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# Implementing Lean Best practices in an automotive component parts manufacturing company

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# Executive Summary

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Flextech Manufacturing (Pty) Ltd manufactures Control Cables and Rear View Mirrors for the local as well as global automotive industries. The company, situated in Pretoria Gauteng is also known for its manufacturing of tools and the production of plastic mouldings.

The aim of this project is to investigate the lean tools available, select the best suited approach to develop a waste reduction priorities in a specific area in Flextech.

Constraints were identified based on an investigation of the environment of Flextech through structured discussions with management, constraints were identified. The Front Park Brake Cable production line of Ford South Africa was chosen for this project to implement Lean thinking tools. The Front PKB can be better described as the framework of the new Ford Ranger's hand brake.

Gaps in the Front PKB process were identified using engineering techniques and lean tools such as Value stream mapping. Each of these identified problems was analysed in detail. Solutions or improvements were developed.

The brazing area was seen as the key problem where the proposed lean implementation road map could be used. The problem was thoroughly analysed by investigating the current situation at Flextech. The goal was established as improving the throughput at the Brazing area for the Front PKB Brackets, meeting daily requirements of 600 brazed brackets per day using only the day shifts.

Countermeasures identified improved the Brazing layout and provided visual target boards for each individual operator. Changing the layout resulted in improving the continuous flow of the material as well as eliminating double handling of the material. The target boards motivated the operators to achieve their requirement of 38 brazed brackets per hour.

A Gantt chart was prepared to show the steps of a Lean Road Map implementation improvement plan for the brazing area. This Lean Road Map will be used as a foundation of improving other problems in Flextech. The follow up plan, according to the Gantt chart as steps 10-14, will be completed during October 2012 to mid-December 2012.

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# Chapter 1 Introduction to the problem

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## 1.1 Background

### 1.1.1 Flextech Manufacturing (Pty) Ltd

Flextech Manufacturing (Pty) Ltd is a South African company situated in Pretoria, Gauteng Province. Flextech are suppliers of Control Cables and Rear View Mirrors for the local as well as global markets. Their customers include Ford Motor Company (FMCSA), Toyota (TSAM), Nissan (NSA), Daimler Chrysler (DCSA), General Motors (GMSA) and Volkswagen (VWSA). Flextech has global leading partners and Technical Agreements with Hi-Lex Corporation in Japan, Thai Steel Cables Public Company in Thailand and FICOSA International of Spain.

Flextech is qualified with the following Quality Management Standards: ISO/TS 16949 and ISO 14001. Flextech was accredited by Ford Motor Company with a “Q1 Rating” in 2006.

Flextech currently manufactures approximately 780 000 assemblies of cables per year and is still growing. The manufacturing of cables include: accelerator cables, boot lid cables, heat control cables, fuel lid lock control cables, seat cables, clutch cables, parking brake cable, door cables, window winder regulator cables and hood opening(manual and electronic) cables.

Flextech is also known for its manufacturing of tools and the production of plastic moulding. Constant communication with customers takes place while producing plastic moulds. This ensures that Flextech keeps their customers happy by producing and delivering the needs and demands as required by the customer. This division of Flextech has designed and produced many manufacturing tools over a variety of industrial fields. This equipment includes: Cadcam packages, four 3D machining centres, two conventional spark eroders, four conventional milling machines, two surface grinders, six axis machining centres, three CNC Lathes and one conventional lathe. The tool manufacturing division has a capability ranging from medium sized tooling, sheet metal progression tooling, plastic injection, high pressured die cast moulds and tool designing.

Figure 1: Flextech's plastic products (<http://www.flextech.co.za/products/plastics/>)



Flextech is the one of two companies in South Africa that has a technical agreement with FICOSA, a licensed international market leader in the manufacturing and assembling of rear view mirrors. They are also currently the supplier of VW Polo and Vivo's exterior rear view mirrors.

### 1.1.2 Lean Manufacturing and Lean thinking tools

"Lean Manufacturing is an operational strategy oriented toward achieving the shortest possible cycle time by eliminating waste. It is derived from the Toyota Production System and its key thrust is to increase the value-added work by eliminating waste and reducing incidental work. The technique often decreases the time between a customer order and shipment, and it is designed to radically improve profitability, customer satisfaction, throughput time, and employee morale". (Rockford consulting group, 1999)

Although there are many initiating instances, starting from the 1450's, of process thinking in manufacturing, Henry Ford was the first to create an entire integrated production process in 1913. This was a truly radical break from the shop practices of the American System where parts, after a few changes, were finished products in subassemblies and final assemblies. Problems started occurring when the production flow was not designed for variety and the market started to demand it.

Kiichiro Toyoda, Taiichi Ohno and others, redesigned the process so that continuous flow and wide variety of products could be provided. This is where the Toyota Production System started and so Toyota is still viewed as the greatest and leading Lean thinking implementation company.



## 1.2 Problem Statement

### 1.2.1 Flextech and Lean thinking/manufacturing

Lean Thinking is a tool that, when implemented correctly, can offer competitive advantages in any manufacturing companies. Lean can be used to provide high quality products in a shorter cycle time with high volumes of manufacturing.

The leading lean paradigm of Toyota is on the edge of becoming the largest automaker in the world in terms of overall sales. The strongest proof of the power of the lean enterprise is looking at Toyota's overriding achievement from increasing sales and market shares in every global market to a clear lead in hybrid technology.

Three wastes are available as defined by Toyota, which are Muri, Mura and Muda.

Muri, meaning overloaded, is the unreasonable amount or type of work that is given by management to workers or machines. This can be dangerous working tasks, heavy weight carrying or working too fast for the pace that the workers can handle. Muri is also seen as pushing and overworking employees beyond their limits.

Mura, meaning unevenness and variation, is all due to human error. Examples may include assembly line problems and scheduling conflicts.

Muda, meaning eliminating wastes, is divided into seven types of wastes namely; overproduction, waiting, transporting, inappropriate processing, unnecessary inventory, unnecessary/ excess motion and defects.

Although Flextech is a leading automotive manufacturing company, its operational efficiencies related to resource utilisation and material flow can still be improved. Over-processing and over producing the products is only some of the problems that can be eliminated by using Lean thinking tools, such as the Seven Wastes and Value Stream Mapping.

The waiting times in production and from one station to the next is sometimes extremely high and varies on a daily basis. A lot of time is wasted on inefficient motion in production, as well as transporting the unfinished product from one station to another. Defects are one of Flextech's major problems in wasting time, material, labour and money.

### **1.3 Project Aim and scope**

The aim of the project will be to investigate Lean best practices, to analyse and discover waste reduction priorities in Flextech and to reduce the non-value added waste area in using lean manufacturing tools.

### **1.4 Deliverables**

The key deliverables of the project will mainly be:

- Defining Lean thinking by considering the different tools used, strategies implemented, theory versus practice and philosophies.
- The Seven Wastes best practices as well as implementing challenges.
- Implementing Seven Wastes approach into Flextech, by drawing up a value stream map of the company and identifying gaps as well as key wastes to eliminate.
- Designing a Lean Road Map plan to implement in Flextech that includes how to eliminate wastes in manufacturing.

### **1.5 Project Approach**

#### **1.5.1 Activities and tasks that will be done which will form part of this project are:**

- a) Identify problem and root causes in Flextech.
- b) Analysing the processes of Flextech.
- c) Investigating the seven wastes of Lean thinking and how it can be identified.
- d) Finding buffers in processes.
- e) Identifying regular problems in products.

## 1.6 Organization of the Report

The aim of the research report is to find all possible waste problems in Flextech and so to eliminate the most important wastes for future customer satisfaction. The report starts by reviewing applicable literature which is followed by useful methods that are used and analysis that are conducted with the goal of transforming the Company's data into valuable information that will contribute to achieving the project's aim.

The research report consists of:

- Chapter 1 presents an introduction and background of the project as well as the background of the company. It shows the problem statement, the aim of the project, which in order is to achieve the elimination of the wastes and the scope within which the project will be conducted.
- Chapter 2 investigates the best practices of Lean manufacturing and the tools that are applicable to the problem stated in Chapter 1.
- Chapter 3 describes the environment of Flextech's Front Park Brake Cable ,the problem area chosen for the project,. The constraints identified before any Lean thinking tools were implemented by evaluating structured .
- Chapter 4 shows the lean thinking tool, the Value stream map of the Front Park Brake Cable, which can be seen as the current process flow. The gaps are then identified, analysed and improved.
- Chapter 5 describes the Kaizen process which will be used as a basis of determining shows the improvement plan in the form of a Gantt chart
- Chapter 6 shows all the conclusions and recommendations for the project.

# Chapter 2 Lean Best Practices

## 2.1 Comparisons of different programs

Different methods are available in the industry to achieve continuous improvement. Comparing these different programs can indicate and show clarity on why Lean thinking will suit Flextech better than six sigma or TOC. By looking at Nave, 2002, comparison in Table 1, the following programs will be discussed in detail.

**Table 1: Comparing Six Sigma, Lean Thinking and TOC**

| Program                | Six Sigma   | Lean thinking   | Theory of Constraints   |
|------------------------|---|---|---|
| Theory                 | Reduce Variation  | Remove Waste  | Manage Constraints  |
| Application guidelines | 1. Define   | 1. Identify Value   | 1. Identify Constraint  |
|                        | 2. Measure  | 2. Identify value stream  | 2. Exploit Constraint   |
|                        | 3. Analyze  | 3. Flow   | 3. Subordinate processes  |
|                        | 4. Improve  | 4. Pull   | 4. Elevate Constraint   |
|                        | 5. Control  | 5. Perfection   | 5. Repeat Cycle   |
| Focus                  | Problem focused   | Flow focused  | Systems constraints   |
| Assumptions            | A problem exists<br>Figures and numbers are valued<br>System output improves if variation in all processes is reduced | Waste removal will improve business performance<br>Many small improvements are better than systems analysis                             | Emphasis on speed and volume<br>Uses existing systems<br>Process interdependence                                    |
| Primary Effect         | Uniform Process output  | Reduced flow time   | Fast throughput   |
| Secondary effects      | Less waste<br>Fast Throughput<br>Less inventory<br>Fluctuation-performance measures for managers<br>Improved quality  | Less Variation Uniform output<br>Less inventory<br>New accounting system.<br>Flow-performance measure for managers.<br>Improved quality | Less inventory/waste<br>Throughput cost accounting<br>Throughput-performance measurement system<br>Improved quality |
| Criticisms             | System interaction not considered<br>Processes improved independently   | Statistical or system analysis not valued   | Minimal worker input<br>Date analysis not valued  |

According to Nave, 2002

### 2.1.1 Six sigma

Most elements covered in the six sigma program are those that constrain the flow of a process. Dave Nave says, that the improvements that can be made according to his study are reduced variation, better quality and improvement in the volume of the process output. The problems of using six sigma are usually that it is a very costly program to use. This methodology are implemented by using application guidelines called DMAIC; Define, Measure, Analyse, Improve and Control.

- Define: know what exactly is required by querying the customers and getting the key problems and the key characteristics. This is where you can define the process of what exactly needs to be done.
- Measure: categorizing the key characteristics into main focus points. This is where the necessary data is collected.
- Analyse: the data gets analysed in such manner that it can make sense to the process that was defined and get better insight on the process. These data usually includes the most important causes of problems or defects.
- Improve: Develop new solutions and new ways to improve the process.
- Measurements: used to see the results given by the improvements.
- Control: the sustaining step in six sigma. Keeping the process under control so that no unfamiliar and unexpected changes can happen.

### 2.1.2 Lean Thinking/manufacturing

The main focus of Lean is to remove waste. This includes any activity not adding value to the process. Lean is used to improve the time spend in the process and to reduce damages. This simplifies the process and at the end reduces variation. Lean creates improved performance through identifying the constraint of the process using value stream mapping. Lean has five steps defined by Dave Nave, 2002:

1. Identify the features that will create value. Value can be seen as the standpoint of the customers' needs and wants, including price and specific time.
2. Identify the sequence of activities called value stream. Value stream is the specific sequence that entities enter in a process. This is used to identify where there are entities involved that is not necessary or takes up too much time, which will be identified as wastes.

3. Make the activities flow. Flow can be defined as the continuous movement of the whole process, including the end user service. According to the study of Dave Nave the major buffers identified of an entire flow process are; queuing, batch processing and transportation. Buffers also tie up finances that usually can be used elsewhere in the process or business.
4. Allow customer pull product or service through the process. This is where the customers 'demand and specifications come into play with responsiveness, by giving the customer when and what is needed exactly on the time they want.
5. Work towards perfecting the process. A continuous process is needed to improve and perfect the process flow. This is done by constantly eliminating unwanted wastes seen as non-value added processes.

### **2.1.3 TOC/ (Theory of Constraint)**

TOC focusses on the improvement of interdependent processes. The system contains groups of interdependent links which together creates a chain. The problem in the chain is called the constraint. This is seen as the weakest link which can interfere in the performance. The main success determinants in a TOC system are the speed and volume.

TOC consists of five steps:

1. Identifying the constraints where possible.
2. Exploit the constraints, by improving the process without major expensive upgrades or changes.
3. Subordinate other processes to the constraint, because the speed of the constraint determines the pace of the other sub processes.
4. Elevate the constraint if the outcome of the previous improvement in the chain is not satisfactory. This will sometimes involve major expenditures.
5. Repeat the cycle, as the next constraint will take place when the previous one was solved.

### **2.1.4 Implications for Flextech**

By identifying the main theory of the three programs, the effect each one will have on a company when implemented correctly and showing the results of each program , the best possible method was chosen for Flextech.

First the following had to be identified;

Comparing the three methods, as described above, the main theory of each program, can be shortly described as:

- Six sigma: Variation reduction
- Lean: Waste reduction
- TOC: Constraint reduction.

Identifying the relationship and the techniques of these programs, the main effect that each program will have when implemented correctly in Flextech can be defined as:

- Six sigma: If the main focus is on reducing variation in the industry, then a successful implementation of six sigma will result in a more uniform process.
- Lean: If the focus is on waste removal, flow time of the processes in an industry will be improved.
- TOC: If the emphasis is on reducing constraints, then the improvements will mainly be on throughput volume.

After the main theory of each program has been developed and the effects of each one are revealed, the subordinate properties (the results) that each program will provide in a process are the following:

- Six sigma: Reduced waste, throughput time and inventory levels.
- Lean thinking: Less variation, a uniform output and reduced inventory.
- TOC: Results in fewer inventories and a different accounting system.

All of these methods/ programs can be successfully implemented in Flextech, but to narrow the programs down to what will be the best fit in the company, each program can be defined as in what company the program will be the best fit and not vice versa.

- Six sigma: Is suitable in an organisation that values the association of data, chart analysis as well as analytical studies.
- Lean: Is best suited for an organisation who wants to see (visually) the results as the change takes place.
- TOC: Is best suited for the organisation that requires a system approach with little employee participation and where the separation between worker and management is compulsory.

## 2.2 Lean Manufacturing

Flextech will need to follow lean manufacturing. Flextech is a very deadline driven company that wants to visually see the results. Lean thinking will result in the best possible program for continuous improvement and immediate effects.

Lean manufacturing is seen as the method that involves different ways of thinking and not always just focussing on the costs or cutting the company's floor space, but rather concentrating on reducing waste as to add value to a process and so quality. Dr Bijay Nayak (n,d) describes lean management and value management to be both cost reduction and continuous improvement techniques for businesses. The techniques are initiated in teamwork, waste elimination and value added processes. Lean incorporates communication, teamwork, efficiency of using resources, waste-elimination and continuous improvement.

### 2.2.1 Overview of Lean

It is said, that to compete in the next decade's manufacturing contenders, the focus of the organization must be emphasized on moving products and information as fast as possible through the company's entire supply chain. All logical and physical procedures in the supply chain must be performed accurately and effectively. This forms part of the cycle starting at, the faster your company moves information, parts and decisions through the organization, the faster and more effectively responding can happen to satisfy customers' needs.

It was the Japanese, Toyota, who discovered Lean manufacturing. In fundamental nature, Toyota saw defects as waste and started by putting methods in place to prevent the same defects from happening again. This was done rather than using inspection techniques to discover the defects only at the end of some process. Similarly, they saw over-production as a waste, and focused mainly on reducing process set-up times, so that they could at the end economically produce smaller quantities of products efficiently that at the same time goes with actual customer demand (Hayes et al, 1984, Skinner, 1974).

"Womack describes Lean production as a structure that uses less, in terms of all inputs, to create outputs similar to those of traditional mass production systems, while offering increased choices for the final consumer." (G. Bergmiller, 2006).

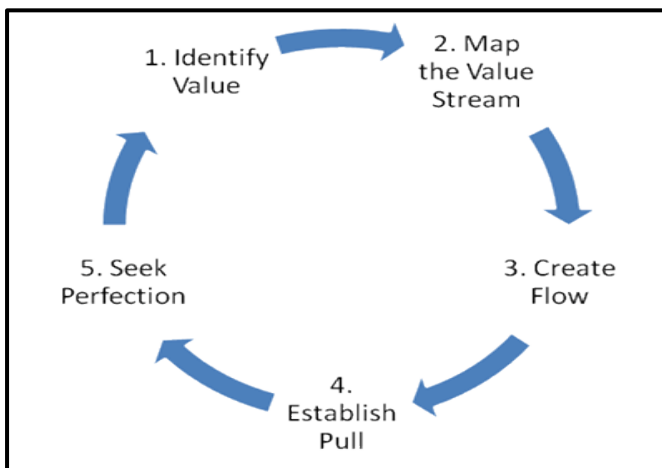


### 2.2.2 Key concepts

Key concepts and characteristics of Lean manufacturing are very easy to become familiar with but quite a challenge to implement. Five principles to implement Lean are identified in Figure 2 which can be described as:

1. Identify the Value: specify the value that the customer wants as the final product.
2. Map the value stream: Identify all the steps and process needed to get to the final product, by eliminating all non-value added processes.
3. Create Flow: Using the value stream map, create continuous flow so that the process can run smoothly.
4. Establish Pull: Customers pull value from the next upstream activity.
5. Seek perfection: redo the whole process until perfection is reached with no waste, continuous flow and high quality products.

