UTILISING VALUE STREAM MAPPING TO IMPROVE OPERATIONS AT TRANSWERK UITENHAGE

BY

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DECLARATION
I Andile Elliot Silo declare that the copy of this treatise is my work and all the sources used have been quoted. This treatise has not been submitted by me for a degree in any institution.

Andile Elliot Silo

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Promoter: Prof JJ.Pieterse

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ABSTRACT
Transwerk is a business unit of Transnet. It was established in 1940. Since 1940 until 1994, Transwerk operated as the engineering section of Spoornet and was known as South African Railways.

Transwerk emancipated in 1994 and had plants in all nine provinces of South Africa. In the past, trains were hauled by steam locomotives, which were manually operated. With the improvement of technology, steam locomotives were replaced by diesel locomotives. The recent technology improvement brought about electric locomotives which are more reliable than diesel locomotives.

With the introduction of Transnet in 1994, Transwerk was separated from Spoornet. Transwerk focused on maintaining and refurbishing wagons, coaches and locomotives for Spoornet.

Transwerk maintains and refurbishes passenger trains, locomotives, coaches and wagons. In 1995, Transwerk introduced a concept of focused businesses instead of departments. Each business focused either on locomotives, wagon building and refurbishing, coach and components.

Transwerk has a plant in the Eastern Cape Province which is situated in Uitenhage. This plant focuses on refurbishing wagons for Spoornet. This research is about improving the refurbishing processes of Transwerk Uitenhage.
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CHAPTER ONE

Transwerk Overview and Research Plan

1.1 INTRODUCTION

The business environment has changed during the last ten years. It seems no industry is immune to the direct or indirect consequence of global competition. For many organisations, obsession with quality and productivity is evident. Womack (1996:10) maintains that very few organisations take into consideration the following:

- Production of items which are not needed
- Mistakes in processes which require rework
- Steps in the production process which are not actually needed
- Movement of employees and transportation of goods from one place to another without any purpose.
- A group of employees downstream who are standing without any work to performs.

As much as 60 percent of operations in a manufacturing business do not add value to the product and customer, (www.wmep.org/valuestreammapping.html).

World-class organisations tend to invest on sophisticated technology with the intention of saving costs. This form of
cost saving only applies to reduced labour costs, which is a short-term solution to the problem of inefficiency.

According to Womack (1996: 1), in this day and age, managers are forced to think lean. Some organisations, especially in the manufacturing industry, have decided to implement Lean Six Sigma. George, Rowlands and Kastle (2004: 4) maintain that using Six Sigma in the organisation has the following benefits:

- Helps the organisation become more profitable by cutting costs, improving delivery time, reducing inventory and increasing customer satisfaction.
- Develops valuable job skills such as decision-making, problem solving and teamwork.
- Makes the workplace better by getting rid of waste.

Transwerk, the core business unit of Transnet, which focuses on refurbishing, will be briefly discussed, depicting the problem that they are now facing. The main problem will be identified and addressed by this study.

This will be done by identifying the sub-problems, establishing and confirming the key assumptions, conducting literature studies and implementing the philosophies and principles identified in the literature study at Transwerk. This study is aimed at answering the question of how value stream mapping will be used to add value to the bottom line of Transwerk and eliminate all non-value adding activities in the process flow of refurbishing rolling stock.
1.2 BACKGROUND

Transwerk is an engineering division of Transnet, comprising a group of product-focused businesses that concentrate on refurbishing, upgrading and manufacturing rail related transport products. Transwerk’s objective is to meet and exceed all the commitments, obligations and expectations of all its stakeholders. Aspects such as delighting the customers, harmonious working relations with labour and sustainable profitability are core to Transwerk’s objectives.

While Transwerk’s most valuable customers are Spoornet and the South African Railway Commuter Corporation (SARCC), it is positioning itself as a world-class competitor in the international market and in Africa in particular. Strict adherence to business imperatives, corporate governance and legislation has made Transwerk an efficient, profitable and environmentally friendly world-class company. (Transwerk Corporate Strategy, 2006:3)

Transwerk actively supports the government’s initiative and programmes of economic growth strategy, black economic empowerment, and employment equity and skills development in an endeavour to redress the historically disadvantaged people of South Africa.

The vision, mission and the company’s values are the main drivers of the manufacturing system in Transwerk. The entire manufacturing and refurbishing process is controlled by SAP system. SAP controls the procurement of raw materials, which consist mainly of steel purchased from Mac Steel and
Transwewrk also procures components from Dorbyl RSD and Knorr Brehmse in the United States of America.

The SAP system is therefore aligned to the strategy of the company through good corporate governance by means of regular audits of transactions, delivery of raw material, contractual agreements with suppliers and customers as well as processing and delivery of a final product to Spoornet. The vision, mission and values are set out below (Transwerk Corporate Strategy, 2006:5).

VISION

Africa’s Undisputed World Champion in Transport and Logistic Solutions.

MISSION

Transwerk is a Rail Related Transport Business that Strives to Delight the Customer Focusing on Engineering Excellence in Refurbishing, Upgrading and Manufacturing whilst exceeding all its Stakeholder Expectations.

VALUES

Transwerk’s values are entrenched in integrity, honesty, trust and respect. It values highly, business excellence, customer focus, commitment and good work ethics. Furthermore, good leadership, teamwork, empowerment, innovation and equitable
distribution are Transwerk’s hallmark. (Transwerk Corporate Strategy, 2006:8).

1.3 BUSINESS STRUCTURE AND LOCATION

The activities within Transwerk were consolidated into product-focused, ring fenced businesses consisting of Rail Freight Refurbishment, Coaches, Locomotives, Wagon Build, Wheels, Components and Tarpaulins. These products are sold to Africa and European countries. These businesses are located throughout the seven centres in South Africa.

Work is carried out at Germiston, Koedoespoort, Salt River, Durban, Bloemfontein, Langlaagte and Uitenhage. However, while the Rail Freight Refurbishment business is located in Durban, Germiston, Bloemfontein and Uitenhage, the locus of speciality in the different centres is diverse. The same applies for the rest of the product-focused businesses.

A National Business Manager is responsible for the product-focused business and the performance criteria are cascaded down from the National Business Manager to the Local Business Managers.

A Centre Manager is assigned at each centre and has the responsibility to ensure that financial targets, transformation targets in terms of affirmative action and Black Economic Empowerment are met and exceeded. Production and efficiency improvements, waste reduction and overall cost effective running of the business are expected from a Centre Manager. The following organogram of Transwerk depicts the structure of Transwerk ring fenced businesses as discussed above:
1.4 MAIN PROBLEM

South African businesses are facing unforeseen opportunities and threats following the country’s remarkable political transformation that culminated in its first non-racial, democratic elections in April 1994 (Kruger, 1997:138).

The rail industry of South Africa is characterised by inefficiencies and failure to transport goods on time. Transnet is the major player in the rail transport industry in South Africa. Transnet Chief Executive Office, Maria Ramos, supported by the Department of Trade and Industry, identified these inefficiencies.
As a result of these inefficiencies, Transnet has decided to embark on a five-point turn-around strategy, which included restructuring of all their business units with the objective of disposing of all non-core business units, and consolidating all core businesses. Transwerk is one of the five core businesses of Transnet.

Every so often one reads in the new papers that manufacturing industries are doomed unless the government gives them more tax cuts or other forms of tax break (Cole, 2005:3).

Global competition is based on reduced waste, good product quality, efficiency and cost reduction. Toyota in Japan was the first manufacturing company to develop and apply lean manufacturing practices through Toyota Production Systems (Cole, 2005:13).

Lean manufacturing is a manufacturing strategy that seeks to attain a high level of throughput with a minimum of inventory (Wisegreek, 2005). One of the primary focuses of lean manufacturing is to reduce waste by eliminating what does not add value to the bottom line of the organisation.

Lean Six Sigma was subsequently introduced as another wing of lean manufacturing. It focuses mainly on delighting the customer by meeting and exceeding product quality and speed of delivery and in so doing meeting the organisational goals, (George, Rowlands and Kastle, 2004:25).

Value Stream Mapping (VSM) is a combination of both Lean manufacturing and Lean Six Sigma. Value Stream mapping is a method of visually mapping the flow of information and
material from raw material through all manufacturing processes until final product stage, (Williams, 2004:1). George et al (2004: 28) state that Value Stream Mapping has the following benefits:

- Helps to visualise the production process at plant level and not just the process. It is a holistic concept.
- Helps one see the sources of waste in the organisation.
- It shows the linkage between information flow and material flow.
- It forms the basis of the implementation plan and serves as a point of departure in the improvement of manufacturing processes.
- It ties together lean concepts and other manufacturing techniques to enable improvements that are reflected on the organisation’s bottom line.

Lovelle(2003:22)stated the value of VSM as “Powerful but simple, no other tool can outline and distinguish the true value of a product as Value Stream Mapping can “.

