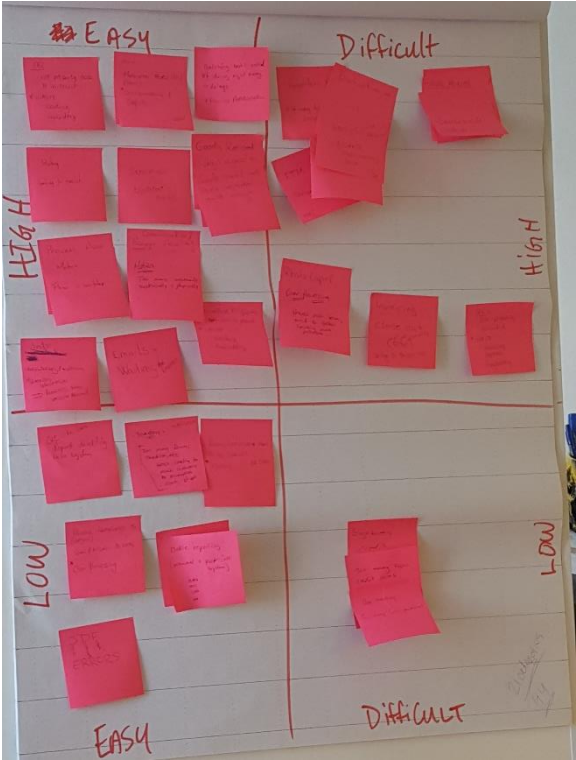


Figure 23 Ease Impact Model.

Each improvement suggestion was reviewed, discussed and prioritized collectively by the

team in an ease/impact model. Type of waste was identified on each suggestion, all relating to the seven wastes under Muda.

The two boxes at the top are filled with suggestions that will have a high impact to the organization if implemented. The boxes below were considered as low impact. The two boxes to the left will be easy to implement, while the boxes to the right will be hard.

High and easy: Just Do It! To be implemented straight away.

Low and easy: Just Do It!

High and difficult: Plan implementation. Can the improvement be implemented through a project? Or a new Kaizen event? Will we be dependent on input from external factors to implement the improvement suggestion?

Low and difficult: Forget it!

During this process, 14 tasks were identified.

5.5 Current State Opportunities

The creation of the value stream identified 22 processes required to get from order to invoice, while it took 17 steps to get from order to deployment (framed below).

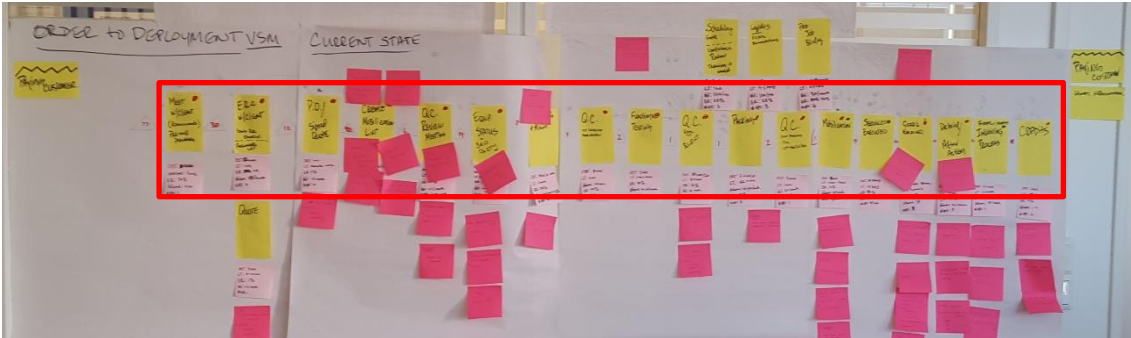


Figure 24 Oppertunities.

5.6 Main Findings

Quality Controls

From the 22 steps in the value stream, 4 were Quality Controls. The controls were set in place because errors had occurred, a typical example of treating the symptoms and not fixing the underlying problem(s). The Quality Controls are considered a non-value adding activity and a Type One Muda: It cannot be eliminated. Having several controls is considered Muda Type Two addressing waste defined as over-production, over-processing, inventory (building up waiting for QC) and waiting and should be eliminated. There was even a tendency to rely on QC picking up errors reducing the feeling of ownership and triggering errors.