Figure 2: Lean Process



According to: [www.lean.org](http://www.lean.org)

### 2.2.3 Techniques and methods

By implementing these characteristics and designing the best solution possible to fit the company's needs, the key techniques usually used, are implemented in such a way as to provide a good growth foundation and continuous improvement over a period of time. The key concepts are explained as follows:

a) 5S

“A Visual system and a system for engaging employees. 5S must be a team effort and the results must enable anyone to "tell at a glance" what is right and what is out of place. It also must make doing the work easier. Implementing 5S occurs in two phases: initial implementation and later refinement.”(Mike Bresko, 2009)

As seen, in Table 2, 5S consists of: Sorting, Simplifying, Systematic Cleaning, Standardizing and Sustaining.

Sorting: Organising workstation by workstation to improve flow.

Simplifying: Making sure all the things needed are supplied and in place.

Systematic cleaning: Those materials that are not needed are disposed of.

Standardizing: The things needed on the line must be brought to the line. Pictures and working instructions are used.

**Table 2: 5S Definitions of Japanese terms**

| Japanese Term   | Description   | English Translations            |
|-----------------|---|---------------------------------|
| <b>Seiri</b>    | Eliminate all items not immediately required in the work area.              | Sort, sift, separate            |
| <b>Seiton</b>   | Efficient placement & arrangement of equipment and materials.               | Set, set in order, set in place |
| <b>Seiso</b>    | Maintain clean & tidy workplace.  | Sanitize, sweep                 |
| <b>Seiketsu</b> | Develop & maintain standards for housekeeping.                              | Standardize                     |
| <b>Shitsuke</b> | Establish the discipline & leadership for area maintenance and improvement. | Sustain                         |

Source: <http://www.nwlean.net/sponsors.htm>

b) KAIZEN

Kaizen is a continuous process created to solve a particular workflow problem. It documents and identifies the present state for the starting point, thinking out of the box to create new ideas and to solve problems or to improve stations. These improvements or new ideas are tested and evaluated by deciding if it will actually improve the current flow.

The best idea then gets implemented; necessary training starts to sustain this improvement. Kaizen refers to any progress, done once or on a continuous process, large or small. According to best practices in McDermott International, Kaizen is an everyday activity, with the main purpose of which goes further than simple productivity upgrading. Employees or employers at any level of the business can participate in kaizen, from the CEO down to the operators on the floor, as well as external stakeholders when applicable.

Quick changeover or SMED (single minute exchange of die) is used to reduce the time and amount of steps it usually takes to perform each manufacturing process. This is usually done by eliminating or looking at processes that can take place simultaneously and those steps that can be completed while the machinery is down. (Mike Bresko, 2009)

c) VSM(Value Stream Mapping)

“Value is defined by the customer and is the goods and/or services that the customer pays for. Anything that does not directly contribute to the creation of value is considered waste in the Lean philosophy. This concept of value to the Lean manufacturing system is akin to quality in the Total Quality Management system whereby quality and value are ultimately defined by the customer.”(G. Bergmiller, 2006).

The main focus is to add value at every step in the process by eliminating all non-value added processes or time. If non value added process is in the flow, it needs to be either eliminated or tried to be improved. Insert cycle time, waiting time, inventory levels, operators and other important aspects of the process needed. The mapping is used as a starting point to show where continuous flow can be improved and seen. This is called a future state of the value stream mapping where all the new improvements or problems are allocated and can be eliminated to improve the continuous flow by using other lean techniques. The future state is seen as the goal (Mike Bresko, 2009)

Value Stream Mapping is a material and information flow representation of all the processes in the organisation. This method shows you where Lean techniques can be implemented and where to implement the tool for maximum effect. Mapping the process, as it is known, helps to avoid common mistakes and human errors.

d) Seven Wastes:

Three forms of wastes exist;

Muda- Eliminating non value added tasks.

Mura- Eliminating inconsistency of a process.

Muri- Eliminating excess strain and stress.

Muda is then further broken down into the famously known Toyota production system, the seven wastes. These seven wastes are defined and briefly explained:

Waiting: Time that is wasted due to parts that are not moving. Waiting is seen as a waste due to the fact that parts are never supposed to wait to undergo the next transformation phase. This happens due to long production runs, unnecessary travel distances and poor material flow.

Waiting usually happens when processes in production are not balanced. If machines and operators need to wait either for a previous process to bring the material (starved) or for an on-going operation to receive material (blocking), then the production lines are not producing value. Machines that are idling or waiting to manufacture, still consume energy, water and create dangerous and green house emission.

Transporting: Moving of products from one location to another. Transportation is classified as a waste due to the fact that it adds no value to the product. Process flows are mapped incorrectly that causes unnecessary movements which result in damaged or lost goods that lead to a waste of money. Although this waste is easy to identify, it is a difficult procedure to eliminate. Mapping the transportation of each individual product, will give a clearer view of what can be seen as unnecessary or transportation that can be eliminated to reduce time as well as costs.

Unnecessary Inventory: It is the waste of having too much inventory on the floor of your company when production is taking place. It usually also covers up other wastes and can lead to amplified lead times, limited floor space and poor communication. Unnecessary inventory is the direct effect of wastes such as waiting and overproducing.

Inappropriate Processing: Using the wrong equipment or processes for a simple part. At times a worker will attempt to make a faultless part, surpassing the customer's requirement. While their

intentions are meant to be good, over-processing can direct to defects. A lot of companies use expensive overcomplicated equipment to produce simplicity. This can happen by using the wrong suppliers or using the wrong process to do a specific job. High precision equipment usually leads to over production of goods. An example of inappropriate processing can be seen as applying too much heat to a solder joint to make it perfect, beyond customer requirements, and burning up the electronic component in the process.

Unnecessary/excess motion: The waste that is caused by health and safety risks. It is often caused by a certain behaviour-based safety. Behaviour-based safety is not always linked to the employees' behaviour but can be the behaviour of the equipment and the way it is manufactured. This can lead to unnecessary stretching, bending, walking, lifting and reaching. It is based on poor ergonomics in the plant.

If unnecessary motion is used to move a product from one operation station to the next, either inventory will build up or the worker will use a great amount of time moving individual parts from one operation station to the next. Lean manufacturing works in such a manner that it minimizes excess motion so that a worker can assemble quality manufactured goods with the slightest amount of effort.

Defects: Defective parts causing major cost issues in the company. Defects are one of the most important wastes to eliminate in a manufacturing process. A small minor defect can cause massive impacts on your inventory, inspection, scheduling and greatly affect your bottom line of the manufacturing process. For example, defects cause over processing and production that would not have been necessary if the defect did not take place in the first place. Incidence of defects often slows down or stops the movement of an assembly line causing that other processes in the production line has to wait until the defect in the process is determined. Some companies divide this waste into two different wastes, namely defects and employees, so that more emphasis can be directed to this specific waste. These wastes can be directly pointed towards employing the wrong staff to do a skilled work related activity.

It has been brought to company's attention that by employing creative skilled workers, they can eliminate a whole bunch of the different wastes. The purpose is to eliminate all of these wastes, so that only value added processes will exist in the different types of manufacturing process.

Over production: Producing more than what is needed of a specific product or part. This happens when a manufacturing company produces products at a rate that is too high for customer needs and wants. This occurs due to undependable equipment, unreliable processes and high changeover times. Over production is seen as a waste due to the fact that it increases unnecessary costs for the company as well as lowers the quality with its long storage time on the shelf.

#### 2.2.4 Disadvantages

Although Lean manufacturing has a lot of key concepts that can improve a small to medium-sized manufacturing company, the disadvantages are usually the cause why a lot of company's do not implement this methodology.

In lean companies like Toyota, it was easy to see the waste techniques used on the factory floor, but the management system that was used to develop this technique was far less obvious. This flaw became much clearer when other companies tried to implement the lean manufacturing techniques without the needed management system. The solution was not sustainable and the companies implementing the techniques were not achieving the same results as Toyota.

Disadvantages can be seen in supply problems where Lean depends on the suppliers but without disruption or late deliveries. Strikes, delays in transportation from the suppliers can be fatal in manufacturing. Wholesalers may not want to supply the parts in a different schedule which can cause non-profit costs, cause tension on the manufacturing process and so often supplier changes occur.

High cost implementation; with processes and systems being changed. Payroll expenses increase due to excessive employee training needed and purchasing of new machinery to increase efficiency. "Small to medium-sized businesses, in particular, may find the cost of changeover to lean manufacturing processes prohibitive."(Lang wood, n.d)

Lean manufacturing needs to have complete and continuous input from all employees involved to ensure constant quality. A lot of workers are not qualified for this extensive amount of work. Workers can also be set in their ways and are not open for change. This resistance can influence others in the workplace. Good management skills are crucial in these situations but are often difficult to find with adequate leadership skills.

“Lean Manufacturing is in direct opposition with traditional manufacturing approaches characterized by use of economic order quantities, high capacity utilization, and high inventory. In changing from a traditional environment to one of lean production, cultural issues will emerge quickly, as well as resistance to change. A managing change program is needed to accompany the effort.” (Rockford consulting group, 1999)

### **2.3 Concluding Remarks on Lean Best Practices**

Lean manufacturing seven wastes and value stream mapping will be used to identify and eliminate all non-value added processes in the Ford assembly line in Flextech. To identify problems in the company, structured discussion with individuals will be used. The seven wastes and value stream mapping will be taken into consideration when trying to eliminate and identify problems in Flextech.

Design and analysis will be mainly on the mapping of the Front Park Brake Cable Value stream and possible continuous improvement plan using the Kaizen method.

# Chapter 3: Operational analysis Of Flextech

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The best practise of lean manufacturing has highlighted the need to understand the current situation of the problem.

Flextech as an automotive parts manufacturer makes their own parts used in the assembly process, such as bolts, nuts, plastic covers, brackets, equalisers, rubber coverings and seals as well as cable covering.

By using lean manufacturing, identifying the key problems and eliminating wastes, any area in Flextech can be used because of its diversity. For project purposes the Ford Front PKB were chosen to describe and implement Lean tools.

The focus of the structured discussions was to identify what the key wastes constraints in Flextech are according to the people involved in the production. A risk rating was included in the structured discussion, as to amplify the importance of the non-value added wastes per department.

## 3.1 Flextech Constraints

Flextech's overall constraints in the factory have been established by asking questions related to the Lean thinking tool, the seven wastes. The managers were used for this research by answering structured questions seen in Appendix 8.3 for examples of some of the answered discussions.

### 3.1.1 Structured Discussions

The most useful information gathered was through individual key structured discussions with the operators and management working in the plant. This information is much more accurate due to the fact that when processes are observed, problems that sometimes are not visually spotted by an outsider, can be much easier identified by the operator itself and solutions are easier found and implemented. Workers are much more aware of specific minor problems that can cause a lot of other major difficulties that can be visually spotted.



Key constructed discussions per department in Flextech, where scheduled and answered individually by managers. Human Resource and finance were excluded due to scope restrictions.

The discussions were mainly about identifying the problems in the divisions and applying personal risk ratings for each waste identified. The discussion integrated day to day problems with the lean seven wastes as to slowly start to make the staff comfortable and acquainted with the basics of seven wastes and lean. The following questions were asked:

- What is the main problem in your divisions?
- Why is this problem?
- What will you recommend as a feasible solution for this problem?
- What would you describe as waste in your department that is unnecessary?
- Choose one of the seven wastes, most common in your divisions; overproduction, waiting, transportation, unnecessary inventory, unnecessary motion, over processing and defects.
- What risk rating, out of ten, will you give your waste, chosen in the previous question?
- What will be the best way to solve this waste?

### 3.1.2 Evaluation of structured discussions

After all the constructed discussions were completed with the managers, a summary was made by using graphs to analyse the findings. The wastes that Flextech's staff recognised in their divisions were also tabulated. This can be used to identify key wastage problems in Flextech and can be used in future with the design and analysis of the project to reduce non-value added processes.

Figure 3 shows the different wastes acknowledged in each department. The X-axis describes the different departments in Flextech that was used in the structured discussion to evaluate Flextech's wastes. The Y-axis is the amount of wastes recognised in each department. Most of the departments only listed and discussed their highest risk waste, where other departments discussed all their possible wastes. Different colours were used in the graph to show clearly the different waste per department, so that if more than one waste is present, different colours are shown. Results shown that defects and unnecessary inventory is the two most important wastes that need to be eliminated in the future.

To illustrate the risk per department, a second graph was (Figure 4) constructed to compare the risk with the department wastes, to emphasise which waste needs to be solved or eliminated first. Maintenance and logistics were seen as the highest risk department.

By comparing the two graphs' outcomes, maintenance and unnecessary inventory matched up, which must be considered to be eliminated when improvement plans and recommendations for future problem areas are considered.

Figure 3: Identification of Constraints

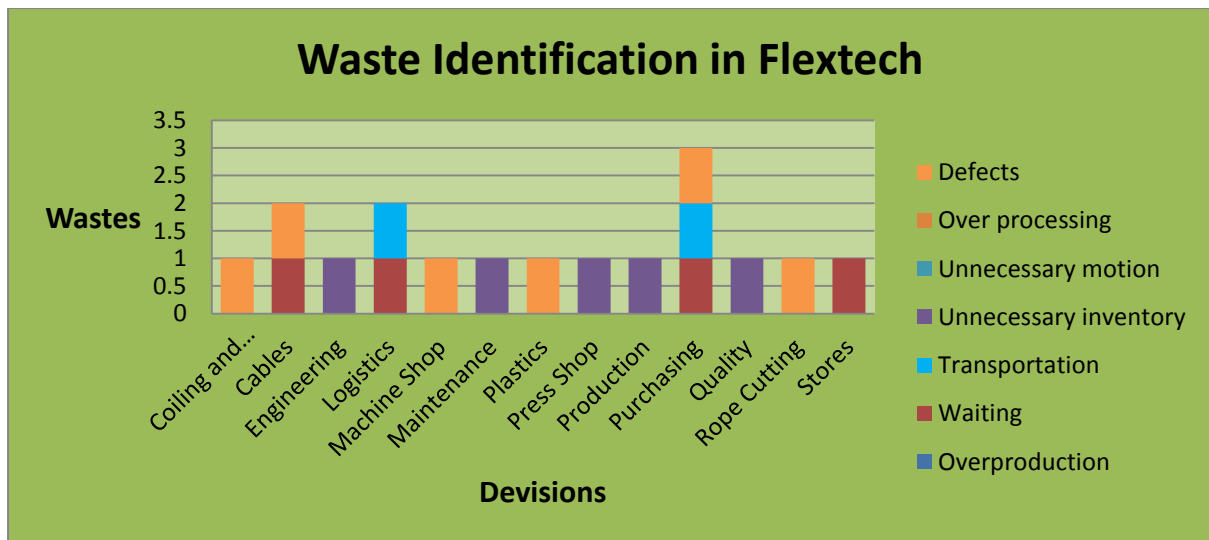
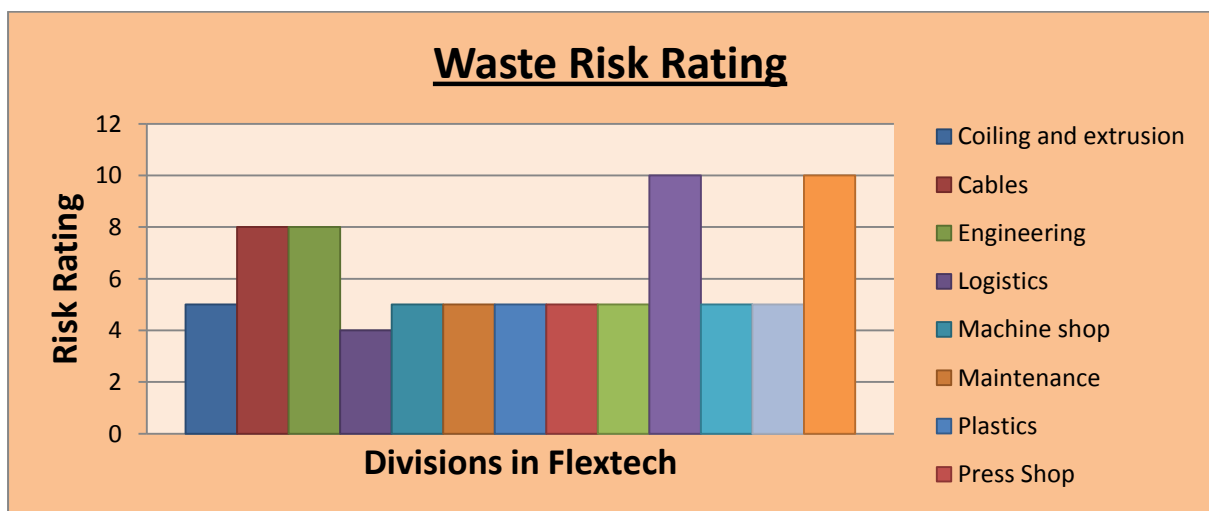


Figure 4: Risk per Flextech's Departments



## 3.2 Front PKB Cable

### 3.2.1 Overview

The Front Park Brake cable is the hand brake for the new Ford Ranger. The Front Park Brake cable, better known as the Front PKB, is mounted onto the Ford Ranger's chassis and then torqued to a maximum force of 20 KN. Figure 5 and 6 shows the final assembled Front PKB before mounted onto the chassis.

Ford requires a daily demand of 600 brackets of the Front PKB. This adds up to a total of 2500 brackets per week that must be supplied to Ford. Suppliers for the parts of the Front PKB are; Thai Steel Cable, Vendico, Bay Tool & Die and Zinchem. Thai Steel Cable supplies the Front PKB's pipes, cover parking, weld bolt and washers. Bay Tool & Die supplies the seal rubber and cover for the Front PKB. Vendico and Zinchem both supply the Front PKB's zinc and metal sheets. The suppliers need to deliver a requirement of 11000 pieces of each part, when an order is placed by the Purchasing Manager. Flextech manufactures their own small individual parts that are not mentioned above and each part will be discussed.