Multinational companies that reside in South Africa have started implementing lean manufacturing techniques. Ford Motor Company of South Africa and Toyota South Africa have implemented lean manufacturing techniques through Ford Production Systems (FPS) and Toyota Production Systems (TPS).
Transwerk, as the major rail transport producer and refurbisher in South Africa, and as a global competitor is not exempted from these world best practices. Transwerk Uitenhage is currently using a Kanban system to control manufacturing and refurbishing process, which is not even applied consistently throughout the organisation. There are daily material shortages, which lead to wasted time and inability to meet daily output and customer demand. This tendency subsequently leads to lost profits and customer dissatisfaction.

Raw material is received and accepted by Inventory staff without proper inward inspection. Raw material defects are only identified during the manufacturing and refurbishing process. This also leads to lost production and wasted time through rework.

Bills and routing for the fabrication of material into Work in Progress remain incorrect. Fabricated material issued to production lines for fitment onto wagons is processed backwards. Fabricated material is returned to inventory stores as Work in Progress. This material gets drawn from inventory stores to production lines. This is a time consuming flow. Before the wagon, final product is delivered to Spoornet, their representative is called to inspect and accept or reject the wagon.

This process described above leads to the discussion that Transwerk has poor quality systems and fails to delight the customer. Transwerk is always behind on agreed delivery schedules with Spoornet due to the problems mentioned above. This lag in the delivery of wagons to Spoornet creates problems for Sasol, who is Spoornet’s major client.
This leads to the research question mentioned below which will be addressed by this research:

**How can Value Stream Mapping at Transwerk be used to add value to the bottom line?**

### 1.4.1 Sub problems

In developing a research strategy that will resolve the main problem, the following sub problems were identified:

- What manufacturing best practices are suggested by the literature?
- How is Transwerk applying manufacturing processes from the receipt of raw material through production processes to the release of a refurbished wagon to Spoorncot?
- How can the results obtained from the resolution of the first sub problem be integrated and implemented in Transwerk?

### 1.5 DEFINITION OF SELECTED CONCEPTS

#### 1.5.1 Rail Freight Refurbishment
Rail Freight Refurbishment is a product-focused business unit that is responsible for refurbishing and manufacturing rail transport related products.

1.5.2 SAP

It is a software system that controls the receiving, processing and release of final product, a wagon to the customer. It regulates one process to the other and ensures good corporate governance though regular systems audits. It is inventory control system that controls the delivery of raw material by suppliers and issuing of fabricated and raw material to production lines.

1.5.3 Lean manufacturing

It is a manufacturing strategy that seeks to achieve a high level of throughput with minimum inventory. It is a Japanese methodology that was pioneered by Toyota through Toyota Production Systems. It is centred on placing stockpiles of inventory in certain stations or operations of the assembly line rather than a centralized warehouse.

1.5.4 Ford Production Systems

The Ford Production System is a set of manufacturing principles used by Ford Motor Company and is based on lean manufacturing principles.

1.5.5 Kanban system
It is one of the elements of lean manufacturing. It consists of small bins stationed in strategic positions of the assembly line, where material is stored for easy access and availability against a centralised warehouse. It is aimed at making material available for production without delay.

1.5.6 Value Stream Mapping

Value Stream Mapping is the method of visually mapping the flow of information and material from the time the raw materials are received through manufacturing process to the final product. It maps out the activities in the production process with cycle times, down time, in-process inventory, material moves and information flow paths. It is used to guide the transition from current to future state.

1.5.7 Rolling Stock

Rolling stock is all rail-related products produced and refurbished by Transwerk for transporting rail freight. These products include wagons, locomotives, coaches, wheels and components.

1.6. DELIMITATION OF THE RESEARCH

Delimiting the research makes the research manageable. However, omitting certain topics does not imply that there is no need to research them.
1.6.1. Management level

The research was conducted at the Rail Freight Refurbishing (RFR) business at the Uitenhage centre and involved Production Foremen, Operations Managers and the Centre Manager.

1.6.2. Size of organisation

Uitenhage Rail Freight Refurbishing centre has a staff complement of nine hundred, of which seven hundred and fifteen are in the Wagon Repair Section and the rest in support services. There are thirty-seven middle and senior managers and forty-two production foremen. Transwerk Uitenhage has the following sections:

RFR: This is the wagon repair section and constitutes more than 70 % of the entire workforce. (RFR Uitenhage Financial Business Plan, 2006:1).

Fabrication: This section prepares and fabricates raw material into work in progress, which is used for the refurbishing of wagons.

Machining: The machining of components, which have been removed from old wagons for refitment into refurbished wagons is done in this section.

Wheels: This section refurbishes old wheels, which have been removed from wagons that came in for refurbishing. New wheels are also manufactured in this section on customer request. (RFR Uitenhage Structure, 2001:5)

1.6.3 Geographical demarcation
The empirical component of this research was limited to the Uitenhage Centre and the survey was conducted by means of interviews in which management’s attitudes towards manufacturing and refurbishing processes was tested. Attention was be given only to the RFR business. Coaches, Locomotives and other Transwerk businesses were excluded from this research.

1.7 SIGNIFICANCE OF THE RESEARCH

The results of this research would increase awareness of Transwerk Uitenhage management of the available world best manufacturing practices that can be applied not only by Transwerk Uitenhage, but also throughout all Transwerk seven centres in South Africa. This would increase Transwerk competitiveness by improving productivity, quality, reduce waste, cost saving, and customer satisfaction.

It would also produce a motivated workforce through working smarter rather than harder. In addition, it could result in integrated and holistic approach to manufacturing and refurbishing. As Transwerk strives to be a globally competitive organisation, the application of world best practices, with particular reference to manufacturing was be considered and adapted to suit Transwerk Uitenhage. Upon the success of the Value Stream Mapping in Transwerk Uitenhage, the project would be rolled out to other Transwerk plants throughout the country.

1.8 RESEARCH DESIGN
This section describes the broad methodology that has been followed in this research.

1.8.1 Research Methodology

The following procedure was adopted to solve the main and sub problems:

1.8.1.1 Literature survey

The influence of value stream mapping in achieving organisational goals would be identified from the literature.

1.8.1.2 Empirical study

The empirical study consisted of:

- Interviews

Interviews were conducted among production foremen and managers at Transwerk - Uitenhage using a questionnaire drawn up by the researcher to establish the attitudes of production foremen and managers towards manufacturing and refurbishing processes as well as to evaluate the current manufacturing system.

- Measuring Instrument

As mentioned above, the researcher has developed a questionnaire for interviews to determine the attitudes of
production foremen and managers and evaluate the existing wagon refurbishing system.

- Time study

Accurate time study was conducted to determine the cycle time per wagon per station, the time it takes to move a wagon from one station to the next, the time it takes to transfer material from inventory stores to the production lines as well as determining time lost waiting for material. The value stream map was drawn, showing the current state from which a future state value stream map could be drawn, with recommendations.

- Sample

The employees of the Uitenhage RFR centre were used. This included Production foremen, Operations Manager and Centre manager. A sample of five production foremen, two Operations managers and Centre manager was used.

- Developing a value stream map for wagon refurbishment process at Transwerk Uitenhage

The results of the literature survey and the empirical survey were integrated to develop a value stream map that would reduce waste, eliminate unnecessary processes and add value to the organisation’s profit line.
1.9 KEY ASSUMPTIONS

In this research it was assumed that:

Assumption One

The organisation had reviewed its business strategy, goals and objectives before manufacturing and refurbishing wagons.

Assumption Two

Top Management, from the Chief Executive Officer to production foremen level, are committed and have successfully driven the implementation process.

Assumption Three

A strong culture of productivity is entrenched within the entire Transwerk Uitenhage organisation.

Assumption Four

All employees were involved in the manufacturing process and are well trained to perform their function.

Assumption Five

All employees take personal responsibility for their work and are competent
Assumption Six

An output measurement method was developed, through which employees can be monitored and measured.

1.10 CONCLUSION

Value stream mapping represents current global best practice for the analysis and improvement of lean operations. It can also be applied to service organisations to ensure that unnecessary activities are eliminated from the value stream. Transwerk will be able to quantify the benefits derived from the value stream mapping through improved profits and speed of delivery of rail related products to their customers. This chapter serves as a roadmap, introducing the reader to the approach that was taken to implement Value Stream Mapping at Transwerk Uitenhage. Literature study was dealt with in the next chapter.
CHAPTER TWO

Literature Study

2.1 INTRODUCTION

This chapter is aimed at introducing the reader to the literature study concerning lean manufacturing principles and value stream mapping. The information gathered in this chapter was used to help the researcher to implement the relevant methodology when conducting value stream mapping at Transwerk Uitenhage.

The purpose of the organisation may be to earn profits for its owners. The mission statement of the same organisation may be to offer a full service or product. The distinction between the mission statement and the purpose of the organisation can be a fine one (Smith and Cronje, 1992:65). The goals at the highest level of abstraction express an organisation's overall purpose, whereas goals at the lower level are relatively specific as shown in Figure 2.1 below:
Figure 2.1. Hierarchy of business goals

Source: (Management Principles, P.J. Smit & GJ de Cronje, 1992 pp 64)

According to Smith, the well-managed business has goals in eight areas as follows:

- Market Standing
  An indication of the percentage market share desired by the firm.