This was considered a high impact action, easy to implement but complicated in nature: the root cause of errors had to be identified and handled before removing the excess Quality Controls.

High Impact and Difficult.

Lead time for invoicing

| | | | |
|-----------------|----------------------|--------------|-----------|
| Creation of ERC | Creation of Mob List | Mobilization | Invoicing |
|-----------------|----------------------|--------------|-----------|

The analysis identified that the lead time for creating one invoice could be up to 30 days. Explanations for this lead time could be found throughout the value stream:

The ERC (Equipment Recommendation Checklist) is created by the coordinators to the client to give an overview and a price for equipment recommended going offshore. The list only includes chargeable items. The document is used by Invoicing to control against invoice.

The Mob List is a document of all equipment going offshore: both chargeable and non-chargeable items. This list is created by coordinators to Workshop to mobilize the correct equipment.

The Delivery Ticket is a list of all equipment sent offshore, chargeable and non-chargeable. The list is created in the company's ERP system by Operation assistant and is the basis for creating the invoice.

The analysis identified both errors and long lead time for all three documents. During the creation of the value stream, it was revealed that the ERC and the Mob List was made in excel by each coordinator. The process was tedious and complicated and clearly open

for making errors.

This process identified several possibilities for improvement: Using the ERP system from ERC creation or maybe even from signature of contract would eliminate the manual excel process where each document was created individually. The ERC should be the basis for generating the Mob List from the system, and the Delivery Ticket should be generated from the Mob List. This would eliminate extra manual work for coordinators, Delivery Ticket creation for Operations assistant and control against ERC for invoicing.

The new process has to enforce correct information to avoid errors being generated from one list to another. The role of Operations assistant and Invoicing could be controlling rather than processing documents.

Improving this process will have a high impact to the value stream. It will also be hard to do as there are several considerations to take and depending on the possibilities in the ERP system.

High Impact and Difficult.

Hot load outs

50% of the load outs were categorized as “hot” load outs, meaning that Workshop had less than 4 days to prepare shipment. A consequence of this was overtime and high transport costs. Information collected during the event indicated both that Workshop was “fighting fire instead of planning” and that the coordinators waited to the last minute before communicating with Workshop.

Reducing hot load outs would have a direct financial benefit in reducing both transport cost and overtime. At the same time there are indications that this issue can be solved through the bigger issues described above.

5.7 Action Plan

The suggestions for improvement manifested into the following Action Plan:

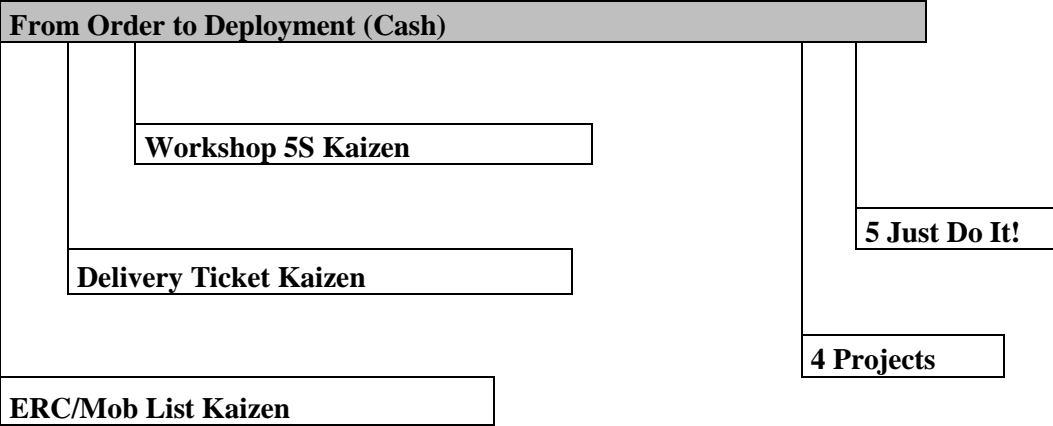


Figure 25 Action Plan.