Figure 5: Bottom view of Front PKB

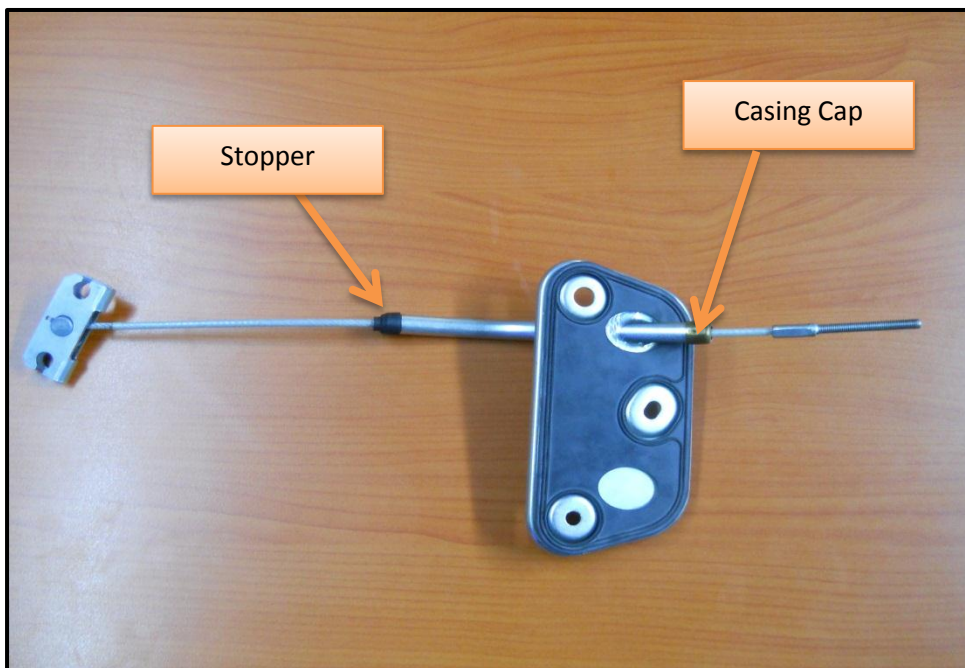
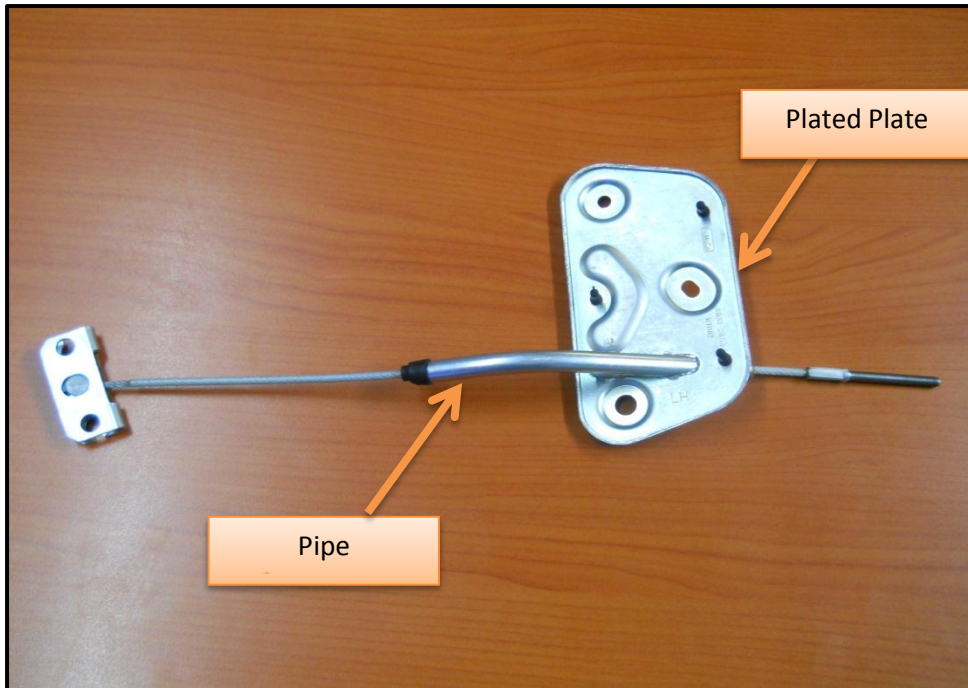


Figure 6: Top view of Front PKB



### 3.2.2 Bill of Material for the Front PKB Cable

The Bill of Material as seen in Table 3 is a list of all the parts and material needed to complete one Front PKB Cable. The Front PKB Cable can be manufactured as a right hand, a left hand or the special Park brake Cables which are specially made for the 4x4 Ford Rangers, which have an extra seal. The definition of the parts descriptions will be discussed in the following section.

**Table 3: Bill of Material of the Front PKB**

| Drawing Item Number | Flextech Part Number | Customer Part Number | Description   | Material   | LHD Seal | RHD Seal | LHD | RHD | Machining Type     |
|---------------------|----------------------|----------------------|---------------|--|----------|----------|-----|-----|--------------------|
| 1                   | C52                  | 935L3N               | Inner Cable   | Ø0.4 7x19 SWRH62A Zinc Plated, Ø3.5 OD, P-AM (Nylon) White Coating Ø4.3 OD | 1        | 1        | 1   | 1   | Rope Cutting       |
| 2                   | F1/33                | AJ21133F0            | Screw End     | SWCH35K (EN8)  | 1        | 1        | 1   | 1   | Machine Shop       |
| 3                   | P47                  | PC60037F0            | Pipe          | STKM11A  | 1        | 1        | 1   | 1   | Press Shop         |
| 4                   | G244                 | PG90007R00           | Seal Rubber   | R-EA510-K2, black  | 1        | 1        | 1   | 1   | Injection moulding |
| 5                   | G245                 | AK20060R0            | Cover         | SC515C, black  | 1        | 1        | 1   | 1   | Injection moulding |
| 6                   | O197                 | PZ30022F00           | Equaliser     | SPCC, t=2.3  | 1        | 1        | 1   | 1   | Press Shop         |
| 7                   | DC63                 | PT10026D0            | T-End         | Zinc Die-Cast  | 1        | 1        | 1   | 1   | Die cast           |
| 8                   | I43                  | 37056G               | Liner         | P-BT, White  | 1        | 1        | 1   | 1   | Extrusion          |
| 9                   | Q102                 | AC11024B0            | Casing Cap    | C2680  | 1        | 1        | 1   | 1   | Assembly           |
| 10                  | O198                 | PZ10053FD            | Plate         | SAPH440, t=2.0   |          | 1        |     | 1   | Press Shop         |
| 11                  | O199                 | PZ10055F0            | Stopper       | SPCC, t=2.0  |          | 1        |     | 1   | Press Shop         |
| 12                  | O200                 | PZ10054FD0           | Plate         | SAPH440, t=2.0   | 1        |          | 1   |     | Press Shop         |
| 13                  | O201                 | PZ10056F0            | Stopper       | SPCC, t=2.0  | 1        |          | 1   |     | Press Shop         |
| 14                  | G246                 | PK90002PA0           | Cover-Parking | P-AC (POM)   | 1        | 1        |     |     | Injection moulding |
| 15                  | R 67                 | PM60004F0            | Weld Bolt     | W703778-S300   | 1        | 1        | 1   | 1   | Spot weld          |
| 16                  | Q105                 | PW10024F00           | Washer        | SPCC t=1.6   | 1        | 1        | 1   | 1   | Spot weld          |
|                     | GR01                 | Berusil FO 36-2      | Grease        | Hilex Grease   | 1        | 1        | 1   | 1   | Assembly           |

### 3.2.3 Important Definitions

- Inner Cable: The steel wire inside of the plastic covered cable.
- Screw end: (See Figure 13) a threaded and tapered piece of metal with a cylindrical head is crimped to a square. This part is the only visible part from the top view of the chassis and is used to fasten the whole assembly onto the actual hand brake in the vehicle.
- Pipe :( See Figure 3 and 4) a hollow cylinder or tube used to place the plastic covered cable in.
- Plate: (See Figure 3 and 4) the flat piece of metal blanked and formed for the Front PKB.
- Blanking: Compressing the whole part of the sheet metal and then an upper and lower punch cuts out the desired blank part.
- Forming: A sheet of metal pressed as to give a certain desired form by adding pressure onto the plate.

- Rope Cutting: (See Figure 10) several thinner cords twisted together to create a specific thickness. These wires are then covered with plastic and cut into a specified length to use on the Front PKB.
- Rope Cleaning: ( See Figure 11) After the rope, better known in Flextech as the cable, has been cut to desired length, a small piece of the plastic is removed from the wire, so that the steel wire is visible.
- Rope Upsetting: (See Figure 12) A small steel wire bud is created on one of the end sides of the already cut and cleaned rope, so that the zinc of the Die casting can firmly set around the cable.
- T-end Die Casting: ( See Figure 14,15 and 17) The term refers to the method of forcing molten metal, under great pressure into a die to give it a specific shape that is known as the T-end in Flextech.
- Equaliser: (See Figure 18) the metal sheet formed around the T-end, which is used to connect with the other cables when assembled in the chassis of a vehicle.
- Brazing: (See Figure 19 and 20) a joining process for metals using a filler metal that includes a base of copper combined with silver, nickel, zinc or phosphorus. Brazing temperatures range from 470°C - 1190°C.
- Spot-welding: ( See Figure 22 and 23) "Sheet metal joining process in which parts to be welded are held together under pressure by electrodes. When a current is applied, the resistance at the interface of sheets causes a coalescence only at the contact point (spot) and effects a weld." (Business Dictionary, nd)
- Plating: (See Figure 3 and 4) A zinc coating is applied to protect the metal parts from rust and also gives a silver colour finish to the part
- Gusset: (See Figure 19) a small, bended triangular piece of material brazed onto the pipe of the Front PKB to improve the fit or for strengthening the brazed process.
- Liner: A plastic tube inserted into the metal pipe with grease, is used to simplify the assembly process of inserting the plastic covered cable through the metal pipe.
- Casing Cap: (See Figure 3 and 4) Brass cap placed at the end of the pipe to stop grease from interfering with the assembly process.
- Stopper: (See Figure 3 and 4) Rubber cap placed at the end of the pipe to stop grease from interfering with the assembly process.
- Cover parking: A plastic cap at the top of the screw-end which forms part of the chassis assembly process.

- Bracket: A brazed assembly of a formed and blanked plate, pipe, and gusset.
- Weld Bolt: (See Figure 23) A threaded bolt spot-welded onto the brazed bracket.
- Washer: (See Figure 22) A thin plate with a hole in the middle. This washer is spot-welded onto the bracket.

### 3.2.4 Process Flow

The process flow of the Front PKB will be discussed in detail under Process Analysis in Chapter 4.

# Chapter 4: Design and Analysis

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## 4.1 Value Stream Mapping

### 4.1.1 Process Analysis

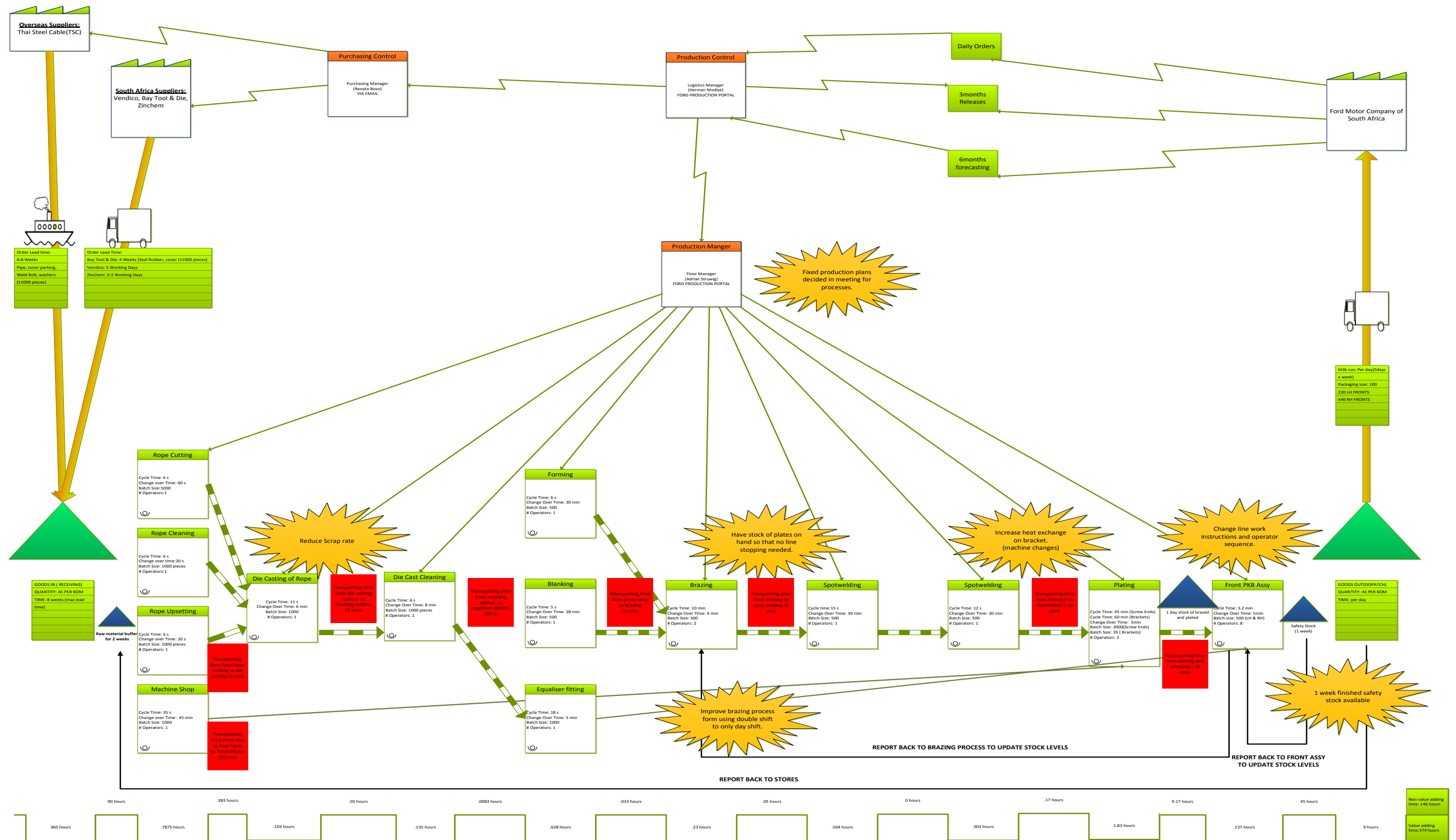
After a detailed operational analysis at Flextech and the identification of the seven wastes in Flextech, the Front Park Brake (PKB) Cable of Ford South Africa, as seen in Chapter 3, was identified as the best production process to be used to apply lean tools and to improve in Flextech.

The detailed process of the Front PKB was used to design a value stream map, one of the lean thinking tools, to identify possible improvements and problems present in the production process from suppliers through to, Ford S.A., the customer.

The completed Value Stream Map (VSM) can be seen on the next page, as Figure 7. To understand the process of the Front PKB Cable, the different sections of the completed Value Stream Map is discussed.



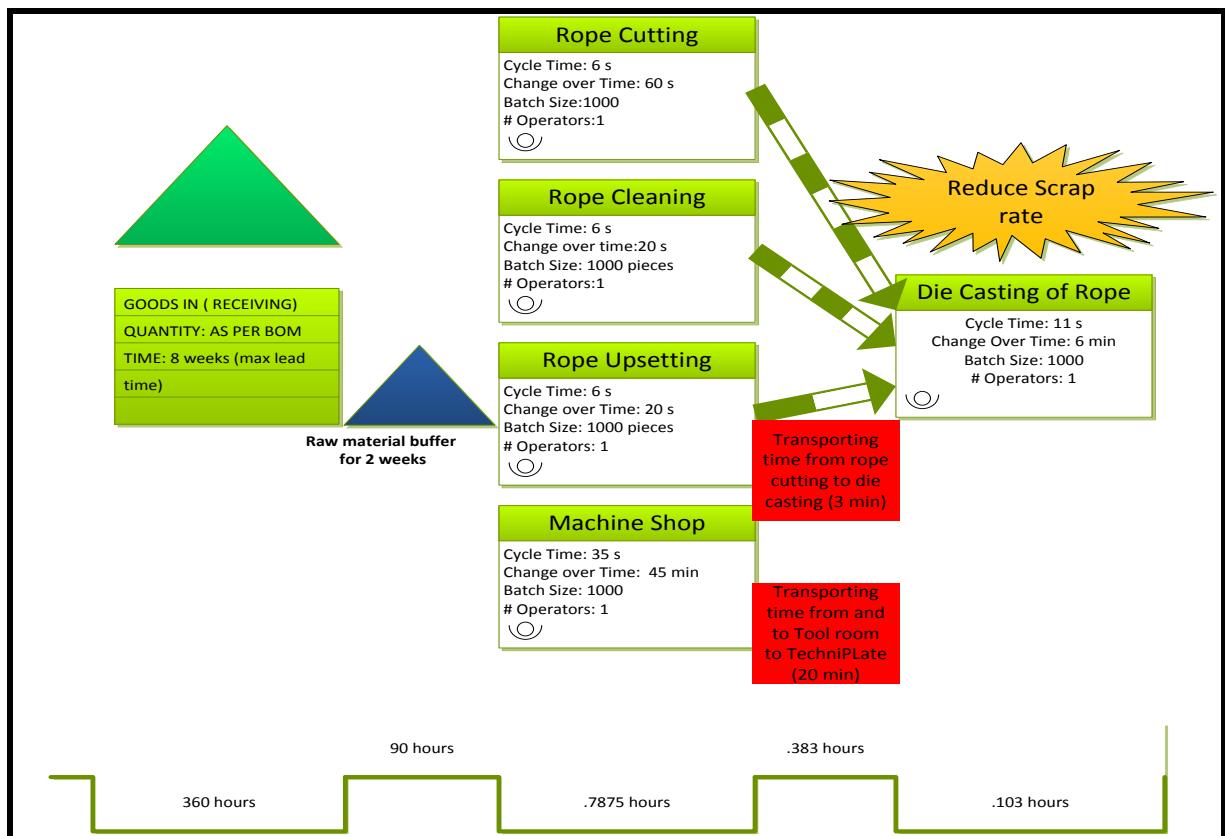
Figure 7: Value Stream Mapping of the Front PKB



I. VSM Section1

- Figure 8 shows the raw material that is delivered at the receiving area. The maximum lead time that can be expected is eight weeks, as the shipping of international suppliers is very time consuming.