- Innovation
  Recognition of the need to develop new products using best practice methods.

- Productivity
An efficiency measure that relates to resources used to output generated.

- Physical and Financial resources
  The acquisition and efficient use of physical and financial resources.

- Profitability
  An indication of the firm’s profitability as measured by one or more financial indexes, such as return on investment.

- Manager Performance and Development
  Effective conduct of managerial roles and development of potential in the individual.

- Worker Performance and Attitude
  Effective conduct of the managerial roles and maintenance of positive attitudes on the part of employees.

- Public Responsibility
  A consideration for the firm’s impact on society.

These areas can be performed successfully with the application and implementation of Lean Manufacturing principles and Value Stream Mapping.

As global competition intensifies, achieving best practice and would class performance is not just a desirable goal, it is a necessity for survival, (Total Quality Management, 2000:113). Globally active companies today are applying best practices in the form of Lean Thinking, Lean Six Sigma, Lean Manufacturing, Value Stream Mapping et cetera. These manufacturing practices are discussed in the next section.
2.2 Lean Manufacturing

According to Smalley (2005:8), lean manufacturing has dramatically lifted the competitiveness of many manufacturing companies and the value they deliver to the customers.

Smalley states that core elements of Lean Manufacturing were developed in Japan at Toyota Motor Corporation between 1950 and 1955. The following key concepts were tested under strict supervision during the development of lean manufacturing:

- Task time, which is the desired time between units of production output and is synchronised to customer demand.

- Process flow, which is relates to both material and information flows between customer and suppliers who work together in a supply chain.

- Standard work, which is found where the method of doing work has been planned and written in detail and to perform the same each time.

- Single minute exchange of die (SMED), refers to the set up time or exchange of die that can be counted in a single digit of minutes.

- Pull system, this is a system of planning and producing strictly acc to the customer demand.

Smalley (2005:10) further states that the lean manufacturing system is a system of thinking that practitioners can learn by doing. Toyota strives to
implement a framework of helping to establish basic stability in the manufacturing processes. Basic stability implies general predictability and availability of manpower, machines, material and methods of production.

In order to ensure that basic stability in the manufacturing process is achieved, the following points must serve as a yardstick:

- Availability of machine uptime to meet customer demand.
- Availability of material to meet production needs.
- Availability of trained employees to handle the current manufacturing processes.
- Availability of clearly defined work methods as basic instructions or Standard Operating Procedures (SOP’s).

Lean manufacturing is providing more and more with less human effort, less equipment, less inventories, less time and less space while coming closer and closer to providing customers with exactly what they want and when they want it (Womack & Womack 1996:46).

According to Jackson (1996: 33), lean manufacturing is used in companies that pursue zero waste relentlessly in all processes and operations. It is about operating the most efficient and effective organisation possible with the least cost and zero waste.

Womack et al (1990:14) suggests that the main goals of a lean organisation within a manufacturing process are the elimination of waste and continued efforts to:

- Provide world class customer service.
- Reduce manufacturing lead times.
- Increase labour efficiencies.
- Improve product quality.
• Increase labour flexibility.
• Increase market flexibility.
• Reduce inventories and.
• Lower the cost of overheads.

2.3 LEAN MANUFACTURING PRINCIPLES

The organisations that subscribe to lean manufacturing practices focus on the reduction of waste and the creation of value in all its processes. They continually improve their products through research and development. Products that do not perform in the market are removed from the production lines and new ones are introduced through the results from market research. Womack et al (1990:59) suggest the following principles to enhance lean manufacturing in order to ensure that processes followed to produce products do add value to the bottom line of the organisation.

2.3.1 No buffer of safety stock

The authors point out that making only few parts before assembling before assembling them makes mistakes to show instantly. It is therefore important not to retain buffer stock.

2.3.2 Work Teams

An important aspect is to group workers together into teams with Team Leaders rather than a foreman. This allows shop floor employees to make decisions regarding their activities in the manufacturing processes.
2.3.3 New Material Handling Systems

New ways are sought to coordinate the flow of parts within the supply system on a day-to-day basis. These systems include the Just- In-Time system called KANBAN at Toyota. (Womack et al, 1990:62).

2.3.4 New Model Development Time

Firms take a long time to change production and model specification in mass production and are expensive. By contrast, a pre-eminent manufacturer such as Toyota needs half the time required by mass production to design a new product. This means that Toyota can offer twice as many cars with the same resources and budget (Womack et al, 1990:64). Having a competitive advantage over your competitor is very important in the global market.

2.3.5 Demand fulfilment

Womack et al (1990:66) state that all the variety available from lean manufacturing would be nought if the organisation could not build or produce what the customer needs. Meeting the customer requirements is key to lean manufacturing. On time delivery of quality goods to the customer’s specification is important for customer satisfaction.

2.3.6 Make to order

At Toyota, the dealers become part of the production system. Build to stock system does not add value to the organisation’s bottom line as products produced are kept in stock rather than being sold to customers (Womack et al, 1990:67).
2.3.7 Customer involvement

Toyota focused relentlessly on repeat buyers and went directly to them to plan for the new product. They added value and had a contribution in the development process of the cars (Womack et al, 1990: 67).

2.3.8 Shop floor involvement

All information pertaining to daily production targets, equipment breakdowns, personnel shortages, overtime requirements and so forth are displayed on the andon boards (Electronically lighted displays) that are visible from every work station (Womack et al, 1990:99). Information sharing with employees is important. It enables them to know how the business is performing.

2.3.9 Idea Stimulation

Womack et al (1990:99) state that employees must be encouraged to think actively, indeed proactive so they can devise solutions before problems become serious. Employees are the source of solutions as they are involved in processes everyday and have long term experience of certain processes. Involving employees leads to then taking ownership of the organisation and thinking proactively to resolve problems.

2.4 CHARACTERISTICS OF LEAN VALUE STREAM

Womack et al (2003:43) refer to lean manufacturing as trying to get one process to make what the next process needs and when it needs it. It is aimed as
looking all processes from the final consumer back to the raw material stage in a smooth flow without detours that generate the shortest lead time, high quality and lowest cost. A Lean Value Stream has the following characteristics:

2.4.1 Takt time

Takt time synchronises the pace of production to match the pace of sales.

\[ \text{Takt time} = \frac{\text{available working time per day}}{\text{Customer demand rate per day}} \]

Example = \underline{27,600 seconds} \\
460 pieces

= 60 seconds


2.4.2 Continuous flow

Continuous flow is not always possible in the value stream due to the following reasons:

- Some processes are designed to operate at very slow or fast cycle times and need to change over to accommodate other products.

- Some processes of suppliers are far away from the manufacturing factory and shipping one piece at a time is not realistic.

- Due to certain lead times and unreliability of the supplier, it is difficult to couple those processes to a continuous flow (Womack et.al, 2003:62).
2.5 BASIC LEAN CONCEPTS

A few basic concepts are regarded as the building blocks of lean manufacturing (George, Rowlands, Price & Maxey, 2005:199). George et al (2005:199) further explain the following basic lean concepts that exist in any manufacturing organisation:

2.5.1 Total Lead Time
It is also called process cycle time by some organisations. It is basically the time from when a product enters the process until it exits.

2.5.2 Things in Process (TIP) or Work in Process (WIP)
This is any work item that has entered the process and not yet exited. The work can be materials, customers, assemblies and so on.

2.5.3 Average completion rate (Exit rate on throughput)
This is the output of a process over a defined period of time.

2.5.4 Capacity
This is the maximum amount of output or product a process can deliver over a continuous period of time.

2.5.5 Takt rate (Customer demand rate)
This is the amount of products or service required by the customer over a continuous period of time. The process should be timed to process at a takt rate.

2. 5.6 Time trap

This is any step or activity that inserts a delay time into a process.

2.5.7 Capacity constraint

This is the activity in the process that is unable to produce at the completion rate required to meet customer demand.

2. 5.8 Value-add time

This is any process activity that transforms the form, fit or function of the product or service for which the customer is willing to pay.

2. 5.9 Non-value-add costs

This is waste by a process. Customers are not willing to pay for non-value add costs.

2. 6 LEAN MANUFACTURING GOALS

The main goals of a lean organisation are the elimination of waste and continued efforts to:

- Provide world class customer service.
- Reduce manufacturing lead times.
- Increase labour efficiencies.
- Improve product quality.
• Increase market flexibility.
• Reduce inventories.
• Lower the costs of overheads (Womack et al, 1990:14)

Wonack et al further contends that lean manufacturing addresses all aspects of business from strategic planning to maintenance, engineering, work culture, information management and production systems.

In addition, Womack et al (1990:13) say a key objective of lean manufacturing is to push responsibility far down the organisational ladder. He states that operators need to make decisionson the shop floor.