The excess Quality Controls and the errors and long lead time related to ERC, Mob List and Delivery Ticket will be approached through two Kaizen Events:
ERC/Mob List Kaizen scope: From (Contract) ERC to Mob List delivered to Workshop.
Delivery Ticket Kaizen scope: From equipment arrives at yard to equipment is received and reconciled in the ERP system.

The Hot load outs will be approached through a 5S Workshop Kaizen:

Workshop 5S Kaizen scope: From equipment checked-in to equipment packed in container.

In addition to these actions, 5 Just Do It and 4 Projects were identified and included in an Action Plan describing the following items:

Action Step: Kaizen Event/Project/Just Do It!

Expected benefits: Reduced errors/Reduced lead time/Reduced task time/Increased quality etc.

Action Owner: Responsible for executing the action.

Action date: Date of completion.

The list will be followed-up on a weekly basis documenting progress until all actions have been completed.

5.8 Future State

A new Value Stream Map was created showing the future state after all actions has been completed.

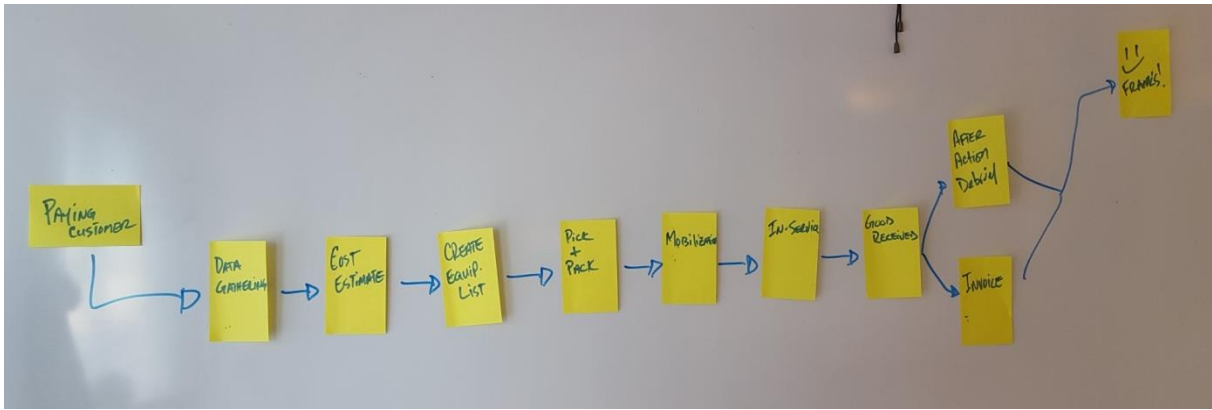


Figure 26 Future State VSM.

The value stream has been reduced from 22 processes to 9.

5.8 1 RACI Model

A RACI model was completed to establish the different roles in the Future Value Stream: Identification of who is **Responsible**, who is **Accountable**, who is **Consulted** and who should be **Informed**.

| | | Processes | | | | | | | | |
|-------|---------------------------|----------------|---------------|----------------|---------------|----------|------------|----------------|---------|----------------------|
| | | Data Gathering | Cost Estimate | Equipment List | Pick and Pack | Mobilize | In-Service | Goods Received | Invoice | After Action Debrief |
| ROLES | Rig Coordinator | R | R | R | I, C | I, C | I, C, R | I, C | C, I | R |
| | Operations Manager | C, I | I | C | C, I | I | I, C | I | | I |
| | Country Manager | | C | | | | I | | I, C | |
| | Workshop Supervisor | | | I | C, I | A | | A | | I |
| | Operations Logistics | | | | I | R | | I, C, R | | |
| | Finance | | C | | | I | | I | R | |
| | QHSE | | | C | C | | I, C | | | I |
| | Operations Supervisor | A, I | A | A | I | I | I, C | I | | A |
| | FSS | C | | C | C | I | A, R | I | | C |
| | Operations Engineer | C | | I | | | I, C | | | I, C |
| | Technical Manager | | | C | | | I, C | | | I |
| | Purchaser | | | C | R | | | I, R | | |
| | Materials and Log. Coord. | | | | R | C | | C | | |
| | Asst. Workshop Sup. | | | | A | C | | R | | |
| | Finance Manager | | | | | | | | A | |
| | Personnel Coordinator | | | | R | R | I | R, I | | R |

Figure 27 RACI model.