Figure 8: Section 1



- The rope department, as seen on Figure 9, is an area on the floor where all the rope cutting, cleaning and upsetting takes place. The die cast cleaning is also done at the rope department. All the mentioned processes are done during day shifts.

**Figure 9: Rope Department**



- Rope cutting; the first process of the Front PKB Cable. The rope is cut according to specifications of +/- 42 centimetres. Eye protector glasses should be worn as some rope shrapnel can be sharp and dangerous. Figure 10 show the rope cutting machine. An average cycle time of six seconds was taken at the rope cutting operation, with a machine change over time of one minute.

**Figure 10: Rope Cutting**



- Rope Cleaning; after the above mentioned cutting of the rope into desired lengths, two centimetres of the rope covering is then cut off, which is called the cleaning of the rope. This process can be seen in Figure 11. The rope cleaning process is needed for die casting purposes. An average cycle time per cleaning process is six seconds, with a 20 seconds tool changeover time.

Figure 11: Rope Cleaning



- Rope Upsetting: this process and the rope cleaning are specifically done for the die casting of the rope. Upsetting can be described as the small wire bud that can be seen in Figure 12. The process of making one wire bud takes an average of six and 20 seconds is used to change tools.

Figure 12: Rope Upsetting



- Machine shop; the machine shop and the tool room are not on the main factory premises, due to the excessive amount of electricity used by the machines. These workshops are situated in Silverton. The screw ends are threaded, cleaned and cut to size according to specifications. Figure 13 shows the complete screw end product before the head is crimped to a square on the assembly line. The cycle time is 36 seconds with a long change over time of 45 minutes. Although the changeover of the jigs is a very time consuming process, it is only done once or twice a month.

Figure 13: Screw End



- Die Casting of the rope; this procedure takes place at the assembly lines of the Toyota Cable, as this is an old machine, as seen in Figure 14, and was first used on Toyota before the new Ford Ranger production started. This process also needs to be separated from the other production lines, as the liquid aluminium spatter and this can be harmful to workers. When the rope gets die casted the T-end is created. The uncleaned product can be seen in Figure 15. An average cycle time was taken as 11 seconds per part, with tool change over time of six minutes. This process is done during night shift.

Figure 14: Die Casting



Figure 15: Uncleaned Die casted T-end



I. VSM Section 2

- Figure 16 shows the T-end cleaning process which is done at the rope department. This process is usually done early in the mornings due to the fact that the die casting of the T-end is done at night. A cleaned, quality checked T-end of the Front PKB rope can be seen in Figure 17. The tool changeover is quite difficult and takes a lot of time and preciseness. The Die Cast cleaning process has a changeover time of eight minutes and a cycle time of six seconds. Only a trained operator is used because of its level of difficulty.

Figure 16: Section 2

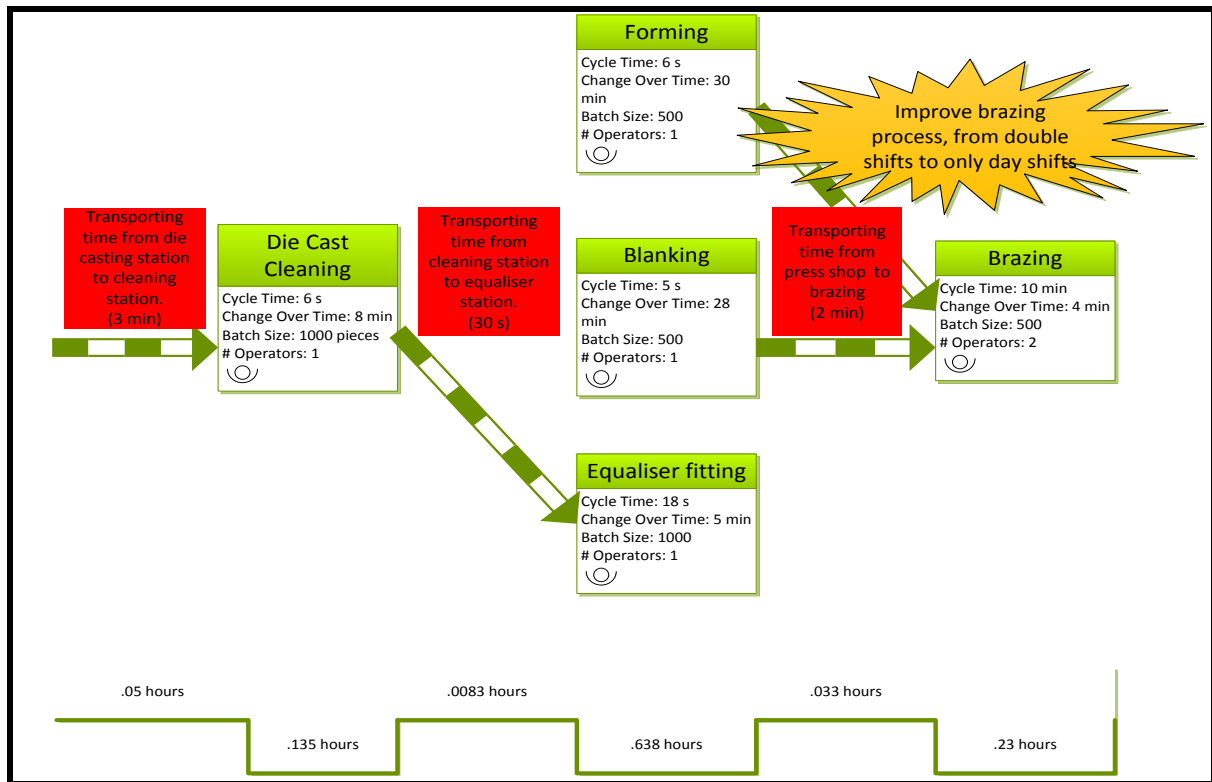


Figure 17: Quality checked T-end



- Forming, blanking and equaliser fitting; three individual processes done at the same time. These three processes are part of the press shop, but because of the size of the machinery, it has been moved out to the allocated area for the machine shop. Forming and blanking is fast and loud processes where ear protected gear should be worn at all times. Both processes has a cycle time of five seconds per 10 blanked or formed metal plates and an extensive tool change time of 28 to 30 minutes. These tools however only get changed once or twice a week.
- The equaliser, as defined in Chapter 3, is the plate formed around the T-end. The process starts by receiving the cleaned die casted ropes from the rope department and the equalisers from the press shop. This process, seen in Figure18 involves the bending and crimping of the equaliser over the cleaned T-end buds. With an average cycle time of 18 seconds.

**Figure 18: Equaliser**



- Brazing; one of the major issues in the Fronts PKB cable. Or the time it takes, 10 minutes to brace 4 parts and the buffer it creates. Two operators are used for brazing. Operator one brazes the gusset onto the pipe (Figure 19), whereas the Operator two brazes the pipe onto the plate, as seen in Figure 20. Combining the time of these methods a total cycle time of ten minutes is achieved.



Figure 19: Brazed gusset onto pipe



Figure 20: Brazed pipe onto plate



I. VSM Section 3

- Figure 21 shows Flextech's Spot-welding process; two different types of spot-welding are done on one machine and both are for the Front PKB cable.

Firstly the spot welding of the washer is done (see Figure 22) at 15 seconds per washer. A 30 minute changeover of tools and settings are required before the second spot-welding process can start.

The second process is spot-welding the bolt onto the brazed bracket which takes 12 seconds per spot-welded bolt.

Figure 21: Section 3

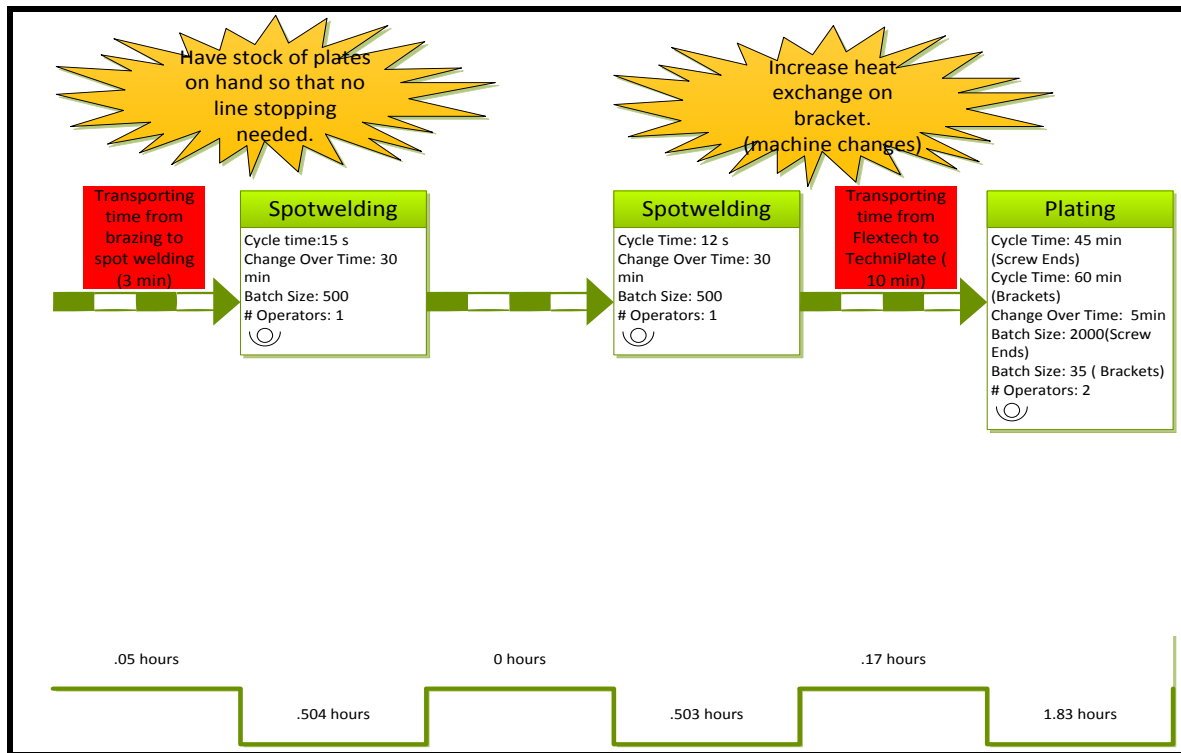


Figure 22: Spot-weld of washer



Figure 23: Spot-weld of bolt



- Plating; this process is done after the completion of both spot welding processes. Plating is however not done at Flextech, but at a company called Techniplate. This company uses two different methods of plating.  
First method: plating the screw ends that come from the tool room. The screw ends are thrown in large steel bins filled with liquid zinc. These bins can take up to 2000 screw ends at a time. The bin plating process takes 45 minutes to complete 2000 screw ends.  
Second Method: Plating the brazed and spot-welded brackets. This is a more delicate process, as the bracket may not be damaged. The brackets are hanged on an automated conveyor belt mounted on the ceiling and dipped individually into the liquid zinc. This however takes an hour for 35 brackets to be plated.

## II. VSM Section 4

- Figure 24 shows the assembly process and packaging of the Front PKB Cable. After all the processes are done and the brackets as well as the screw ends return from plating, batches of each component are placed, as a Kanban system, near the Front PKB production line. An assembled Front PKB Cable takes an average of three and a half minutes. This cycle time is taken from the checking station right through to the packing station. Figures 25-29 show the different working stations at the final Front PKB production line.
- A Pull process needs to be implemented to make sure all stocks are updated from stores to Fronts PKB assembly line and from the assembly line back to receiving area.

Figure 24: Section 4

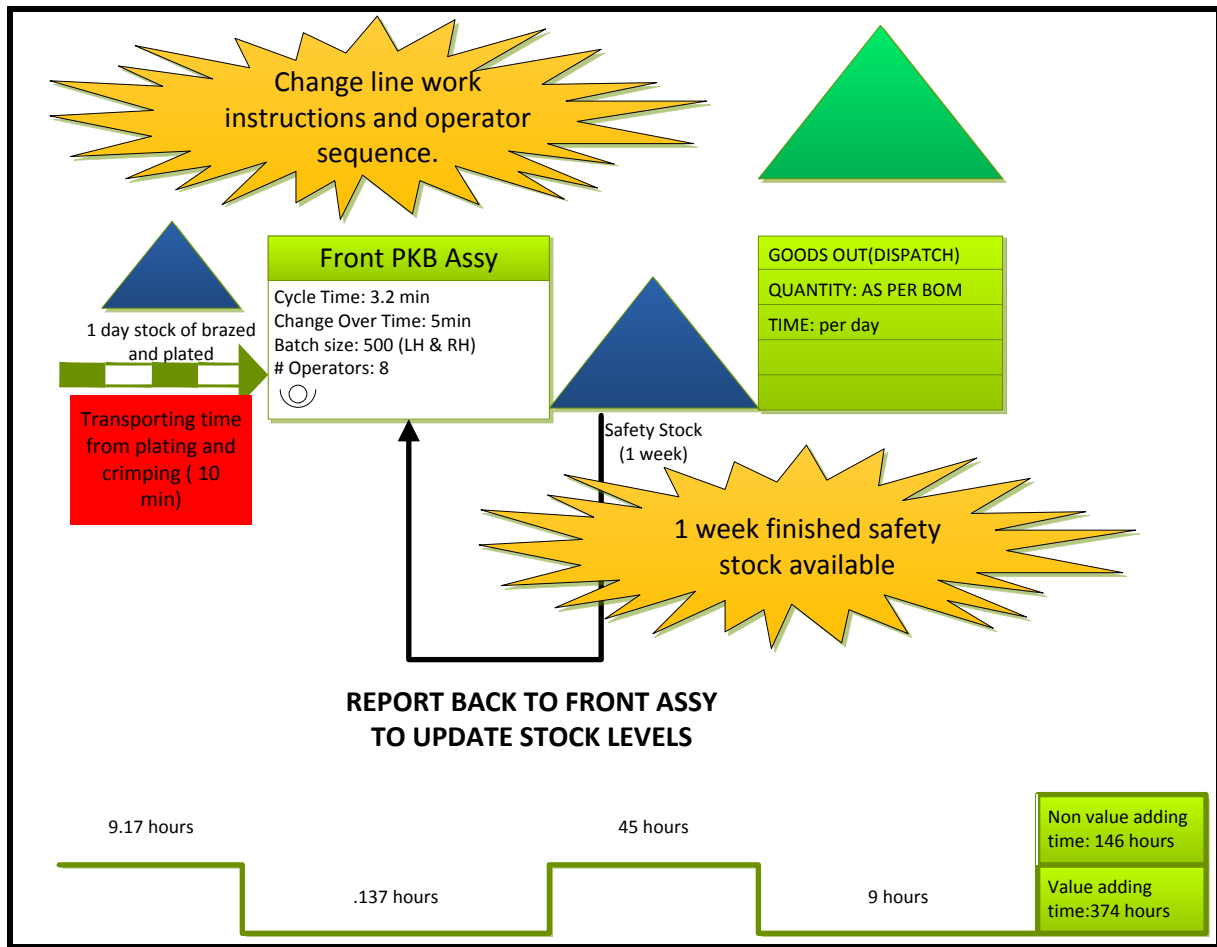


Figure 25: Test thread

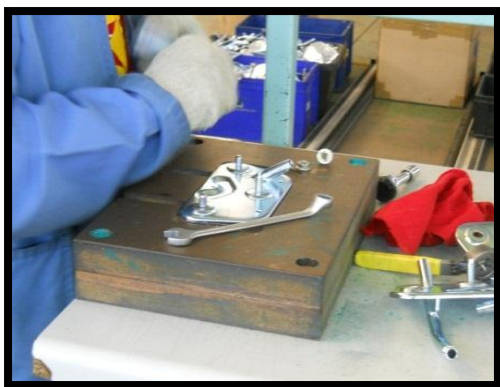


Figure 26: Checking Station



Figure 27: First Crimping Station



Figure 28: Second Crimping station for Screw end



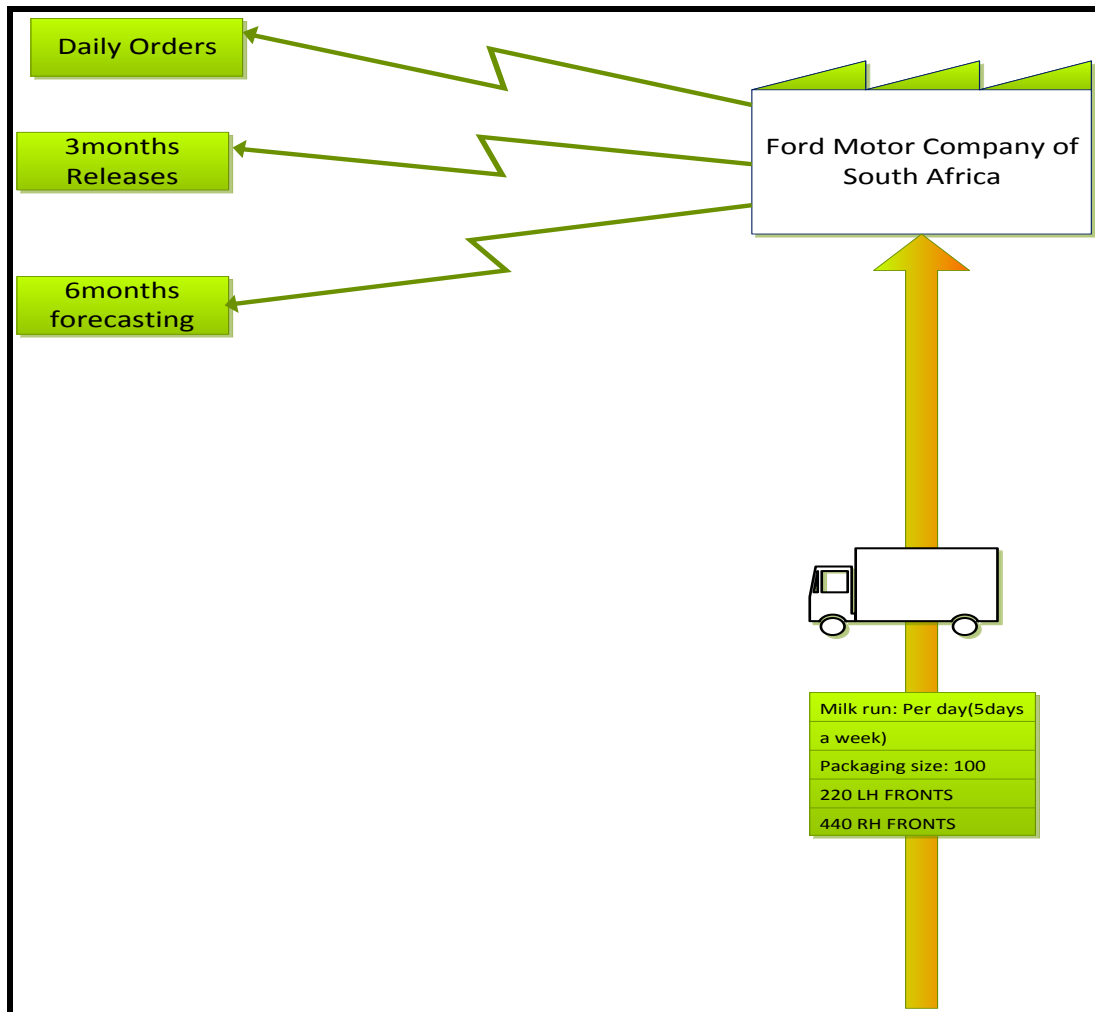
Figure 29: Checking Fixture



III. VSM Section 5

- After packing, a milk run is provided by Ford S.A that sends a pick-up truck to fetch all the assembled Front Park Brake Cables.
- Daily orders, three month releases and six month forecasting are available on the FORD S.A portal that can be electronically viewed.