Smooth flow of production is important in a manufacturing organisation. Lean manufacturing strives to reduce waste of material and time that results from a manufacturing process that is not operating and flowing smoothly. This statement is supported by Womack et.al (1990:62) where they say Toyota sought new ways of co-ordinating the flow of parts within the supply systems on a day-to-day basis. One of these ways was the introduction of Kanban at Toyota. Continuous and smooth production flow is a key attribute of lean manufacturing.

Womack et al (1990:99) sees the involvement of shop floor employees as the integral part of lean manufacturing. He states that all the information with regards to daily production, targets, cars or products produced for the day, equipment breakdown, personnel shortages and overtime requirements are displayed on electronic boards and placed on every workstation. Womack et.al (1990:99) also further emphasises the issue of obtaining suggestions from employees. He states that employees need to be encouraged to think actively
and pro-actively so they can come up with solution before problems become serious.

Boln, (2000:83) states that in business organisations, there are invariably more problems than people have the time to deal with. At best, this leads to situations where minor problems are ignored and at worst, chronic fire fighting consumes an operation’s resources. Companies with a complex research and development and manufacturing processes are prone to destructive “fire fighting”. Managers rush from task to task without finishing before another interrupts them. Productivity suffers and managing becomes a constant juggling act of deciding where to allocate overworked people and which crisis to ignore for the moment.

According to Boln, “fire fighting” is an old traditional way of doing business, especially in new product development and manufacturing. People rush from one crisis to the next, never really fixing problems, just stopping them from getting worse. A set of principles can actually prevent most fires.

2.7 VALUE STREAM MAPPING

Value Stream Mapping is all the , both value adding and non-value adding in the process. These actions are required to bring the product through the processes flows that are essential for every product.

Womack and Jones (2003:3) state that the product flows from new material into the hands of the customer and the design of the product flows from concept to launch.

It is important that waste, in manufacturing processes be reduced to an absolute minimum. Other organisations like Goodyear Tyre Manufacturers, Ford Motor Company of South Africa and General Motors South Africa measure
their efficiency on waste. Targets are set for waste on each and every process and explanations accompanied by corrective action plans are expected from the department manager.

Koskela (2000:56) states that waste in manufacturing is all the efforts that do not add value to the final product from the point of view of the customer. He suggests the following actions in reducing waste:

Reduce variability in the manufacturing process
Reduce the share of non-value adding activities
Reduce lead time
Simplify by minimising the number of steps, parts and linkages
Increase flexibility

Womack & Daniel (2003:37) states that value stream mapping is all about mapping all the process steps, each individual action involved in the process of physical production and order taking for specific products

2.8 VALUE STREAM MAPPING AND PROCESS FLOWS

George, et al (2005:33) suggest the following process flow tools:

- Process Mapping: This is a process where the analysts observes and documents the process steps through the production line. It is recommended that walking the floor and talking to staff asking questions about the process must be done when mapping the process. Flow chart get into detail only on processes that will be helpful to identify the problem.
- SIPOC (Suppliers, Inputs, Process, Output and Customer): This is a simple diagram that identifies the basic elements of the process. It is a good tool for translating customer requirements into output requirements and identifying Key Process Outputs (KPO’s).

According to George et al (2005:34), these tools are use for various purposes as suggested below:

- Visually documents and processes, including key data as captured on the value stream map.
- Provides fact-based process description as a basis for understanding current problems (poor flow, rework loops and delays) and opportunities to improve.
- Enables the team to quickly see improvement opportunities in the process and begin to define underlying causes.
- Helps the team to see how the process should work (future state) once they eliminate waste.
- Helps communicate inside and outside the organisation.

A value stream is all the actions both the value added and non value added currently required to bring a product through the main flows essential to every product. The flows are the production flow from raw material into the arms of the customer and the design flow from concept to launch. (Rother & Shook, 2003:3). Value stream mapping analyses the current state and converts it to the future state, having identified and eliminated all the non value added activities in the production flow.

Rother and Shook (2003:3:) state the following reasons why value stream mapping is an essential tool:

- It helps one to visualise not only the single process, but the entire flow.
• It helps one see the sources of waste in the value stream.
• It provides a common language for talking about manufacturing processes.
• It makes the decisions about flows apparent so one can discuss them.
• It ties together lean concepts and techniques
• It forms the basis of an implementation plan. Value stream becomes a blueprint for lean implementation.
• It shows the linkage between the information flow and the material flow.
• It is much more useful than other quantitative tools and layout diagrams that produce a tally of non-value added steps, lead time, distance travelled, and the amount of inventory. Value stream mapping is a qualitative tool by which one describes in detail how the facility should operate in order to create flow.

2.9 VALUE ADD VERSUS NON-VALUE ADD ANALYSIS

According to George et al (2005:49), the above analysis is used to highlight and distinguish process steps that customers are willing to pay for from those they are not.

The objectives of this analysis are to:

• Identify and eliminate the hidden costs that do not add value for the customer.
• Reduce unnecessary process complexity which results in errors.
• Reduce the process lead time.
• Increase capacity by better utilisation of resources.
2.9.1 Value add activity

This is any activity that is essential to deliver the product or service to the customer. It must be performed to meet customer needs and add form or feature to the product or service. It must also enhance quality and have an impact on price competition.

2.9.2 Business non-value adding activities

These are activities that are required by the business to execute value adding work but add no value from the customer perspective. These activities usually include:

- Tasks that reduce financial risk.
- Support financial reporting requirement.
- Aids in execution of value add work, and
- Is required by law or regulation.

2.9.3 Non Value adding activities

These are activities that add no value to both the customer and the business, they are waste.

These activities include:

- Excessive handling and transportation.
- Rework to fix errors that should not have happened in the first place.
- Waiting and role time and delays.
- Over production.
• Over processing, having too many steps in a production process, George et al (2005:51).

Value stream mapping has fundamental pillars that are aimed at ensuring that the customer reaps from the benefits of the service or commodity. It does not only apply within the confines of manufacturing and team manufacturing processes.

It also ensures that these benefits are derived from the economies of scale. Economic value mapping properly distinguishes between the value of highly differentiated products benefits compared to the generally commoditised benefits (Thomas & Nagle, 2005:41). Commodity and product value are the worth of the benefits associated with the features of a product that resemble those of competitor’s product.

Once the Value Stream Mapping is done properly during the manufacturing stage of the product, Customer Value Model surfaces. According to Nagle (2005:41), the customer value model has value in use as one of its four different categories. Value in use is the monetary worth of product or service benefits received by the customer as a result of using the product or service.

Levine, P. (2006:23) states that Value Stream Analysis focuses on a specific process of the business and map out the steps of how something is currently done. It identifies value added aspects of the business operation or manufacturing process that equate to steps required to put actual value into producing a product. Now value added time is the time that is devoted to activities that diminish the operations of the business and the actual production of the product. An analysis of the process in most businesses finds that value adding activities are actually a small percentage of the process time.
3. Lean Thinking

According to Womack and Jones (1996:16), Lean Thinking is a way to specify value, line up value creating actions in the last sequence. Lean Thinking has five key principles namely:

3.1. Specify value

Value is expressed in terms of specific product or services, delivered at a specific price, at a specific time and meets the needs defined by the customer.

3.2. Identify the value

Womack and Jones (1996:19) prepare that value stream is the macro view of the entire door-to-door perspective of productions, from raw materials to delivery. It includes the determination of all actions necessary to produce a product and the separation of non-value adding activities. This includes not only the physical transformation of the physical product, but also the information system necessary to produce the right quantity at the right time.

3.3. Flow

Womack and Jones (1996:21) state that once waste has been eliminated, flow can be accomplished. Flow is the opposite of batch production and requires the movement of product from one value adding step to the next with no waiting or scrap.

3.4. Pull

According to Womack and Jones (1996:24), pull is the production of customer requirements against specified delivery dates. Information travels upstream from the customer, signalling production only when a need is shown instead of pushing product from raw materials to the customer.
3.5. Perfection

Continuous improvement is vital for to perfection, where waste is constantly being eliminated. Perfection reminds manufacturers that reducing waste is never ending. Lean is not a specific control tool, improvement tool, floor layout or principle. It is the methodology or framework that focuses on the ideas of value, waste and meeting customer demand. Womack and Jones also state that Value Stream Mapping resulted as a of determining where the value and waste are located and aids in the reduction of lead time to help make the right product at the right time. The 5 key principles of lean thinking are illustrated below to further explain the philosophy.

![Figure 2.1: The steps towards lean](image)

Source: Steps of Lean Thinking (Womack and Jones, 1996).

Lean Thinking is about putting value stream for specific products relentlessly in the foreground and rethinking every aspect of jobs, careers, functions and firms in order to correctly specify value and make it flow continuously along the whole length of the stream as pulled by the customer in pursuit of perfection (Womack et.al 2003:275).
4. **Lean Six Sigma**

Lean Six Sigma is an improvement method which user data to eliminate and identify unnecessary processes or activities in a certain process. (George, Powlands and Kastle, 2004:5).