5.9 Presentation and Lessons Learned

The evening before the last day, the team was asked to think of lessons learned through the Kaizen Event. The lessons learned will be reported to management and be a part of the Kaizen Event documentation.

The last day is dedicated to presentation.

A Power Point has been prepared by the facilitator, describing all steps in the event:

- Problem definition
- The team
- Scope, objectives and goals
- The Kaizen Approach
- The Current State Value Stream Map
- Waste Identification and Prioritization
- Current State Opportunities
- Action Plan
- Presentation of the 3 Kaizen Events identified
- Future State
- RACI model
- Expected results
- Lessons Learned
- Questions

Each team member was given 1-3 slides to present and 10 minutes to rehearse. This resulted in intense studying for 10 minutes before presentation and no possibilities of being a passive participant in the process!

The lessons learned were personally presented by each team member.

After completing the presentation to management, the event continues to exist until all tasks are completed.

6.0 Discussion

The analysis presents a detailed description of the Kaizen Event, and suggests possibilities of improvement and actions to take.

In the following, findings will be related to the problem statement and research questions.

The results presented cannot be used to explain implementation of Lean in general. This thesis only offers a detailed description of the event conducted and the effects observed the following 4 months after the event.

6.1 Problem Statement

This case study aimed to explore whether the Kaizen event is an effective method of improving processes in the company.

Each research question has been discussed below.

Did the event identify the relevant errors and opportunities without sacrificing quality?

Creating the Value Stream was one of the most challenging parts of the event and probably also the most important source of information for the team. The exercise was unpleasant, revealing errors and long lead time between the processes. It became clear that there was no flow throughout the process and batching work contributed negatively to the lead time. The facilitator held an important role in this process, managing the team to search for root causes instead of blaming each other. He also demanded measures for lead time, task time and error rate for all activities. For some activities this was almost impossible to and an estimate had to be registered. During this intense process, the team developed an understanding of the complete picture and how errors and delays from one step could have huge negative impact in the next. What started out as a chaotic picture of a process resulted in a detailed overview of the complete value stream. Team members could no longer hide behind an unclear process as all connections became visible. This resulted to increased dedication from the team, understanding that changes was necessary and would benefit everyone.

Illustrating all communication points from start to finish was also very educational for the team. Most of the Just Do It actions came from this spaghetti chart, revealing unnecessary communication lines that immediately could be eliminated. Understanding how time consuming unnecessary information is made the team more aware of who should be included in the different stages and a discussion established some ground rules for future

communication.

The extensive and in-depth information collected in this process established a foundation for further investigation.

The process of suggesting improvements was chaotic: 10 minutes to come up with the correct suggestions did not feel like enough time. The outcome of the exercise surprised the team: Collectively the team seemed to highlight all important issues and there was a high consistency among the suggestions indicating that the team had reached a common understanding of the process and the challenges.

The Ease/Impact model was an effective way of attacking the improvement suggestions: the 44 suggestions placed on the value stream gave a chaotic impression and seemed impossible to solve. The prioritization of the suggestions again reflected a high level of agreement among team members, and when the Ease/impact model was completed the chaotic impression had changed to manageable. The prioritization helped the team understand how the suggestions could be approached.

Will Kaizen provide the correct actions?

The event started with creating the value stream map, continued with identifying errors and opportunities and generated an action plan based on these findings.

The future state value stream map indicates that the actions identified will remove waste and improve the process in terms of reduced need for recourses.

Will the implemented actions reduce errors?

The actions identified in the event ranged from simple Just Do It's to more complicated tasks that would require assistance from other parties. The team managed to clearly define what the errors were. To verify if the actions actually helped reduce the errors cannot be measured until all actions have been implemented, and the study can therefore not give a clear answer to this research question.

Will Kaizen contribute to a culture of continuous improvement?

One of the elements highlighted in the theory is what it takes to successfully implement Lean to the organization. The approach should be holistic: the philosophy and background should be understood before the different tools were implemented. (Liker, 2004).