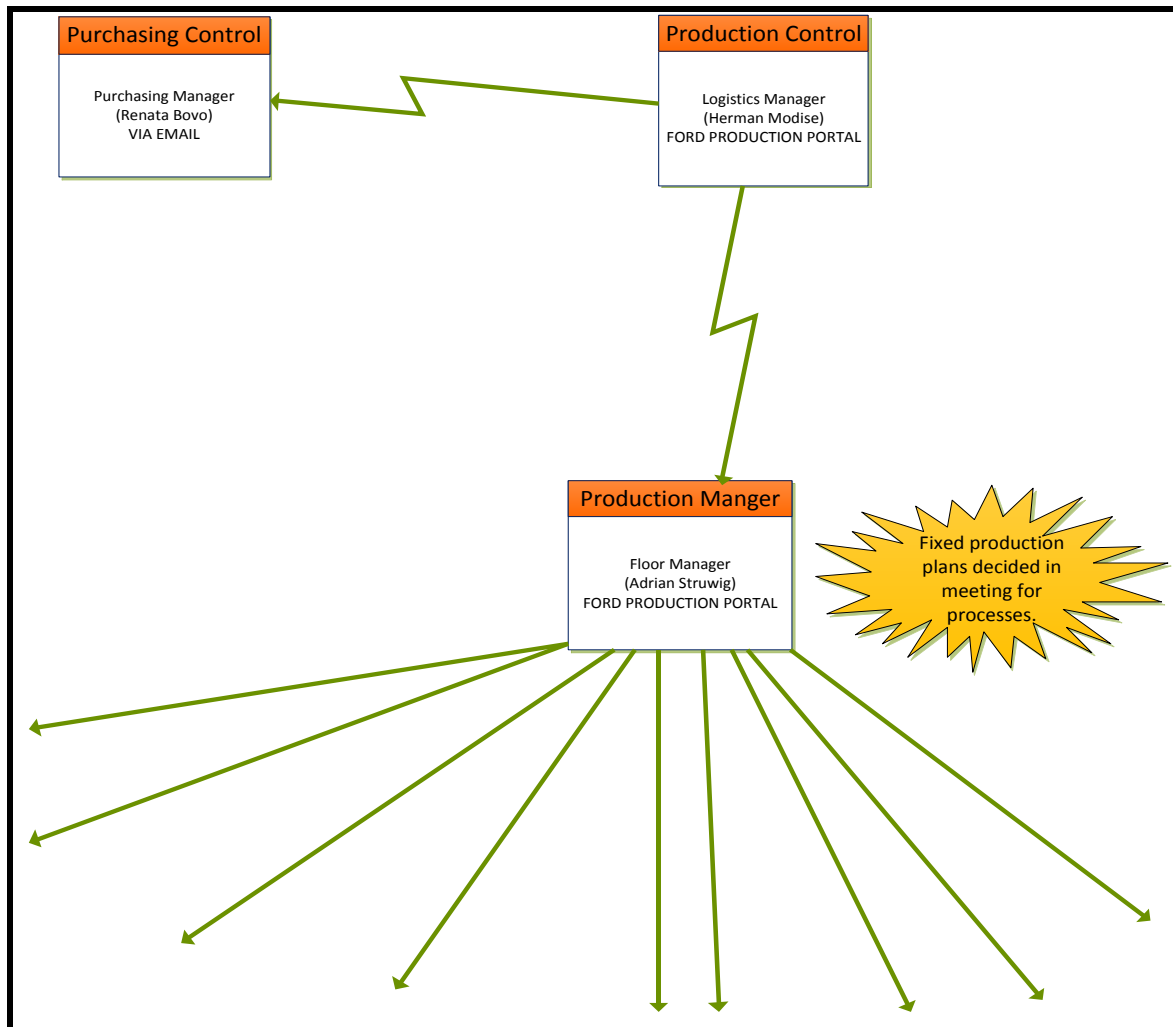
Figure 30: Section 5



#### IV. VSM Section 6

- As discussed in the previous VSM Section, it is clear that the production manager, logistics manager and purchasing manager can access this portal to get relevant information regarding their specific needs.
- The production manager gives a verbal production schedule every morning to the line leaders, but daily production meetings must be used to establish fixed production rates per department.

Figure 31: Section 6

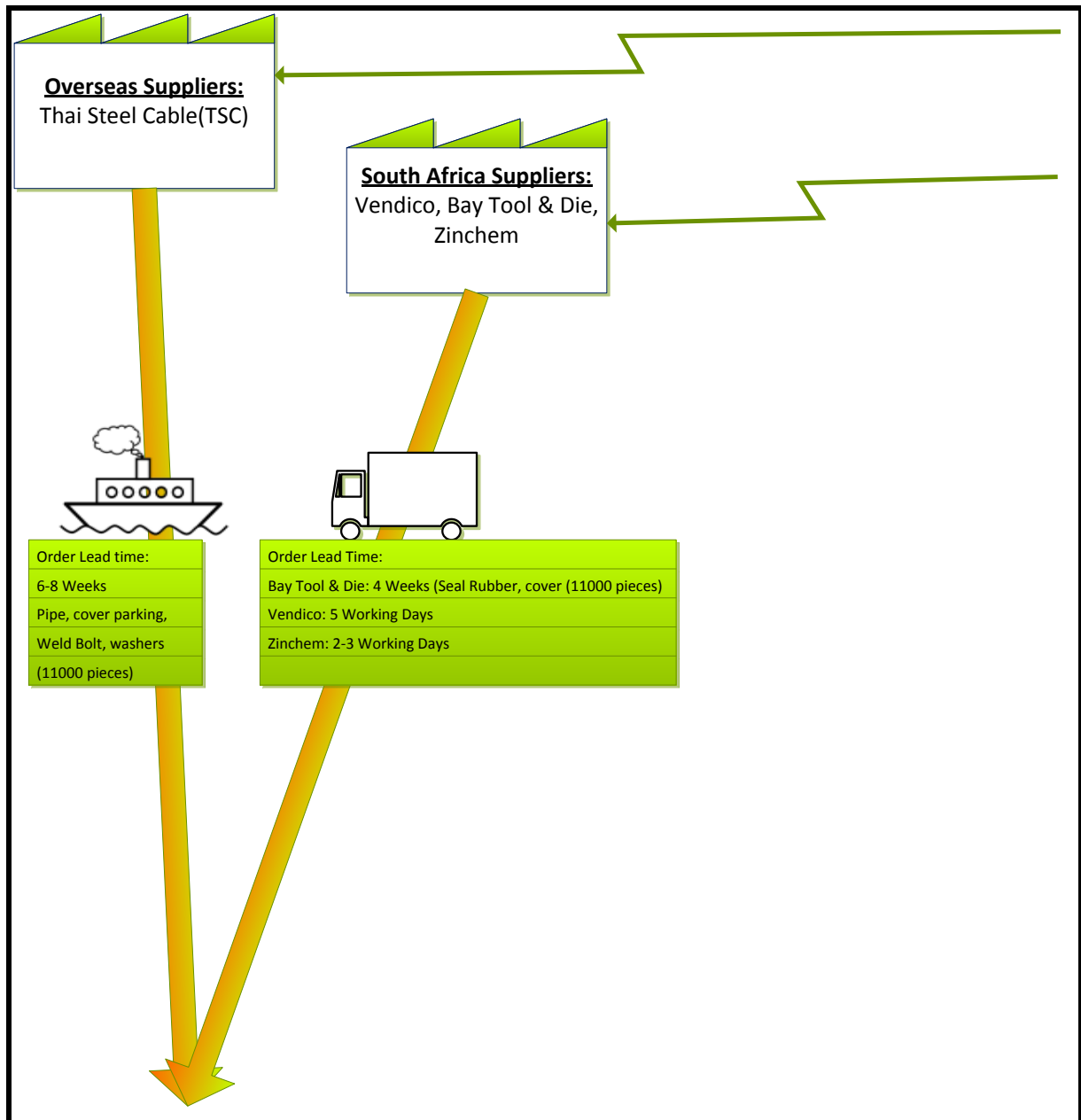


V. VSM Section 7

- Flextech has four suppliers for the Front PKB Cable, as seen in Figure 32. Three are national, by road transport and one an international shipment. The Purchasing manager orders electronically, the amount needed as calculated by the Bill of Material.



Figure 32: Section 7



## 4.2 Key Identified Problems

After a complete detailed analysis of the Front Park brake Cable, problems, better described as gaps, were identified. These gaps were measured with a risk rating of high, medium or low risk, depending on the difficulty, the importance of the problem and the limited time available to advance or resolve the problem.

### 4.2.1 Gap Analysis

Gaps identified in the Value stream map are listed below in Table 4, where all the gaps are discussed in the paragraph below. Detailed discussions will be done on the brazing problem, which will then be further used and discussed in the solutions and for the improvement plans.

**Table 4: Identified Gaps**

| <b>FRONT PKB</b>                  |   |             |  |
|-----------------------------------|---|-------------|--|
| <b>Process</b>                    | <b>Identified Gaps</b>  | <b>Risk</b> | <b>Planned Action</b>  |
| <b>Die Casting</b>                | High Scrap rate   | Medium      | Reduce by continuous maintenance   |
| <b>Production</b>                 | Variable production plans, communication gaps   | High        | Fixed production plans decided in meeting for processes                        |
| <b>Brazing</b>                    | Line interruptions due to time consuming brazing  | High        | Better process for welding   |
| <b>Spot-welding</b>               | High scrap rate and problems occurring at Ford Production   | High        | Increase heat exchange, machine changes already implemented                    |
| <b>Fronts PKB (assembly line)</b> | Time consuming due to difficult process of seal rubber  | Medium      | Find new method, by heating rubber before assembly, or adjust assembly process |
| <b>Fronts PKB (assembly line)</b> | Non value added time due to incorrect machine settings<br>Force on crimping is not high enough, which result in double crimping methods | High        | Change settings on machine and increase electricity capability of plant        |

➤ **Die Casting**

Title of the Gap

Regular maintenance required at the Die Cast machine to improve aluminium liquid flow, as to prevent nozzle blocking.

Background and Current Situation

The Die Cast machine's nozzle gets clogged by the aluminium flowing through the machine, causing blocking of the excess flowing Aluminium. This results in dangerous operational environments, because of the involved hot liquid that the operator is working with. The blocked nozzle also results in excess medium being pushed out through the sides of the nozzle, which result in high material scrap rate. Productivity can also be improved through regular maintenance.

Goal

Improve productivity and safety through regular maintenance on the Die Cast machine.

➤ **Production**

Title of the Gap

Fixed production plans are desired to be established at a general daily production meeting.

Background and Current situation

Variable production plans are verbally communicated from the production manager to the different production lines. Production plans are given to the line operators verbally every morning. Although everyone on the production floor understand what is required of them, data cannot be captured as to know the daily reached production targets of parts in each specific area. This is however known by the production manager because of his experience and knowledge of each specific department on the factory floor, but is not known to any of the other managers in Flextech.

The lack of data became a problem when previous data was required by the engineering department to calculate targets and tact times. Data is also unavailable to check when the specific production of a part for each month was on target or did not meet the target.

### Goal

Fixed formal production plans need to be established throughout the year, with a manager's meeting discussing the importance of change in the quantity and the weekly or even daily production.

### ➤ **Spot-welding**

#### Title of the Gap

Machine designs caused variability in the production and welding of the washers and bolts.

#### Background and current situation

Problems occurred at the spot-welding station due to fatigue, lack of concentration and inaccuracy of the machine design. This was caused by placing the bracket at an angle when spot-welding took place which resulted in uneven welding around the bolt and washers. The unevenness caused the weld to break when high amounts of pressure were tested on the spot-weld processes.

### Goal

The goal was to improve the machine design on the spot-welding operation and so to reduce the scrap rate.

### ➤ **Front PKB (Assembly-rubber seal)**

#### Title of the Gap

Problems occurring due to time consuming processes in the Front PKB assembly line.

#### Background and current situation

The seal rubber manufactured by Bay tool & Die are assembled manually onto the bracket using pliers. It is a very time consuming process, trying to push the small rubber pieces through the holes on the bracket and pulling one by one through the tiny holes.

The production line is designed in such a way that only one operator is assigned to crimp the casing cap onto the steel pipe and to put the seal rubber onto the bracket. This increases this specific station's cycle time, as it is seen as only one process in Figure 33, Station 4. Batches of Front PKB cables get heaped up in front of this process, as the previous quality check and cover parking assembly has a very short cycle time.

**Figure 33: Current Cycle times at the Assembly Line**

| Station 1 Cleaning and testing the bolt's threading (Operator 1)               |       |       |       |       |       |       |       |       |       | Average time (sec)                  |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------------------------------------|
| 1  | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |                                     |
| 58.72  | 40.44 | 41.13 | 47.56 | 29.69 | 48.37 | 39.5  | 31.13 | 38.28 | 37.37 | 41.219                              |
| Station 2 Checking the quality of the bracket after plating.(Operator 2)       |       |       |       |       |       |       |       |       |       |                                     |
| 1  | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |                                     |
| 20.6   | 18.53 | 18.91 | 20.53 | 17.06 | 17.53 | 20.84 | 18.25 | 16.44 | 21.68 | 19.037                              |
| Station3 Applying the cover parking and plastic chube with grease (Operator 3) |       |       |       |       |       |       |       |       |       |                                     |
| 1  | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |                                     |
| 8.9  | 7.97  | 9.22  | 9.56  | 8.22  | 8.85  | 9.84  | 7.9   | 5.34  | 7.72  | 8.352                               |
| Station 4 First crimp and assembly of rubber seal ( Operator 4 )               |       |       |       |       |       |       |       |       |       |                                     |
| 1  | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |                                     |
| 47.9   | 66    | 53.13 | 48.5  | 51.66 | 49.5  | 48.59 | 50.93 | 42.53 | 46.5  | 50.524                              |
| Station5 Second Crimp- crimping of the screw end. (Operator 5)                 |       |       |       |       |       |       |       |       |       |                                     |
| 1  | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |                                     |
| 21.25  | 25.35 | 21.71 | 19.41 | 20.66 | 23.16 | 22.43 | 20.06 | 31    | 27.06 | 23.209                              |
| Station6 Testing and checking fixture ( Operator 6)                            |       |       |       |       |       |       |       |       |       |                                     |
| 1  | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |                                     |
| 19.19  | 13.65 | 12.38 | 18.16 | 14.41 | 17.09 | 15.38 | 15.35 | 13.96 |       | 15.508                              |
| Station 7 Checking, marking of finished assembly (Operator 7)                  |       |       |       |       |       |       |       |       |       |                                     |
| 1  | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |                                     |
| 29.5   | 23    | 22.13 | 22.34 | 18.28 | 22.16 | 18.81 | 18.81 | 19    | 22.05 | 21.608                              |
| Station 8 Packing ( Operator 8)  |       |       |       |       |       |       |       |       |       |                                     |
| 1  | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |                                     |
| 5.51   | 4.34  | 6.1   | 6.4   | 5.5   | 6.32  | 5.89  | 7     | 5.43  | 5.34  | 5.783                               |
| <b>TOTAL</b>   |       |       |       |       |       |       |       |       |       | 185.2397778 seconds<br>3.52 minutes |

Goal

Improving the assembly operator line layout, which will result in total improved cycle time of the assembly line, and more finished front PKB brackets per hour.

➤ Crimping Process at Front PKB Assembly Line

Title of the Gap

The assembly line of the Fronts PKB cable uses an extra crimp which results in extra ten seconds per crimping part, when the crimping at the assembly line is not according to the tested fixtures.

### Background and current situation

When the screw ends are tested, the size after crimping is not according to the fixture created using Ford specifications. An extra crimp method was brought in by the managers. The operator at the second crimping station at the Front PKB assembly line uses a second crimp on the factory floor to get the wanted crimped results. This however causes line interference, where the operator has to crimp the screw ends on the production line as instructed, and then take a batch to crimp it at the other crimp with the right force.

### Goal

To eliminate the second crimping method, by improving or fixing the force needed to crimp the screw end according to Ford specifications.

## ➤ **Brazing**

### Title of the Gap

Improving throughput at the brazing area at Flextech for the part numbers 0204 & 0205, better known as the Front PKB Brackets.