It has four foundations that are fundamental to improving processes and keeping the customer happy at all times. The following foundations are proposed by George et.al

To delight the customer by delivering higher quality product and service at low cost and high speed.

To improve processes by eliminating defects in products and service and focus on the flow of work through the process.

Implement teamwork for sharing ideas in order to solve the problem.

Basing all decisions on data.

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5. **Sources of Waste**

Womack and Jones (2003:42) refer to over production as the main source of waste. According to Womack, over production strives to produce sooner than required by the customer in the form of mass production. It is based on pushing production according to schedules received from the Production Control instead of the needs of the waste stream process and end user.
Over production causes all kinds of waste, not just excess inventory and money tied up to it, Womack (2003:43). It production requires storage space for product that has been produced unnecessarily. It requires handling, people, equipment sorting and reworking of products. It also leads to material and product shortages as resources are tied up an unnecessary product. Money is wasted in that extra capacity must be created to manufacture the required part or product.

Womack and Jones (1996:38) also refer to the following types of waste in addition to overproduction. :

Waiting, this is time wasted where resources are idling waiting for the preceding operation.

Transporting, this is time wasted transporting an item from one operation to the other.

Over processing, it normally happens where the product or service has met the desired or specified condition the process still continues.

Inventory, this is material in stock that gets wasted due to the fact that it is not needed for production.

Motion, when motion is excessive, it becomes waste.

According to Goldratt, E. (1992:53) there is three measurements which express the goal of making money in any organisation, which helps a manager to develop the operational rules for running the plant. Goldratt refers to these measurements as :-

Throughput, the rate at which the system generates money through sales.
Inventory, all the money the organisation has invested in purchasing material for production.

Operational expenses, all the money the company spends is converting inventory into through put.

A company that strives to make profits will focus on reducing waste and unnecessary activities, which leads to waste time and material. Do it all in your own company, however decentralise and create profit centres (Womack, Jones, & Roos, 1990:138)

6. Conclusion

Value Stream mapping and all Lean Manufacturing principles have been around and applied for a long time. Companies that have applied Lean manufacturing principles in their processes have improved their productivity and reduced waste. Toyota is an example. Literature also confirms that proper use of lean manufacturing principles has yielded good results and improved the manufacturing efficiencies.
CHAPTER THREE

Current situation at Transwerk Uitenhage

3.1. Introduction

This chapter explains the current situation in terms of operations at Transwerk Uitenhage. A detailed process flow and the current state map is also explained in this chapter. Transnet, which is the holding company of Transwerk, and all the business units that subscribe under it are also discussed.

The operations of all Transnet business units are briefly discussed with the emphasis made on Transwerk. In terms of Transwerk, all Transwerk plants are discussed. The location, size products produced in each plant as well as customers is also discussed in brief.

Transwerk is a business unit of Transnet. This business unit focuses on the maintenance of rolling stock of Spoornet, which is also a business unit of Transnet. In line with the recent restructuring of the organisation, Transnet decided to focus on the core businesses and dispose of all non core businesses. The core business of Transnet is to transport bulk rail freight for customers and thereby contribute to the economy of South Africa. It is a state owned organisation and drives the objective of the South African Government of
economic growth. Transnet, as mentioned in Chapter one, has five business units which will be discussed below.

3.2. Five Business Units of Transnet

3.2.1. Transwerk

This is the engineering business unit of Transnet. Their main function is to refurbish, build and maintain the rolling stock of Spoornet. Transwerk refurbishes and build a variety of products for Spoornet and other countries like Ghana, Kenya, Botswana and England. These products will be discussed later in the study.

3.2.2. Spoornet

The main purpose of this organisation is to transport bulk rail freight for it's customers. Mittal Steel, Sasol, Kumba and other mining organisations are the major customers of Spoornet. Spoornet transports mainly coal for the mining industry, fruit, beer, iron ore and other products.

3.2.3. Portnet

Portnet is responsible for the off loading and loading of freight into containers and wagons. Their core business is to export coal and other commodities.

3.2.4. Petronet
This business unit is responsible for transporting fuel and oil though pipelines. It is the most profitable business unit of Transnet.

3.2.5. South African Port Operations

South African Port Operations is responsible for the overall operations of ports and harbours throughout the country.

3.3. Background of Transwerk

Transwerk is located in all provinces of the South Africa. Figure 3.1 below shows the geographical location of Transwerk plants throughout the country of South Africa.

Figure 3.1: Location of Transwerk Plants in South Africa: Source. Corporate Strategy, 2006:2
As Transwerk is the engineering business unit of Transnet, they focus mainly on refurbishing, building and maintaining the rolling stock of Spoornet. Transwerk. Below is a brief discussion about the activities of each plant.

3.3.1. Cape Town

The plant in Cape Town is the oldest plant of Transwerk. It is situated in Salt River. They focus on the refurbishing and maintenance of Coaches, Locomotives, Wheels, Components and Tarpaulins.

![Picture 3.1: Products produced at Salt River: Source: Researcher](image)

3.3.2. Pretoria

Transwerk plant in Pretoria is located in Koedoespoort. This is the largest plant of Transwerk. It focuses on the refurbishment of Coaches, Locomotives,
Wheels, Rotating machines and Rolling Stock Equipment. As much as it is the largest plant of Transwerk, it refurbishes the same products as Salt River.

### 3.3.3 Johannesburg

Transwerk plant in Johannesburg is situated in Langlaagte. It is the smallest plant of Transwerk and focuses mainly on rotating machines and locomotive motors.

### 3.3.4 Durban

This plant is situated in the main city of Durban; It is the second largest plant of Transwerk and refurbishes the same products that are refurbished in Koedoespoort and Salt River. Wagons refurbishment is also done in this plant

### 3.3.5 Bloemfontein

This is the third largest plant of Transwerk. It is the second oldest plant of all Transwerk plants. Products refurbished in this plant are exactly the same those refurbished in Durban.

### 3.3.6 Port Elizabeth

This plant is situated in Uitenhage. They refurbish wagons, wheels and wagon components. They are the largest plant in the Rail Freight Refurbishing (Wagons). It has a turnover of R1.2bn and a staff complement of 1208.(RFR Strategy, 2006:6) This research is based on this plant
There are four Rail Freight Refurbishing plants in Transwerk throughout the country as mentioned below. The capacity for each plant has been built and designed to focus on a specific type of the wagon (Specialization).

Figure 3.2: Relative Size of Transwerk RFR Plants: Source: RFR Strategy: 2006:7

Durban: This plant specialises on the refurbishment of Coal wagons.

Germiston: They focus on Tank wagons for fuel, diesel and oil.

Bloemfontein: This plant specialises on Grain wagons.

Uitenhage: This plant has the capacity to refurbish and maintain various types of wagon This is due to its size and the fact that various wagons off load and load in the Port Elizabeth Harbour.

Transwerk Uitenhage has been in existence since 1870. Their core business is Rail Freight Refurbishing which includes inter alia the following activities:

Wagon Refurbishing and conversion
Fabrication of wagons parts
Machining of wagon components, jigs and parts
Surface treatment of wagons and components
Components refurbishing and
Wheel building and refurbishing
Procurement
Logistics

These activities are supported by the following service providers:

Engineering, which is responsible for all wagons and components drawings, designs, building of prototypes, creation of bills and routing and the Bill of Materials.

Human Resources, they have a responsibility to make sure that employees are trained and have the necessary skill to refurbish and maintain wagons and other components and mentioned above.

Customer service, this department interfaces with the customer. All customer requirements and changes in design are channeled through them. They are the link between Transwerk and the customers.

Transwerk Uitenhage refurbishes and maintains wagons that are due for maintenance and also wagons that have been wrecked or damaged in traffic. Annexure A, Picture 3.2 below shows the different types of wagons that are refurbished and maintained in Uitenhage.

3.3.7. Commodities carried by various wagons

CR wagons: These wagons carry Iron Ore for the steel and coal for steel industry.

AR wagons: They are used to carry coal for various customers
AY wagons: They carry ballist.

DKJ wagons: They carry wood and poles and have a moveable end to accommodate various sizes of wood and poled.

CFR wagons: These are converted wagons from 60 tons to 80 tons. They also carry coal.

3.4. Refurbishment planning process in Transwerk Uitenhage

Transwerk Uitenhage refurbishes and maintains more than 6000 wagons every year. In addition to refurbishing wagons for Spoornet, Transwerk also refurbishes wagons for the following customers:

Ghana
Botswana
England
Kenya

Every year in November, Spoornet and Transwerk discuss the budget and the number of wagons that are planned to be refurbished in the following financial year. In order for Transwerk to refurbish all wagons budgeted for on time and in good quality, the following actions must be taken before any refurbishing process starts:

Accept Spoornet budget
After the budget discussions and the number of wagons to be refurbished, Transwerk accepts the budget. The scope of work each wagon type is also discussed as it changes every rear is the basis for the budget.

Determine product mix

Once the above has been done, product mix is determined in order to purchase the required amount of raw material per product.