The Kaizen event was done in 4 days and the Lean presentation only referenced tools and concepts. No information was given of the holistic approach necessary to fully understand the tools.

During the Lean presentation, the facilitator gave the team four different exercises to complete. Each exercise had a surprising twist used to illustrate the superior position of Lean compared to traditional approaches. This method gave a lasting impression on the team and was referenced a number of times during the event.

There is no doubt that a deep understanding of Lean will be an advantage in a Kaizen event. But the findings from this study indicate that the exercises served as a quicker alternative to an in-depth presentation of Lean. It also triggered an interest in Lean, motivating team members to educate themselves.

Another element highlighted in Lean literature, is the importance of upper management involvement. This was very visible in this case study. Upper management from Houston was present the whole week, getting updates from the progress in the event on a daily basis. This involvement increased the commitment from the team: both because there was an element of being observed and evaluated, but it also created a validation to the process and the method that manifested in the team and has increased after the event. The knowledge that Lean is a prioritized method gives validation to continue suggesting improvements in the future.

Improvement involves change.

Theory tells us that people need time to adjust to a change going through different stages of adaption, illustrated by the Kübler-Ross model below. (Kotter, 2012).



Figure 28 Kübler-Ross model.

The essence behind Lean and Kaizen is the continuous search for improvement. Is it possible to create a culture of continuous improvement as described in the literature? And how can the members of the organization overcome the resistance to change?

The Kaizen event possesses the Lean approach of a bottom-up organization. The changes are not implemented from management; they are suggested and implemented from the operational side, from the workshop, from the people participating in the actual processes.

The observations made throughout the case study suggest that there are some key factors that can be crucial to the end result. Using a professional facilitator who had been through this process numerous times before could explain some of the positive effects.

Building a local Lean expert team to ensure continuous focus on improvement might be necessary.

7.0 Conclusion

Continuous improvement is a concept all companies would want to understand and implement, and most firms work actively towards improving their operational processes to stay competitive.

This case study set out to explore if a Kaizen event would be an effective way of improving processes in the company, further with the following research questions:

1. Will the Kaizen Event contribute to identify relevant errors and opportunities in the value stream, making the organization more effective without sacrificing quality?
2. Will Kaizen provide the correct actions for issues identified during the event?
3. Will the implemented solutions reduce errors?
4. Will Kaizen contribute to a culture of continuous improvement?

The Kaizen event proved to be an effective way of identifying errors and opportunities in the value stream. The visibility of upper management resulted in a committed approach to the event, knowing that daily updates of the progress would be reported. The short time frame to certain exercises felt rushed but proved to be very effective. Choosing a team that can represent the whole value stream seemed to be important to effectively run the event.

Sacrificing quality was never an issue. There was a complete understanding throughout the team that quality comes first.

The 14 actions identified through the Kaizen included 3 new Kaizen event that has been completed during the last 4 months. The general impression is that the actions identified have been relevant and important.

Reduction of errors is hard to estimate at this moment. We have seen a reduction in errors but this is likely to be influenced by the decreased activity in the offshore market. Some of the actions related to ERC and Mob List creation is still in process, and it is believed that this will have a huge impact on reducing errors and waste along the value stream.

The future state value stream map is a clear indication that the relevant errors and opportunities had been addressed in the event.

Finally, has the Kaizen event contributed to a culture of continuous improvement?

Participating in this event, spending only four days and being able to make significant

changes to the process establishes a trust in the method.

The three Kaizen events manifested in this case study were all process analysis. During these Kaizen events, Standard Operational Procedures were created, Workshop layout was changed to suit 5S and new processes were created. A new set of vocabulary and a new mindset has been introduced to the company and it has been taken into use through these events.

There are indications that the event managed to increase the awareness for improvements. But as described in theory, the long-term success is dependent on a continuous focus. This thesis can only reflect on the 4 months from the event took place and to today. The contribution to a culture of continuous improvement is visible but for how long is not known.

7.1 Implications for further research

The essence of Kaizen is continuous improvement. The question is if the company is able to continue the improvement process without the assistance of a facilitator.

Further research should be conducted to study the long-term effect of the Kaizen approach, and if the concepts and tools established in the company will be enough to continue to improve

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