### Background

The demand of 600 brackets per day and 2500 brackets per week is required. The brazing area's utilisation of these 2500 brackets is six days including day shift, night shift and overtime. The Front PKB Assembly line's utilisation to meet the requirement of 2500 finished parts is four and a half days.

### Current situation

Two operators are currently used in the day shift brazing O204 & O205. Operator one is used to braze the gusset onto the pipe for the 0204 & 0205. Operator two then uses the brazed pipe of operator one to braze the pipe and gusset onto the plate. The day shift consists of nine hours per day from Monday to Thursday and only six hours on a Friday. An average of only 180 brackets gets brazed by Operator two on day shifts and an average of 600 pipes gets brazed by Operator one in the same shifts .

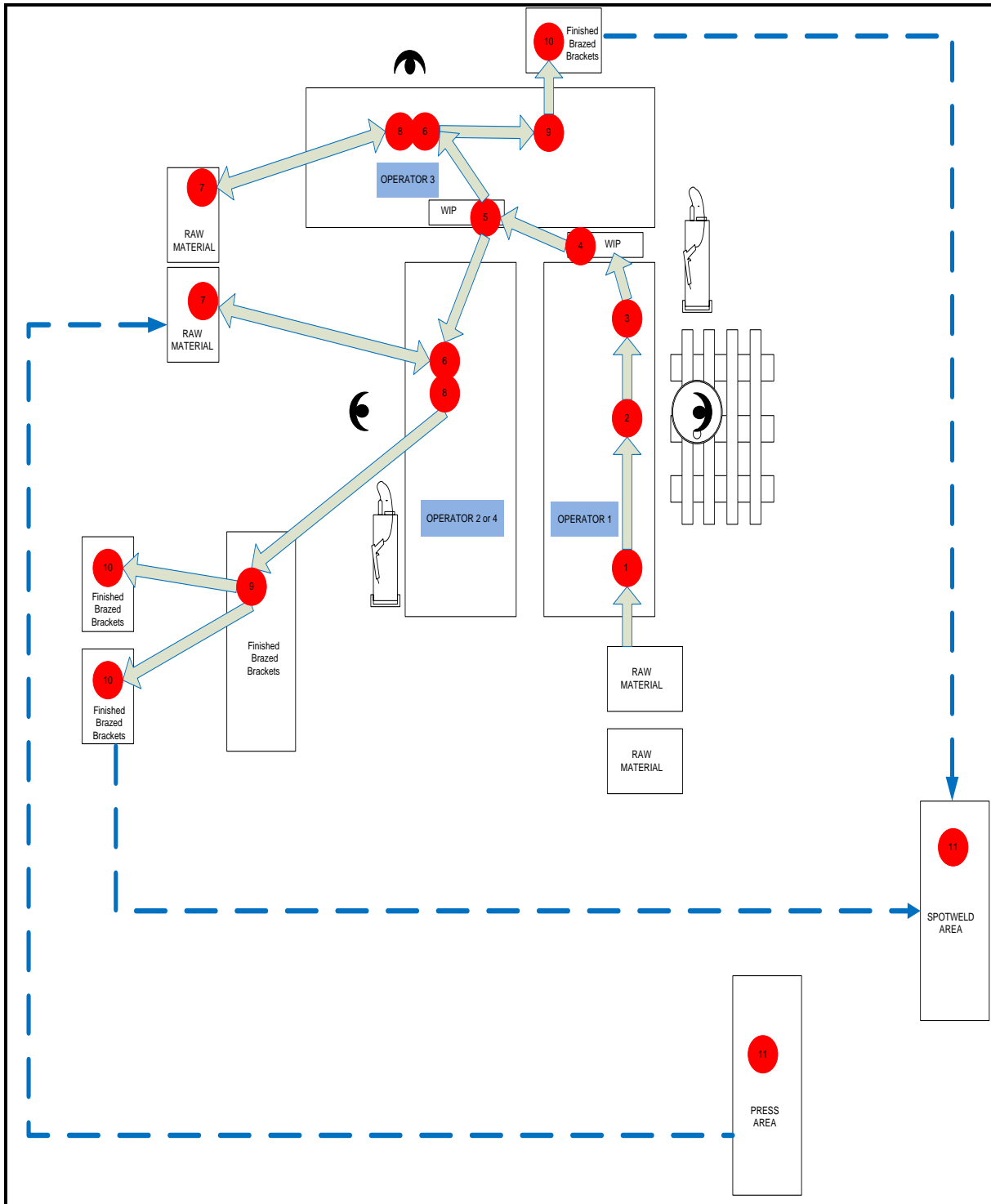
The night shift has two operators, which both are used to braze the gusset and pipe onto the plate for O204 & O205. The night shift consist of 12 and a half hours and an average of 400 brackets can be brazed in this time. For project purposes the night shift operators will be called Operator three and Operator four.

Operator one, has a jig which can take four gussets getting brazed onto four pipes. Operator two and three use a jig which can take four brackets at a time. Operator four's jig can only braze one bracket at a time.

The process flow as seen in Figure 34 shows the current situation that is being used in Flextech at the Brazing area. The process steps can be discussed as follow:

1. Step 1 is where Operator one removes the steel pipes from its plastic packaging and places it on the work bench for easy access. This is also similar to the gussets.
2. Step 2 will be where Operator one brazes the gusset onto the pipe. Four pipes get brazed at a time.
3. Step 3 is where Operator one places the finished brazed pipe next to the brazing jig to allow the pipes to cool down.
4. Step 4; the brazed pipes piling up next to Operator one, gets thrown into a specially designed cooling bin
5. For easier access for Operators two, three or four, already cooled brazed pipes are placed into a plastic container.
6. Step 6 is used to illustrate where the brazed pipes are being placed before getting used at each Operator's work bench, depending on day- or night shift.
7. Plates that are brought to the brazing area from the press shop are then taken by the Operators to get brazed.
8. Step 8 represents the actual brazing of the pipes onto the plate which creates the 0204 & 0205 brackets. Operator two or three can braze four brackets as mentioned earlier, where Operator four can only braze one bracket at a time.
9. Each finished brazed bracket gets placed on a movable table for Operator two and three, where Operator four places the finished brazed brackets on the same work bench as what he uses to braze on. This process is better known as the cooling process of the brackets.
10. Step 10 is where the finished cooled brazed brackets get placed into plastic bins.
11. A spot-welding operator then fetches the finished brackets to be used at his/her station. At the same time operators from the press area, brings the finished blanked and formed plates to the brazed area.

Figure 34: Current Process Flow





## Goal

To achieve the requirement of 600 per day and 2500 per week by using only the day shift.

## Causes of Gap

The cause and effect diagram in Figure 35 shows the effect each category has that may contribute to the cause, which is the failure to meet the weekly requirement of 2500 brackets in only using day shifts. The discussion below will show the linkage of some of the categories as well as the meaning of the effects.

- Man

The operators working at the brazing area reaches fatigue more frequently than other areas in Flextech due to the heat intensity of the torch flames. The Operators also work very slowly when it comes to day shifts, because of the extra 10% income that is related to the night shifts. They work slower so that their shifts automatically move into night shift. These effects can contribute to the cause which results into extensive amount of night shift costs.

- Machine

The jig heats up, which also result into faster operator fatigue. The water system that is already implemented inside the jig is used to cool down the jig, which at this moment is not being used. The setup of the jigs can also be seen as “unfriendly”, which can be better explained as positioned too high for the Operators. The second and third Operator needs to lift their brazing torch too high for comfort to braze the four brackets and this also result into numbness of the upper arm. The settings on the jig used by Operator two and three, needs to be checked and fixed every day before starting the brazing process and during the process. An example of the settings is the nut and bolt of the jig that loosens as the brazing takes place. A lock nut was suggested to be used.

- Material

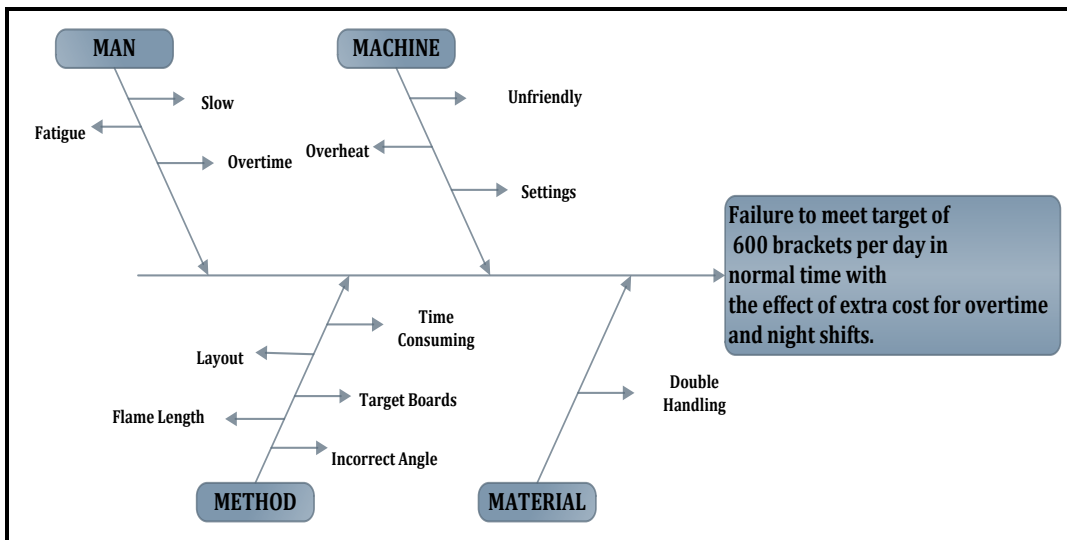
A lot of double handling is present in the current situation as seen in the process flow of the material in Figure 34, which can be described as non-value added time, wasted time.

- Method

The brazing method used by Flextech is a very time consuming process and is also recommended process by Ford to be used on their brackets 0204 & 0205. Although it takes very long to produce finished brazed brackets, some improvements can still be made that result in slowing down the brazing process more than what it needs to be.

- Target boards are one of the methods that are not being used at the brazing process and so Operators never know the exact requirements per day.
- The angle of the jigs can be changed to improve productivity.
- The flame length of the Brazing torch has a massive impact on the time that an Operator uses to braze a plate or pipe. How smaller the flame, the faster the brazing process is, but how larger the flame, how longer the brazing process becomes. Although it sounds simple, some of the brazing operators complained, that when the flame is shorter, they get tired easier than when the flame is larger. This can also affect the problem of not reaching the target in only day shifts.

Figure 35: Cause and Effect Diagram



### 4.3 Detailed Solutions/Improvements

After the gaps and planned action were identified, some of the problems were already solved in the duration of the project. This will be seen as quick fix problems. Brazing will be the only problem thoroughly looked at through a Lean thinking perspective.

#### ➤ **Die Casting**

##### Solution/Improvements

It was required by the operator to have a weekly maintenance on the machine, to prevent blocking and so reduce the time the operator spends in cleaning the machine. This gap identified is an already quick fixed problem that has been solved by having the maintenance manager of Flextech service and cleans the machine on a regular basis.

#### ➤ **Production**

##### Solution/Improvement

The Production manager needs to put up target boards, manned by line leaders, at certain departments on the factory floor, such as the assembly line of the Front PKB. The production manager also needs to address the situation of unavailable data, by verbally communicating to the Operators so that each operator has five minutes in an hour to count their production for the hour and write it on a production sheet as well as with a comment if something went wrong during that hour of production. This is already in progress and will not be further discussed in this project.

#### ➤ **Spot-welding**

##### Solution/Improvements

This problem was seen as a quick fix, which was solved by creating another jig for the spot-welding process which only holds the bracket straight, so that the operator doesn't need to hold the bracket while brazing. This resulted in spot-weld consistency due to no angular spot-welding around the bolt and improved the quality of the bolt spot-welding.

#### ➤ **Front PKB (Assembly-rubber seal)**

##### Solution/Improvements

This problem was also seen as a quick fix solution solved by using a skilled seal rubber assembly operator for the line. Rather than changing the whole production line, only work instructions changed. This however has already taken place and resulted in continuous flow of the assembly line with no heaped batches in front of the different workstations.

**Figure 36: Improved Cycle time**

| FUTURE PROCESS (CONTINUOUS FLOW) |         |         |        |         |        |     |       |        |         | Average time (sec)              |
|----------------------------------|---------|---------|--------|---------|--------|-----|-------|--------|---------|---------------------------------|
| 1                                | 2       | 3       | 4      | 5       | 6      | 7   | 8     | 9      | 10      |                                 |
| 188.322                          | 152.682 | 141.786 | 132.36 | 141.318 | 93.468 | 123 | 121.8 | 132.99 | 122.214 | 134.994                         |
| TOTAL                            |         |         |        |         |        |     |       |        |         | 134.994 seconds<br>2.15 minutes |
| Difference in time:              |         |         |        |         |        |     |       |        |         | 50.25 seconds                   |

As seen in Figure 33, the current situation's total assembly cycle time worked out at an average of 186 seconds. Figure 36 shows the future process as already implemented, with a total average assembly cycle time of 135 seconds. This gives a reduction of 50.25 seconds in total assembly cycle time, for the continuous flow process.

➤ **Crimping Process at Front PKB Assembly Line**

**Solution/Improvements**

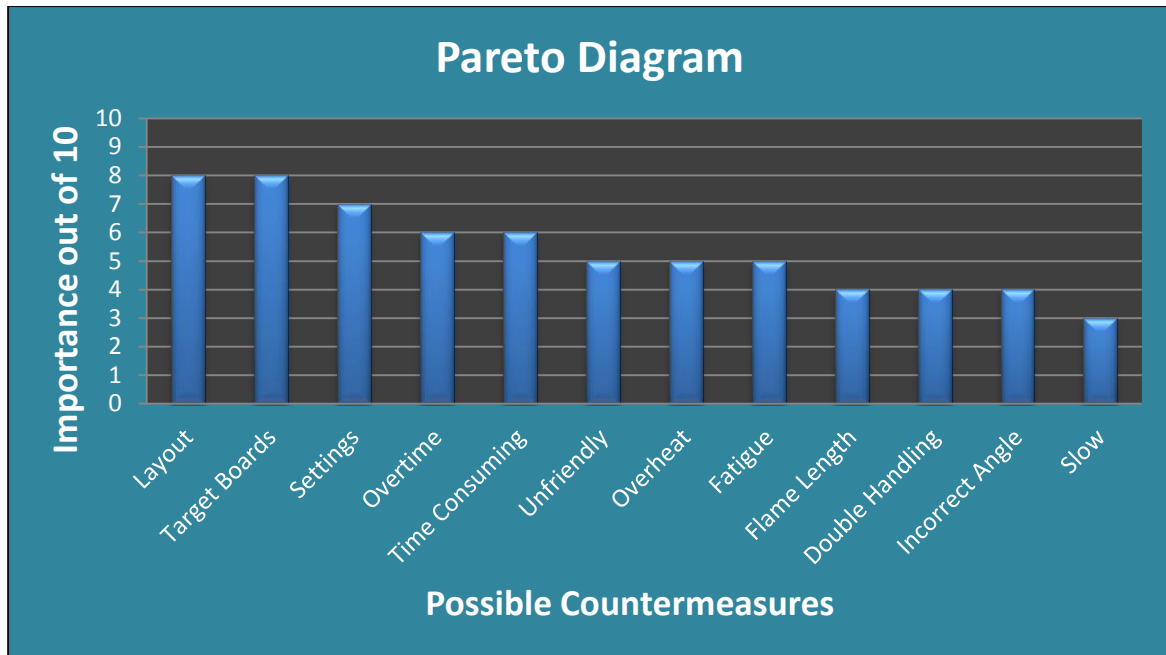
After thorough analysis the problem was detected and solved by changing the jig inside the press. It was discovered that the jig was worn out and if a screw end was crimped the result showed that the corners of the square crimp was round due to the worn out jig.

➤ **Brazing**

**Countermeasures**

After looking at all the possible causes as seen in Figure 35, an importance factor out of ten was given to all the possible countermeasures, as to establish the most important factors that need to be concentrated on for this project. A Pareto Diagram, seen in Figure 37 was drawn up to show the comparison of the importance.

Figure 37: Possible Countermeasures



The Pareto Diagram shows that the main problems that are necessary to emphasize for this project is Layout and Target Boards.

Target boards are requirement indicators set in the operators 'view which shows the hourly target that must be reached so that daily demands can be met. These boards must be completed every hour on a daily basis, where weekly and monthly data will be captured. Updates should also be made when forecasting or daily demand changes according to Ford.

The Layout which is shown in the current situation, Figure 34, will be redesigned to improve the flow of material and eliminate double handling.

The countermeasures, Layout and Target Boards are linked and can be used together to get the best possible results. Both these countermeasures, as seen in Figure 38 and Figure 39, have almost the same improvements and so will be discussed together to show the link between them.

- Man

Productivity: When the target board and layout are implemented, the operators will be forced to work more productively as they have to meet a certain requirement per hour. The layout will then also improve the productivity of the operators due to the time less spent on double handling and more on brazing.

Throughput and cycle time: By improving the productivity through the target boards and the layout, the continuous flow and hourly requirement that will have to be met, will improve the amount of brazed brackets and will also shorten the cycle time due to the fact that the operators will have to work at a certain rate and percentage of utilisation.

- Machine

Improve Utilisation: The machine's usage will improve when more brackets need to be brazed per hour according to the target and the continuous flow. This will continue to increase with time in the future until 100% utilisation will be reached.

- Material

Flow: As linked with the above mentioned improvements, by implementing a new layout for the brazing section, the flow of the material will be more continuous than the current situation seen in Figure 35.

Meet Target: The material will be given to the spot-welders on time with the correct amount, without any overtime used.

- Method

Planning and stream line: The method, brass welding will be planned better so that all management will know where to find what brazed part on the improved layout as well as planned on what needs to be made and when according to the target board. Intense operator observations from the production manager can take place with the layout and target board in place.