Build prototypes

In cases where the wagon is refurbished for the first time, a prototype is built. This is to make sure that the customer requirements are met. All required drawings are made available by the customer for the manufacture and fitment of correct components. The customer is invited to view the prototype and approve it should all requirements be met. After the completion, testing and approval of the prototype, production commences.

Determine Bill of Materials and Routing

During the prototype stage, material and all components required of the refurbishment of the wagon is noted and captured into the Bill of Materials. The routing and the process the wagons will follow during refurbishment is also determined during the prototype stage.

Determine line layout
This is normally the Industrial Engineering function. They are responsible to do a proper line layout based on the routing of the wagon. They also determine the number of operations and personnel required per station and for the line.

Determine employee profile

Human Resources is responsible for training and development of employees. When a wagon is refurbished for the first time and the prototype has been done, the employee profile is determined. This is check whether the skill required to refurbish the wagon is available. If the skill required is available within the organisation, recruitment is done to replace the employee who will now be taking a new responsibility. If the skill is not available, training and development is done through the plant accredited training centre.

3.5. Wagon refurbishment process in Transwerk Uitenhage

Transwerk Uitenhage has been converting and upgrading wagons through its refurbishing process. The following process is followed when refurbishing and converting wagons:

3.5.1. Calling in of wagons

The customer services department call wagons in using the agreed upon wagon call in programme. This programme specifies to the client the number and the type of wagons that must be withdrawn from traffic and com to Transwerk for refurbishing. These wagons are normally called in using wagon numbers and wagon types.

3.5.2. Marking of wagons
Once the wagons arrive in Transwerk Uitenhage, the customer services officer marks the wagons. This is to determine the components that are worn and must be replaced as well as the condition and the extent of damage to the wagon. These areas are marked with the white chalk for employees to see exactly which parts to remove and replace.

3.5.3. Stripping

Stripping takes place after the wagons have been marked. All defective components and parts of the wagon are removed are thrown into the scrap wagon located near the stripping area. The process of stripping wagons is shown on Annexure A picture A1.

3.5.4. Cutting

After the stripping of certain components and parts. The flame cutting process takes place. All floors, brackets and sides are cut and removed. The flame cutting process is shown in Annexure A on picture 3.3

3.5.5. Straightening

Once all the corroded and defective components have been removed from the wagon. Only the under frame remains. In most cases the under frame of the wagon becomes bent due to the loads is carrying for years and the manner in which the wagon was taken care of in traffic by train drivers. All wagons undergo the straightening process after stripping. This process is shown on picture 3.4. in Annexure B.
The wagon straightening process is the last step of the preparation of the wagon. The following steps are the actual conversion and refurbishment of the wagon where new parts and components are fitted onto the bare under frame of the wagon. It is at this stage that material is needed to be fitted onto wagons. The supply of material comes from internal and external suppliers.

Transwerk Uitenhage consists of various departments as mentioned above. Procurement is responsible for the procurement of raw material and components, mainly airbrake components, wheels; steel plates and bogies components. Some material parts are procured in bulk and needs to be further processed internally to suit the required specifications and dimensions.

A fabrication department is responsible for manufacturing mainly plates and channels. These plates are welded together on the Seam Welding machine into side plates and further welded together into 14 metre wagon sides on the Automatic Robotic Welder machine. These sides are fitted onto wagons as shown in Annexure A. The materials managements system is described below.

3.5.6. Materials Management

Transwerk utilises the SAP system to run the entire business. This system is utilised to load the budgets for the month and for the year, the sourcing of in-house manufactured components and parts, scheduling and procurement of raw material as well as actual refurbishing process of the wagons.

After the acceptance of the budget by the management team, the production plan is formulated by the Logistics department detailing the schedules of specific programmes by line. Each production line is scheduled to refurbish a specific wagon type. Each wagon type requires a specific set of materials The production plan is linked to the MRP (Materials Requirement Plan) and orders material automatically.
As indicated above, the material required during the repair process is ordered based on an MRP list. The MRP is based on estimations of material and hours necessary to perform specific repairs. These estimates are determined during the prototype stage of the wagon.

Estimates may, however, be far off, since the condition of wagons differs immensely – depending on their last repair date, the region where they are used (e.g. coastal region) and whether they were out of service and vandalised by squatters. Figure 3.3 shows a schematic representation of SAP utilization.

Figure 3.3: Schematic Representation of SAP utilization: Source: Researcher

3.5.7. Description of SAP components

3.5.7.1. Business Sales Plan (Budget)
The budget for the financial year is broken into monthly budgets and captured in the SAP system. Actual performance against the budget is also captured into SAP on a monthly basis to track the actual spend per month and the fact that the budget will be achieved.

3.5.7.2. Production Plan

As mentioned above, from the agreed and signed budget, the production plan is developed. It entails the quantities of wagons entailed in the budget. These quantities are broken into monthly and weekly targets that will ensure that all wagons planned for the week, month and the year are refurbished and the entire budget has been spent.

3.5.7.3. Materials Requirements Plan (MRP)

The production plan has a direct link with the Materials Requirement Plans. The MRP automatically performs a forecasting function for the materials required to refurbish the wagons stated on the production plan.

3.5.7.4. Operations Manufacturing

Orders are then created for the Fabrication and machining to manufacture of in-house components parts for required by production.

3.5.7.5. Procurement

Raw material is procured and sent to inventory stores. In-house materials and components are also sent to inventory stores. Production Planners from Logistics draw material from stores using Pick lists for production lines.
3.5.7.6. Bills and Routings

Bills and routing are also captured into SAP after the prototype. This is to prevent manoeuvring by individuals. Only certain people have access to the SAP system and are allocated password for control purposes. Materials that are not catered for in the Bill of Material are recorded on the menu list and are captured onto SAP as additional costs. This is to make sure that all components fitted and wagon done on the wagon is paid for as Spoornet and Transwerk perform transactions on SAP. Anything that is not properly captured on SAP will not be paid for. The Inventory stores where material is received from internal and external suppliers and picked and delivered to the production lines is shown in Annexure B picture 3.8.

3.5.8. Quality Control

The quality system used in Transwerk plant is ISO 9002. Although no formal Total Quality Management TQM initiative was launched in the plant, the ISO quality procedure utilised in refurbishing process is written to cover a wide range of aspects, ranging from customer satisfaction to training to supplier certification to continuous improvement. 100% inspection of the product is required by the client, and non-conformance reports are compiled by the client’s representative if major defects were not rectified to specification.

Faults are not measured as defects per 100 units as in statistical sampling, but as an average number of faults per unit. Quality Certificates, important for safety, are required by the client for certain components such as couplers and springs. Some materials, such as paint, may only be purchased from vendors approved by the client. The client accepts no job unless the quality inspector
assigned to the plant has inspected each job, and all faults are rectified to specifications. Hereafter a quality certificate is issued, and the job may be invoiced.

A number of years ago, before Transnet was registered as a company, under the South African Transport Services, quality circles functioned in the organisation, and workers were kept rigorous to routing times and standard operation sheets – all under the so-called “Bonus” incentive scheme. When the scheme was abolished due to costs and the administrative burden associated with the recording of individual performance, these practices were abolished.

The quality procedures are derived from the customer specifications and are broken down and simplified into Production Control Plans (PCP), see annexure D. The PCP is the document that details activities that must be done in each operation on the line. Based on the time studies that were conducted by Industrial and Process Engineers, the PCP stipulates that amount of employees required to perform the function. This further broken down into the number of Trade hands required, Process workers required as well as Artisans. This document also states the required cycle time of wagons per station.

Quality Control Officers are deployed on each production line. Each line has Quality Control hold points. This is where thorough inspection takes place by Quality Officers. There are Quality Check Sheets prepared by Quality department and are used as the yardstick when inspecting wagons at the hold points.

4. Finished Goods inventory

Unlike repetitive manufacturing, the wagon refurbishing process strategy is make-to-order. No jobs are repaired without orders placed by the client. This means that jobs are sold as soon as they are finished, and waste in finished goods is basically non-existent. The only conditions under which excessive finished goods may accumulate are when the client is forced to freeze all
maintenance work due to cost savings imposed by Corporate office, or when a job is finished, but of such poor quality that the client will not accept it.

5. **Employee involvement**

Transwerk strives to involve employees in all decision making processes. There are formal and recognised structures that are in place to ensure employee involvement in decision making. Below is the consultative structure that is recognised at Transwerk;

5.1. **Local Working Committees**

These committees have been established to ensure decision taking place in the local and lowest level of the organisation. The Department Manager called Business Manager, department union representatives and Supervisor sit in this committee to discuss and agree on departmental issues. Should there be disagreement; issues of contention are referred to the Centre Committee.

5.2. **Centre Committee**

This is the highest structure in the plant. Senior management, Full Time Union Representatives (FTUR's) and the Centre Manager sit in this committee. All plant issues including plant performance are discussed in this forum. Issue that could not be resolved in the Local Working Committee are also addressed in this committee. The Local Working Committee and the Centre Committee sit monthly. Issues of disagreement are also elevated to the National Committee Meeting for further discussion.
5.3. National Committee Meeting

This committee sits once a quarter. Business Managers, Centre Managers and FTUR’s sit in this meeting. This committee discusses all national issues and address those issues that could not be addressed in the Centre Committee. The last level of consultation is the Joint Transformation Committee.