**Figure 38: Countermeasure: Target Boards**

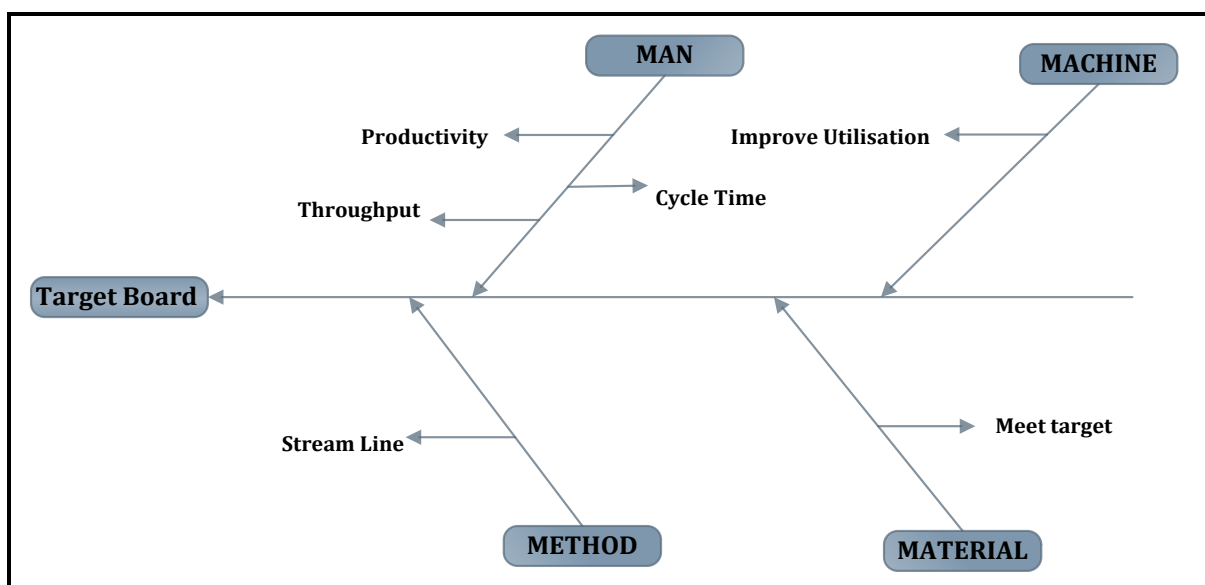
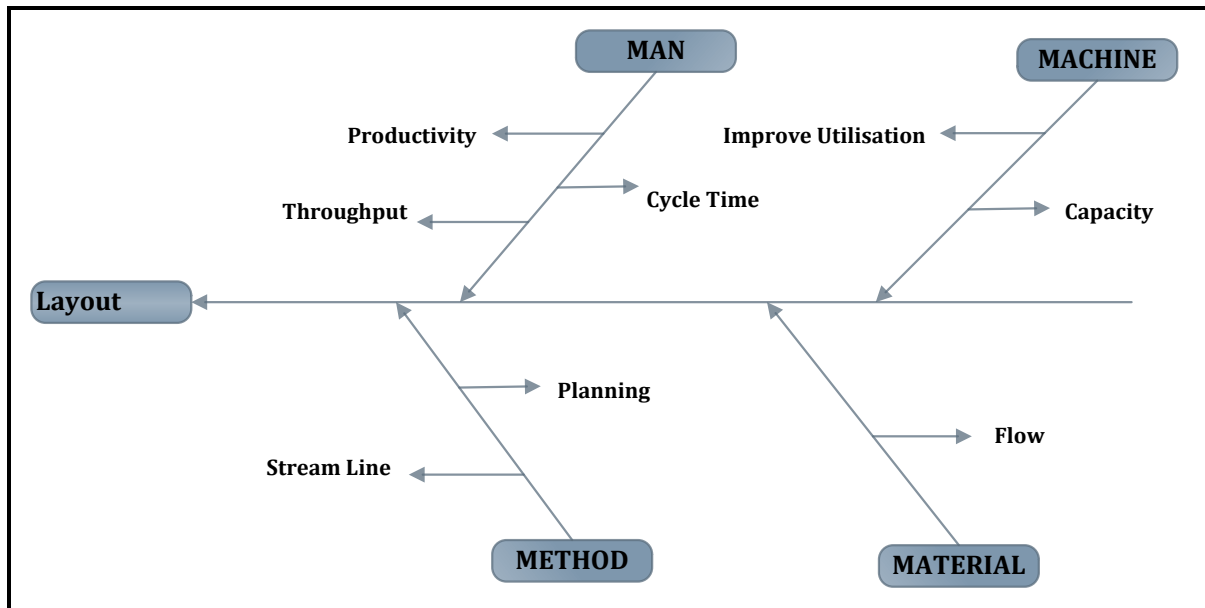


Figure 39: Layout Countermeasure



➤ **Plan**

**Improved Layout**

The proposed layout is seen in Figure 40. This layout shows all the workbenches moved in one line to reduce material handling and reduce the lack of concentration due to communication between Operators while busy brazing. The move and increase of Operators will reduce the cycle time of four finished brazed brackets with half of the time that was spent in the current situation. This layout will result in only using the day shift, as will be further discussed in the Target board planning.

The proposed process flow as seen in Figure 40 will work as follows:

1. The raw material which consists of pipes and gussets are already in place, on a table next to Operator one, for the daily brazing to start. Operator one has already proven that at this station more than the daily demand of 600 pipes can be brazed. As discussed in the current situation under Gap Analysis, Operator one can provide enough brazed pipe for night shift and day shift and still enough for the next day's day shift. This station is not considered a buffer for this project's scope but will be monitored for future improvements.

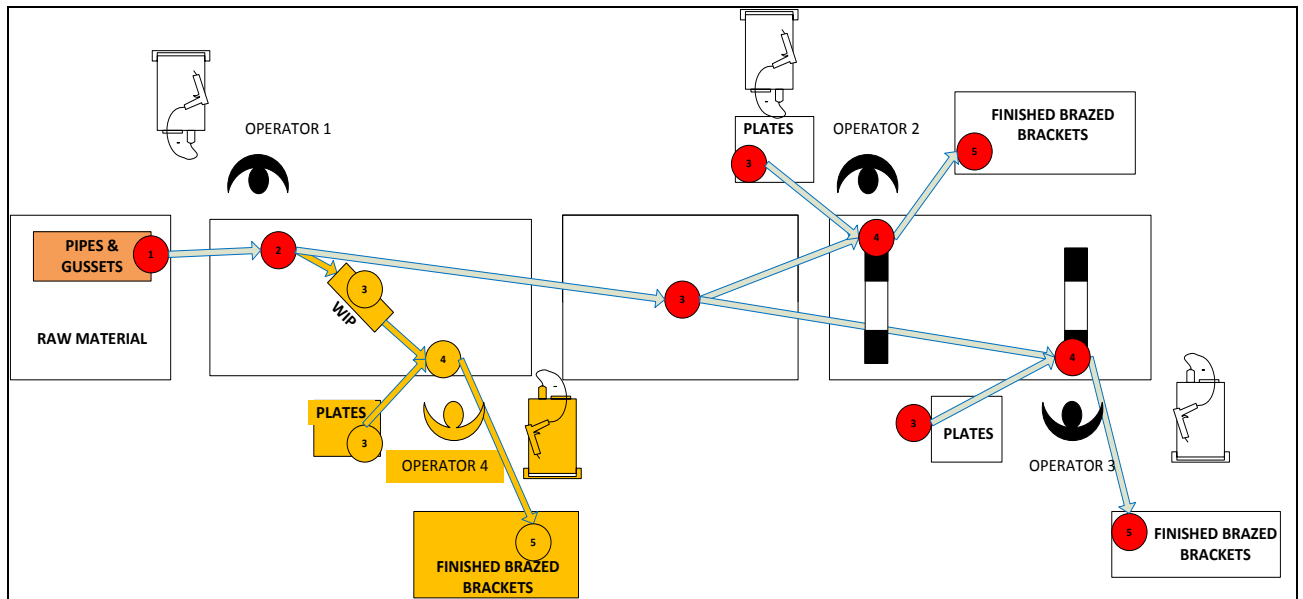
Operator one takes the gusset and pipes from the table and sets up the four pipes and gussets.

2. Operator one brazes the parts. After each four brazed pipes, Operator one puts the four brazed pipes into a cooling bin, as the brazed pipes are extremely hot.
3. The cooled down pipes as well as the blanked and formed plates from the Press shop, is then taken by Operator two and Operator three, to be used in their brazing process.
4. Operator two and Operator three braze only two plates at a time which differs from the current situation, where Operator two brazed all four plates. This will result in shortening the cycle time of four plates from an average of six minutes to an average of three minutes. Giving the same amount of finished brazed brackets in half the time. The jig used in the current situation, will still be used, but will be managed by two operators at a time. These operators may not work directly in front of each other, as visual results showed that Operator two's flame of the torch will burn Operator three if both are brazing at the same time. That is why the work space of each Operator two and three will be on opposite sides of the jig. The jig will still be able to rotate, so that both operators can work on two plates, on the opposite side.
5. After the plates are brazed, the finished brazed brackets are then placed in a cooling bin, as these brackets are also, just as the brazed pipes, extremely hot. The spot-welder for the day will fetch the finished brazed brackets every afternoon, as to have the spot-welding station ready for production in the morning.

YELLOW SECTION (In case of not meeting deadlines): The yellow section indicates another Operator four, which will not be used for daily brazing jobs, but will be used in case of an emergency when something went wrong so that the 600 target was not met. This will then also be a station where the second, third, fourth and fifth step, as explained above, will take place. This station will only be able to braze one plate at a time. This station will also be used for other brazing parts of Flextech.



Figure 40: Improved Layout



### Target Board

After complete implementation of the improved layout, a target board needs to be set up at the brazing area, so that all three operators have clear view of their target boards. Three target boards will be made for each operator, as it was clearly seen after a few daily studies that competitiveness will motivate the operators to meet their daily targets.

As seen in Figure 41, the daily, weekly and monthly target will be displayed on the target boards as asked for by management. Only the day-target will be hourly coloured in by the Operators. It has been decided by Flextech's management to use an 80% utilisation throughout the day. The mornings are much more productive than in the afternoon, where the daily demand's variety will be even out. Comments must be given by each individual operator if he/she did not make the hourly target.

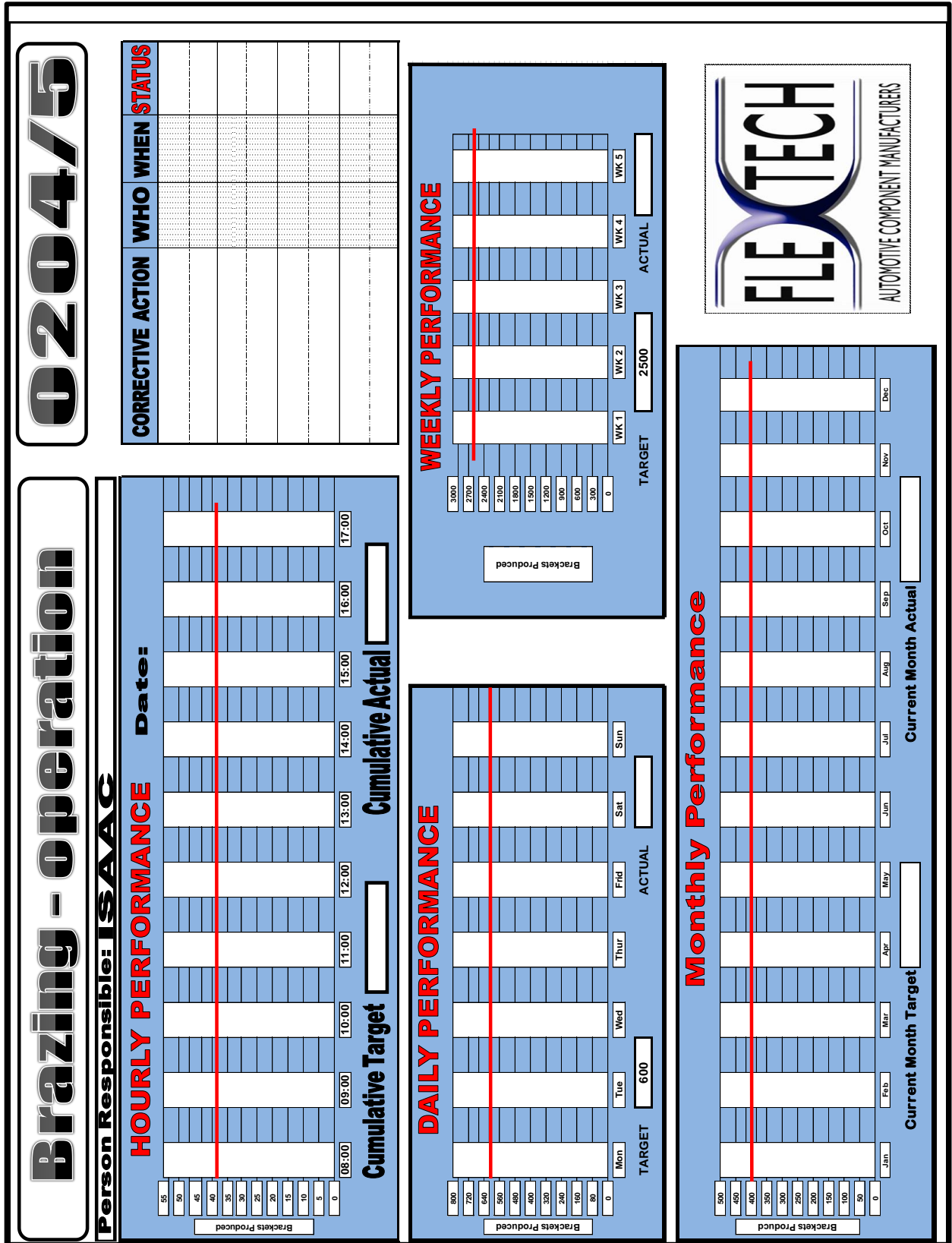
In Table 5 the target board calculations are shown. This shows that at an 80% utilisation, each operator needs to provide an average of 38 finished brazed brackets per hour. This will result in 342 brazed brackets per operator in only using day shift. A daily target of 684 brazed brackets will then be able to be produced, although only 600 is required. This gives the production floor manager, an estimated 84 variable finished brazed stock. This means, that if the target is not met, and it is still more than 600 but less than 684, the requirement of the day is met with a variable safety stock.

As seen in Table 4, a tact time of 54 seconds per brazed plate was calculated, by taking the minutes available dividing it with the daily demand required.

Table 4 also showed the different test results on cycle time. This included the average cycle time of the slowest possible operator, a trainee with a result of 3:45 minutes. An experienced older operator, which resulted in an average cycle time of 3:19 minutes, and the fastest younger operator, which resulted in an average cycle time of 2:44 minutes. Taking these test results and getting an average time it will take to braze two plates, resulted in 3:01 minutes. This average was then divided by two to get the time it will take for only one bracket to be brazed, 1:30 minutes.

In Table 4, 1:51 minutes were the average for brazing on the jig which could only braze one plate at a time. Taking the average between 1:30 minutes and 1:51 minutes resulted in an average time of 1:24 minutes per finished brazed bracket. By calculating the total amount of brackets that can be brazed per day as 436 brackets at a 100% utilisation, the total amount of bracket that could be brazed per hour resulted in 48 finished brazed brackets per hour at 100% utilisation. Brackets per day were then calculated for possible utilisations, shown in Table 4, for one operator, two operators or three operators.

Figure 41: Example of Target Board



**Table 5: Calculations of Target Boards**

| <b>Current Situation</b>              |  |                                   |
|---------------------------------------|--|-----------------------------------|
| <b>RESULTS</b>                        |  |                                   |
| 1                                     | Operator 1: Brazing gusset onto pipe ( brazing 4 at a time)  | 3:14 minutes (average cycle time) |
| 2                                     | Operator 2: Brazing pipe onto plate ( brazing 4 at a time)   | 6:31 minutes(average cycle time)  |
| 3                                     | Total time for 4 brazed brackets                             | 09:45 minutes(average cycle time) |
| 4                                     | Hours in a day   | 9 Hours                           |
| 5                                     | Minutes in a day   | 540 minutes                       |
| 6                                     | Brazed Target per day  | 600 brackets                      |
| 7                                     | Takt time 540/600 (suppose to be)                            | 54 seconds per part               |
| <b>Improved Layout</b>                |  |                                   |
| <b>RESULTS</b>                        |  |                                   |
| 1                                     | Operator 1: Brazing gusset onto pipe                         | 03:14 minutes(average cycle time) |
| 2                                     | Operator 2 : Brazing pipe onto plate                         |                                   |
| 2a                                    | Trainee A: (only two brackets)                               | 3:45 minutes(average cycle time)  |
| 2b                                    | Operator B (Current Day shift operator-brazing 2 brackets)   | 2:44 minutes(average cycle time)  |
| 2c                                    | Operator C (Current Night shift operator-brazing 2 brackets) | 3:19 minutes(average cycle time)  |
| 2d                                    | Operator D (Current Night shift operator-brazing 1 bracket)  | 1:51 minutes(average cycle time)  |
| 3                                     | Average time to braze two brackets (A,B,C)                   | 3:01 minutes                      |
| 4                                     | Average time to braze one bracket (A,B,C,D)                  | 1:24 minutes                      |
| 5                                     | Hours in a day   | 9 Hours                           |
| 6                                     | Minutes in a day   | 540 minutes                       |
| 7                                     | Brazed Target per day  | 600 brackets                      |
| 8                                     | Takt time 540/600 (suppose to be)                            | 54 seconds per part               |
| 9                                     | Average Brazed brackets per day ( 540 min / 1:24 min)        | 436 brackets                      |
| 10                                    | Average Brazed brackets per hour ( 436 brackets / 9 hours)   | 48 brackets                       |
| <b>Bracket Utilisation per hour</b>   |  |                                   |
| <b>Per Operator (minimum)</b>         | <b>2 Operators (used)</b>                                    | <b>3 Operators (maximum)</b>      |
| 48 parts at 100% utilisation per hour | 96 parts per hour  | 144 parts per hour                |
| 38 parts at 80% utilisation per hour  | 76 parts per hour  | 114 parts per hour                |
| 36 parts at 75% utilisation per hour  | 72 parts per hour  | 108 parts per hour                |
| 24 parts at 50 % utilisation per hour | 48 parts per hour  | 72 parts per hour                 |
| 15 parts at 30% utilisation per hour  | 30 parts per hour  | 45 parts per hour                 |
| 10 parts at 20 % utilisation per hour | 20 parts per hour  | 30 parts per hour                 |

# Chapter 5: Improvements

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## 5.1 Improvement Implementation Plan

### 5.1.1 Continuous Improvement process

Kaizen is a practise that if implemented correctly it can improve continuous flow in the entire business and not just in one specific area. This is a method that will greatly suit Flextech because of the integration it brings to the factory as a whole where communication is the key.