5.4. Joint Transformation Committee

This is the company bargaining forum. Decisions and policies are drafted and signed in this forum. The Chief Operations Officer of Transwerk chairs this meeting. The General Manager, Human resources, Corporate Employee Relations Manager General Manager Marketing and Strategy represent management in this forum. The office bearers and FTUR's of all recognised unions sit in this forum as well. Decisions taken in this forum are binding to everybody.

6. Preventive Maintenance

Preventive Maintenance is performed on machinery based on the maintenance plan for plant equipment. Critical machinery and equipment that cannot be maintained due to production pressures are scheduled for weekends and after hours maintenance.

7. Wagon refurbishing process.

Wagon refurbishing in Transwerk Ultenhage is done in conjunction with suppliers and customers. Transwerk has mainly one customer known as Spoornet. More than 90 % of rolling stock refurbished by Transwerk belongs to
Spoornet. The abridged refurbishing process is schematically represented in figure 3.4 below.

![Diagram of the refurbishing process]

Figure 3.4 Transwerk Uitenhage Current State Map: Source: Researcher.

Suppliers: Raw material in the form of steel plates, stanchions and other components are received from our suppliers Mac Steel. Knorr Bremse supplies airbrake components which are the integral part of the wagons. This is done weekly.
Material Requirement Planning: Raw material is ordered from suppliers using MRP on a weekly basis. This raw material is manufactured and converted into wagon sides, end and other components through welding, bending, cutting and other processes.

Production Planning: The Master Production Scheduler does the production planning and monthly forecasts of material based on weekly production. When the planned production for the week has not been met, he changes his forecast accordingly.

Inventory Stores: After the fabrication process from all departments mentioned above, the fabricated material ready for fitment onto wagons is transferred back to stores. In some cases, material is sent to Fabrication, from Fabrication to Machining and back to Fabrication before being received at Inventory stores. Material is delivered to production lines using flat wagons.

Creation of Shop orders SAP: After the material requirements per wagon has been finalised, the Logistics Officer loads the shop orders for production, which includes the fabrication of components and the actual refurbishing of wagons.

Operations: The refurbishing process flow starts in the stripping operation to the airbrake testing operation. Once the wagon passes the airbrake test, it is shunted to the Spray shop where it is he painted and released.

Inspection and Approval: There is a Spoornet Quality Assurance representative in each Transwerk plant. Their purpose is to inspect and approve the wagon. Should there be faults found on the wagon, the Spoornet Q.A. representative attaches a Not To Go Card onto the wagon to prevent it from being delivered to the client.

This card contains the details of the wagon as well as the defect found on it. When the wagon is approved, the Spoornet Q.A signs the RMQA1 certificate and hand it in to the Transwerk Customer Services Officer, who will in return submit it to Spoornet Financial Department for payment. The RMQA1 certificate is the quality certificate that confirms that the wagon meets all the customer requirements and is ready to be released onto traffic to transport rail freight for Spoornet, see Annexure B.
8. Conclusion

This chapter interrogated the wagon refurbishing of Transwerk Uitenhage. It has been depicted in this study that Transwerk utilizes the Kanban system to supply production material onto production line. A number of repetitive tasks have been highlighted by the current state map of Transwerk Uitenhage processes. It was clear that the process used by Transwerk Uitenhage needed to modified in order to eliminate the repetitive tasks that do not add value to the bottom line of the organisation.
Chapter Four

Research Design and Methodology

4.1. Introduction

This chapter explains the research tools that have been applied by the researcher to collect data, analyse and interpret results. In this study, the researcher sought to understand the current situation and process followed by Transwerk Uitenhage when refurbishing wagons. Results obtained were analysed and used as a measure to decide on the appropriate production process to be implemented. According to Bless & Higson-Smith,( 1995:63), research methods is a programme that guides the researcher in collecting, analysing and interpreting data and facts. The following tools were used in this research:

4.2. Tools used in this research

The researcher made use of the following tools and methods to conduct this research:

Interviews: a sample of two Operations managers and five Production Foremen was interviewed to solicit their objective opinion about the existing processes used by Transwerk Uitenhage to refurbish wagons.

Time study, this method was used to determine the amount of time the wagon spends in an operation before it is transferred to the next station.
4.2.1. Interviews

There are many possible ways of gathering information directly from participants if such information cannot be observed. Bless & Hogson-Smith (1995:106) state that one of these direct ways of gathering information directly from participants is by interviews. An interview involves direct personal contact with the participant who is asked to answer questions.

According to Bless & Hogson-Smith, (1995:107), there are two types of interviews, namely, non-scheduled structured interview and schedules structured interview. Non-scheduled structured interview is structured in that a list of issues which have to be investigated is made prior to the interview. It is non-scheduled in that the interviewer is free to formulate other questions as judged appropriate for the given situation.

Bless & Hogson-Smith, (1995:107) also state that the most structured way of getting information directly from the respondents is by means of scheduled structured interview. This method is based on an established questionnaire with fixed wording and sequence of presentation. The researcher used a scheduled structured questionnaire in this research.

4.2.2. Advantages and disadvantages of interviews

4.2.2.1. Advantages

The interviewer is able to assess the extent to which the respondent is prepared to co-operate and the constraints that may affect co-operations. Constraints may be lack of time, fatigue and other priorities the respondent may have. (Bless & Hogson-Smith, 1995:110).
In many cases, the researcher is able to assess whether the respondent is answering questions to please the researcher or to distort reality.

The researcher is also able to assess the extent to which the interview is asking for the information the respondent do not have.

Interviews ensure that the respondent understands the questions.

4.2.2.2. Disadvanges

Interviews are very time-consuming and expensive.
Research assistants need training.
May introduce interviewer bias. ( Bless & Hogson-Smith, 1995:114 ).

4.2.3. Time Studies

The purpose of conducting time studies was to ascertain time taken to perform a specific activity in the process. Line balancing and activity sampling was also conducted to ensure that all operators are fully and equally utilised on the production line. Results obtained from the time studies suggested that certain stations were idling for longer periods. A decision was taken to select activities that must be eliminated or combined.

4.3. Choice of sample
The researcher chose the above mentioned sample due to the benefits mentioned below:

4.3.1 Benefits derived from the chosen sample

Production Foremen and Operations Managers

Production Supervisors are directly involved in production throughout the day. They are responsible for meeting daily targets and at the same time, manage people. They are also responsible for ensuring that machines are efficiently utilised.

Their daily involvement in production exposes them to refurbishing process inefficiencies. Interviewing them presented the researcher the true reflection of process inefficiencies as well as insight as to whether value stream mapping is a relevant tool to eliminate non value adding activities in Transwerk wagon refurbishing process.

The researcher experienced the same benefits when interviewing Operations managers. Operations managers provided the researcher with the overall department processes and where inefficiencies are hidden. This once again presented to the researcher the overall department view and which production lines have activities in their refurbishing process that do not add value to the bottom line of the organisation.

The Centre Manager

The Centre Manager is responsible for the overall performance of the business. His performance is measured on the basis of the bottom line of Transwerk
Uitenhage and business growth. The interview with him will benefit the researcher in that, departments that do meet their targets in terms of production, waste reduction and operating profits are highlighted. This enabled the researcher to know which departments are inefficient and why.

4.4. Validity

A sample that was chosen by the researcher was representative of the population being investigated. RFR has a total of 12 Production Foremen and four Operations Managers. The chosen sample is a good representation of the wagons refurbishing process in Transwerk Uitenhage. According to Bless & Hogson, (1995: 82 ), in order to ensure validity, the sample must be representative of the whole population and must simulate the real world as closely as possible.

4.5. Conclusion

The approach that the researcher has take when conducting this study was explained at the beginning of this chapter. A better understanding of the wagon refurbishing process in Transwerk Uitenhage was also gained through interviews. It was also clear from the time study results that the takt time of 120 minutes was not based on time studies, it was just decided that a wagon is allowed to spend two hours on the station before it moves to the other.
CHAPTER FIVE

Implementation of Future State Map and Recommendations

5.1. Introduction

This chapter focused on implementing the future state map and making recommendations based on the research results. The Process Flow Chart
of wagon refurbishing was also discussed in this chapter. In this chapter, actions taken to get to the future state are discussed and explained.

5.2. Process Flow Chart

Pieterse, (2005:35) states that a process flow chart is a picture of what happens first, second, third etcetera in a process. All the steps in the process are listed. The chart is used to determine which processes add value and which not, so that as many non-value adding steps as possible can be eliminated. Value add steps are those steps that physically change the part, or advance the product towards completion and without which the part cannot be produces.