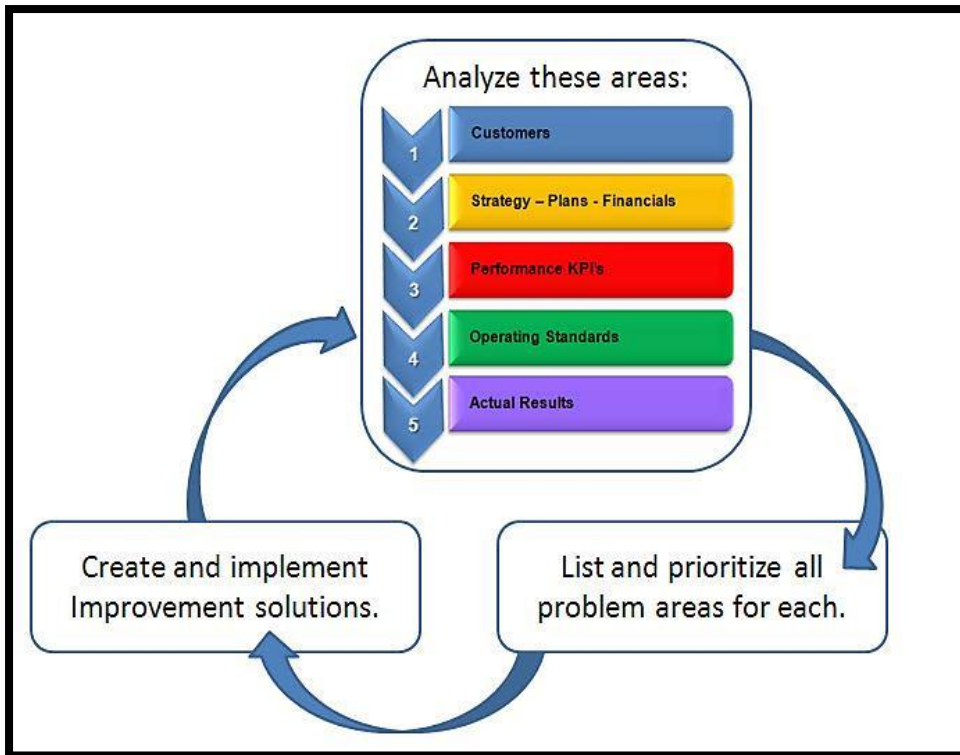
Kaizen can be implemented in Flextech using the following steps guided by Workwise Inc., 2012;

1. Identify the problem area and select a process.

To identify the problem areas, the following criteria seen in Figure 42 can be analysed.

- The customers; improvements that are suggested by customers so that the needs and wants can be achieved in desirable time.
- Strategy plans; the finances of Flextech, how they are managed and where the key problems in this specific department could be.
- Performance KPI's;
- Operating Standards; where continuous problems occur in the operation process of the Front PKB cable.
- Actual results; analyse the results of the previous mentioned criteria above.

Figure 42: Kaizen Process



According to: <http://www.workwiseinc.net>

2. Organize the team.  
Human resource department will be asked to organise the team that will be responsible for implementing and managing the Kaizen process in Flextech.
3. Map the critical process.  
A QMS (Quality Management System) and BPR (Business Process Recording tool) need to be available and regularly updated.
4. Document current performance, root cause, waste, objectives.  
This again will be accomplished by the QMS as well as shop floor control done on a regular basis. All upcoming continuous problems occurring must be documented.
5. Simplify Research and develop alternatives.  
The Kaizen team will need benchmarking and brainstorming to develop alternative solution to the continuous problems identified on the shop floor.
6. Compare, verify and document results.  
Implement the brainstorming and benchmarking ideas.
7. Standardize and implement the improvements.

## 5.2 Implementation Road Map for Flextech

By using the Kaizen process as a baseline for creating a road map for Flextech, a Gantt chart was created as seen in Figure 43. The Road map was implemented on the Brazing problem as discussed in Chapter 4. The process is as follows:

1. Identify the problem in Flextech. For project purposes the Brazing area was used as an example to show how the map will be used to solve problems using Lean thinking tools.
2. Choose a project team that consisted of managers as well as the operators at the brazing area.
3. Investigate the Brazing area, by asking operators questions, collecting data, spending time at the different working stations and understand the method of brazing and how the operators work.
4. Grasp the situation: Visually analyse the process, by taking photos and drawing up the flow of the process.
5. Start on the project reporting method which includes;
  - The title of the project, which describes the project's main focus.
  - The background: Daily requirements, methods used, amount of operators used.
  - The Current Situation: Describing why this is a problem by identifying how the process is working at the moment.
  - The Goal: What wants to be achieved after this project is completed and signed off by management.
  - Causes of the Gap: Draw up cause and effect diagrams to understand what the problem is and what resulted in this problem by looking at Man, Machine, Material, and Method.
6. Identifying the possible countermeasure: This needs to be drawn on a countermeasure Fishbone diagram. What possible improvements can be made by changing certain problems such as the layout and the target boards.
7. Plan how the countermeasures will be implemented for improvements.
8. Draw up the plans, such as the improved layout and suggested target boards.

The steps form 1-8 has already been implemented as seen in the previously discussed Chapters. The Gantt chart shows the time that will be spent on the future steps that still need to take place to implement this Brazing solution. These steps are discussed below;

9. Divide the Countermeasure plan between the Lean Team members. Make sure that the member chosen is familiar with the problem and the area which he/she will take responsibility for.
10. Create a follow-up plan which includes daily meetings on production scheduling, feedback on improvements, daily requirements, brazing problems that needs to be solved and possible improvements.
11. Capture all the follow up meetings' improvements, daily target board's data and weekly time studies as to see if the layout made a change.
12. After a six week period, a meeting with management will be held at Flextech to show all the improvements and a graph which shows the daily or weekly improvements.
13. When the project is done, the Lean Team Leader will sign off the project as improved, but still keep the process under supervision.
14. Flextech is closed for the December holidays.
15. A new project will be identified, until all the areas on the production floor have been improved with the new Lean Road Map.





# Chapter 6: Recommendations

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## 6.1 Conclusions and recommendations

Thorough investigation and research were done on Lean thinking tools, how to implement lean in small to medium manufacturing companies and the possible improvement that can be achieved through eliminating non value adding waste.

After analysing Flextech, problems were identified at the Ford Front PKB Cable process. This process was used to implement Lean thinking tools, such as the Value Stream Map. Value added and non-value added processes were shown on the Value stream map as to identify the gaps.

The gaps identified in the Front PKB Value Stream Map, was analysed for possible improvements or solutions on these gaps. Most of the gaps were quick fix problems which were solved throughout the duration of the project. The key focus however was drawn to the brazing area. The proposed Road Map for Lean implementation was used to analyse what the problem is and the possible countermeasures that can be used to solve the problem. The goal was to achieve the requirement of 600 brazed brackets per day and 2500 brazed brackets per week by using only the day shift.

The current layout of the brazing area was changed to improve the material flow and to eliminate double handling of the material. A target board was designed to motivate the operators and so to meet daily requirements in only using day shifts.

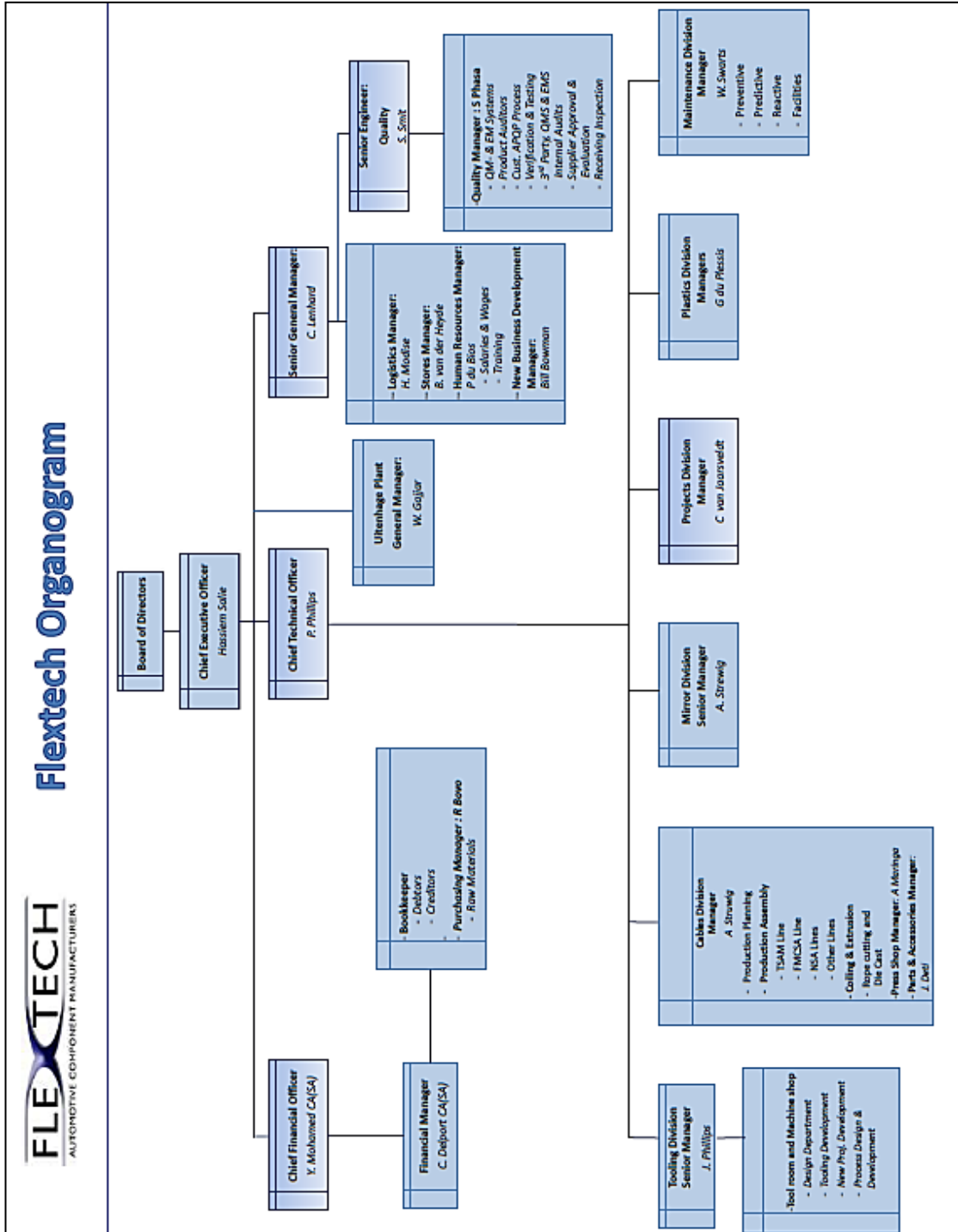
The Gantt chart in Chapter 5, illustrates the implementation plan of Lean in this project. Step 9 to 15 will be done, by the Lean team members, during October 2012 until January 2013. This project however will be fully implemented by middle December 2012.

## 7. Referencing

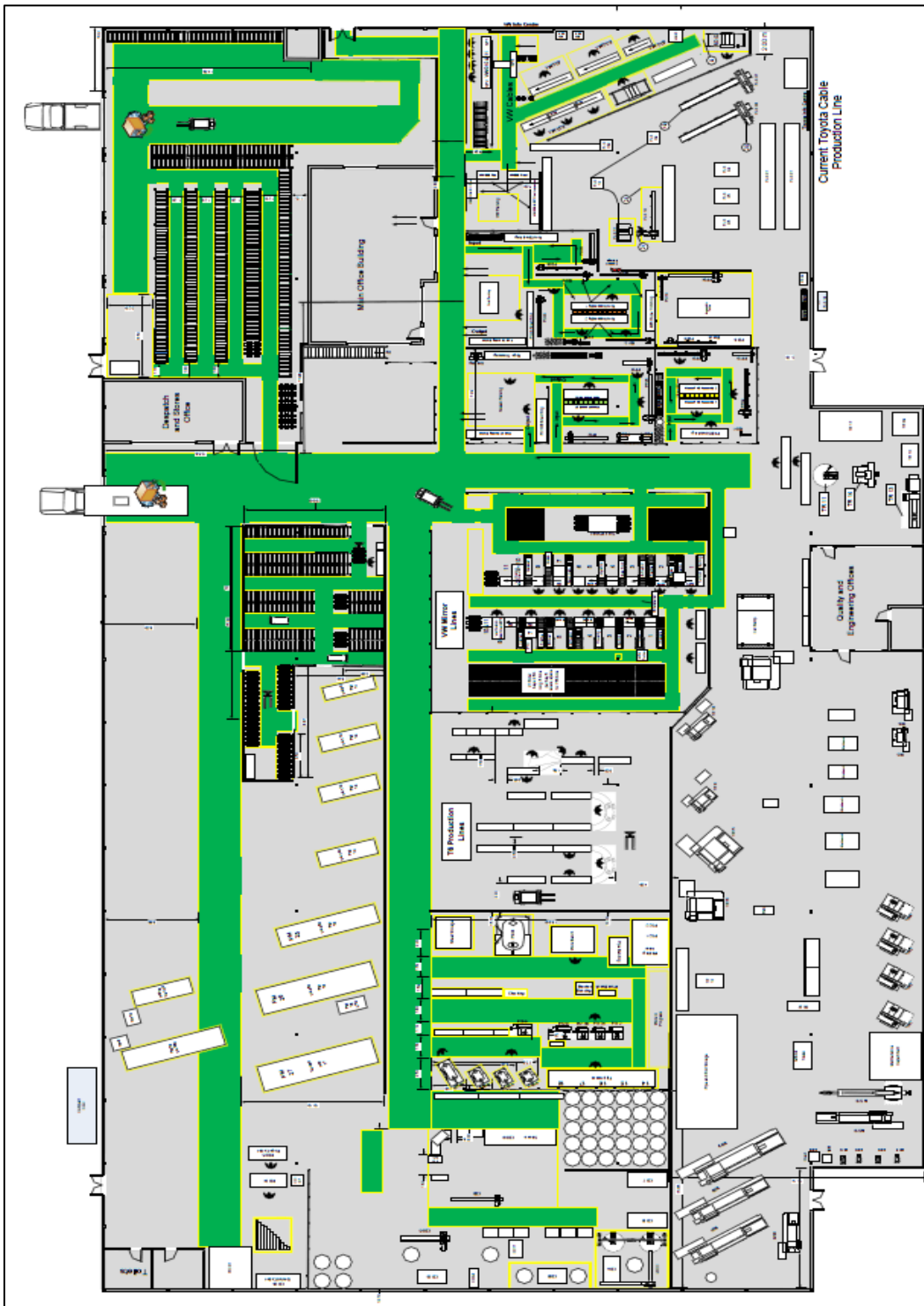
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# 8. Appendices

## 8.1 Organogram



## 8.2 Floor Plan



### 8.3 Key structured discussions

## Problem solving Survey

**Division** Machine Shop **Manager:** Jonathan Phillips

1 What is the main problem in your Division?

Defects + Identify where defects come from.  
 ↳ Tracability of defects.

2 Why is this a problem?

Processes not being followed according to work instructions  
 Scrap rate < 1%.

3 What will you recommend as a feasible solution for this problem?

Upskilling, Ensuring work instructions are followed properly,  
 if not, the correct disciplinary <sup>measures</sup> ~~actions~~ to be put in place

4 What would you describe as waste in your department that is unnecessary?

Room Off cuts from bars. (± 250mm per bar).  
 Reworking defect parts.


5 Choose one of the 7 wastes, most common in your division.

|                       |                                     |  |
|-----------------------|-------------------------------------|--|
| Overproduction        | <input type="checkbox"/>            |  |
| Waiting               | <input type="checkbox"/>            |  |
| Transportation        | <input type="checkbox"/>            |  |
| Unnecessary inventory | <input type="checkbox"/>            |  |
| Unnecessary motion    | <input type="checkbox"/>            |  |
| Over processing       | <input type="checkbox"/>            |  |
| Defects               | <input checked="" type="checkbox"/> |  |

6 What risk rating, out of 10, will you give your waste, chosen in number 5? (10-high risk, 5-moderate, 1-no risk)

5

7 What will be the best way to solve this waste at number 5?



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## Problem solving Survey

Division

Quality

Manager:

Stephan Smit

1 What is the main problem in your Division?

DEVIATIONS ON PARTS & MATERIALS

2 Why is this a problem?

INCORRECT LEAD TIMES & LOGISTICAL ACCURACY

3 What will you recommend as a feasible solution for this problem?

RELOOK CURRENT LEAD TIMES & IMPLEMENT A HIGHER BUFFER STOCK. THEN GRADUALLY DECREASE THE BUFFER TO A SAFE STOCK HOLDING LEVEL.

4 What would you describe as waste in your department that is unnecessary?

PEOPLE WORKING SHIFTS

5 Choose one of the 7 wastes, most common in your division.

Overproduction  
Waiting  
Transportation  
Unnecessary inventory  
Unnecessary motion  
Over processing  
Defects

|  |
|--|
|  |
|  |
|  |
|  |
|  |
|  |
|  |

6 What risk rating, out of 10, will you give your waste, chosen in number 5? (10-high risk, 5-moderate, 1-no risk)

5 INCORRECT OR UNNECESSARY INVENTORY FORCED PRODUCTION TO WORK A NIGHT SHIFT. PRODUCTION CANNOT OPERATE WITH OUT SUFFICIENT QA/QC

7 What will be the best way to solve this waste at number 5?

RELOOK LEAD TIMES, ALTERNATIVE SUPPLIERS CALLING SYSTEM ON PULL ASH RATHER THAN PUSH PULL.

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