The process flow chart documents the flow and various activities by using a number of symbols to identify the different types of activities, see figure 5.1 below. The benefits of using the process flow chart are that it presents a more detailed evaluation of the process. When using the process flow, all activities in the process are considered so that the value the activity has in the process can be seen and measured.

In order to be able to identify non value add activities, the researcher had to interrogate the process flow of Transwerk Uitenhage. This analysis is focused on the wagon refurbishing process. The process is broken down into various activities to look for repetitions and idle times. This exercise explicitly highlights to the researcher activities that can be improved or eliminated completely from
the wagon refurbishing process. The Transwerk Uitenhage process flow chart is illustrated in figure 5.1 below:

<table>
<thead>
<tr>
<th>Element description</th>
<th>Activity</th>
<th>Distance</th>
<th>Time</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Stripping</td>
<td></td>
<td></td>
<td>419.2 min.</td>
<td></td>
</tr>
<tr>
<td>2. Transfer to building station.</td>
<td></td>
<td>12m</td>
<td>20.7 min.</td>
<td>Overhead crane used.</td>
</tr>
<tr>
<td>3. Building</td>
<td></td>
<td></td>
<td>539.5 min.</td>
<td></td>
</tr>
<tr>
<td>4. Transfer to rustist station</td>
<td></td>
<td>4m</td>
<td>7.3 min.</td>
<td>Capstans used to pull a wagon on rail.</td>
</tr>
<tr>
<td>5. Russist (Hold point )</td>
<td></td>
<td></td>
<td>45 min.</td>
<td>Rust resistant solvent.</td>
</tr>
<tr>
<td>6. Transfer to welding station.</td>
<td></td>
<td>5m</td>
<td>5.9 mi.</td>
<td>Capstans used to pull a wagon.</td>
</tr>
<tr>
<td>7. Welding</td>
<td></td>
<td></td>
<td>61.39 min.</td>
<td></td>
</tr>
<tr>
<td>8. Transfer to testing station.</td>
<td></td>
<td>14</td>
<td>10 min.</td>
<td>Capstans used to pull a wagon.</td>
</tr>
<tr>
<td>Task Description</td>
<td>Duration</td>
<td>Notes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>----------</td>
<td>-------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Test and release</td>
<td>150 min.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Transfer to spray booth.</td>
<td>15 min.</td>
<td>Shunting machine used.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Spray-paint, stencil, inspect and release.</td>
<td>65 min.</td>
<td>Undercoat &amp; Final coat applied</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5.1: Wagon Refurbishing Process Flow

Source: Researcher

- An operation, task, or work activity

- A movement of materials, information, or people

- An inspection, check or examination

- A delay, a pause in the process

- A storage: an inventory of materials or file of information or a queue of people

Figure 5.2: Flow process chart symbols

Source: Flow Process Chart symbols (Pieterse, K, 2005:36)

5.2.1. Process Flow description
5.2.1.1. Stripping

The stripping of the wagon is the first activity after the wagons have been marked and shunted behind the CFR production line.

5.2.1.2. Wagon transfer

The wagons are transferred from one station to the next using either the overhead crane or capstans, or shunting unit. Utilising a crane to transfer wagons takes longer than using a capstan. This is due to safety precautions that must be considered before the wagon is lifted and transferred to the next station. Making use of capstans is much quicker and simpler. The shunting unit is used to transfer a wagon from one department to the other. This process normally involves long distances.

5.2.1.3. Building

The building process of the wagon includes strengthening the wagon under frame, putting the airbrake gussets and plates using huck bolt machines as well as fitting the airbrake components onto the wagon.

5.2.1.4. Russist

This process involves the application of the russist resistant solvent onto the under frame of the wagon. This solvent is made to prevent the wagon from rust and corrosion while in traffic. There is a hold point at the russist station where
the wagon is inspected by a Quality Control Officer on the work done on
previous stations.

5.2.1.5. Welding

The welding process includes mainly the welding of the wagon floors onto the
wagon frame as well as welding the box onto the floor of the wagon.

5.2.1.6. Testing

The single car testers are used to test wagons. These are airbrake testing
devices which are calibrated on annual intervals. Should there be a leakage in
the brake system of the wagon, the wagon is rejected and returned to the
airbrake fitting station for rework. A wagon can only be released when it passes
the airbrake test.

5.2.1.7. Spray painting

This is the second last activity in the wagon refurbishing process. Spray
painting is used to paint wagons. During the painting process, wagons are
first cleaned using wire brushes. This is done to remove welding spatters
on the wagon body. The undercoat is applied and subsequently the final
coat. When the paint is dry, stencilling takes place. This is a process of
writing the wagon type, number, Transnet logo and he date when it was
refurbished.
5.3. Bridging the gap between Current and Future State Maps

This research is about implementing Value Stream Mapping at Transwerk Uitenhage. The researcher found it very important to identify activities which needed to be improved going forward to the future state map. The researcher identified activates from the current state which map were improved in the future state map as illustrated in figure 5.2. below:

5.3.1. Getting to the Future State

The researcher found it important to implement 5S method to clear the production line and only leave required material for the project.

This method is used to ensure that everything in it’s place at all times. Waste and defective components are sorted and removed from the production line. Monden. (1998: 199) states that 5S is used to eliminate waste and organise work place. Monden describes 5S as “Seiri” , which means Sort , “Seiton” , which means Set in order, “Seiso “, meaning Shine, “Seiketsu “ meaning Standardize and “Shitsuke which means Shine.
During the research, the researcher spent time on each activity in the wagon refurbishing process with the intention of identifying non-value add activities. These activities were then plotted on the process flow chart with distances measured between each activity and time taken by each activity, see figure 5.1 above.

Interviews that were held with Production Foremen, Operations Managers and the Centre Managers confirmed to the results presented in the process flow chart and current state map. A comparison between the current state map and the future state map is illustrated in figure 5.2 below.

<table>
<thead>
<tr>
<th>Current State Map</th>
<th>Future Map</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Material delivered in bulk by supplier to inventory stores and then released to the production line.</td>
<td>1. Material delivered to straight to “Supermarket “ in the production lines. Withdrawn from “Supermarket “ when required for production. Material is delivered in the basis of Just- In – Time principle.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>2. Buffer stock between stations maintained at five days stock.</td>
<td>2. Buffer stock reduced to one and a half days between stations.</td>
</tr>
<tr>
<td>3. The process employs 29 operators and the cycle time of 120 minutes and total process time of 480 minutes.</td>
<td>3. The process employs 25 operators and the line balanced to total process time of 350.6 minutes process time.</td>
</tr>
<tr>
<td>4. Welding and inspection stations were operated separately.</td>
<td>4. Welding and inspection stations combined into one station.</td>
</tr>
<tr>
<td>5. Capturing of received material by inventory stores.</td>
<td>5. Electronic communication between &quot;Supermarket&quot; and inventory stores in material received.</td>
</tr>
<tr>
<td>6. Physical and bulk withdrawal of material by Production Planners and transported to the lines.</td>
<td>6. Withdrawal and use of material by operators from &quot;Supermarkets&quot;. No distance travelled.</td>
</tr>
</tbody>
</table>
Figure 5.2.: Comparison between Current and Future State maps.

Source: Researcher.

5.4. Improvements in the Future State Map

Improvements were made on the activities identified for improvement in the current state map. The researcher explains the future state improvements as follows:

5.4.1. Material

The researcher observed that time is wasted waiting for critical components from stores. The actual distance travelled between stores and production lines is 43 metres. When material arrives on the production lines, it is delivered to different stations for production. To save time, the researcher suggested that all critical components be delivered to the “Supermarket” which is situated on the production lines. Material will be drawn when required by operators and used for production without any time wasted. Electronic communication media between the “Supermarket
“and stores was installed to inform the stores of received components for transaction purposes.

5.4.2. Resources

The activity sampling that was conducted by the researcher revealed that between 07h30 and 09h30, 17 out of 48 activities i.e. 35 % of the observed time, operators were idling. This was the indication of the fact that the stripping station was overcapacitated. Operators at this station were reduced from 12 to 9 and the cycle time was reduced from 120 minutes to 90.6 minutes. Operator utilization and value add per employee was maintained at 75 % with all the above improvements. This improvement posed a huge saving, especially from the labour point of view.

Operators were reduced from 29 to 25 in the whole process. This improvement came as a result of combining the welding station and the inspection station. During observations, the researcher discovered that when testing a wagon, the tester is idling. The process flows shows and the curent state map show that the duration of testing a wagon is 150 minutes.

The process flow also shows that a wagon spends 61.39 minutes in the welding station, which is situated just before the testing station. The operator testing the wagon is a qualified welder. The testing process is by means of connecting the single car tester to the wagon and start it. The
researcher suggested that tester should weld the wagon while waiting for the testing machine to finish welding. It is against this background that the researcher suggested to combine the two stations. These improvements are illustrated in figure 5.3 below.

Figure 5.3: Transwerk Uitenhage Future State Map

5.5. Conclusion
This chapter was based on the implementation of Value Stream Map in Transwerk Uitenhage. Improvements that were derived from the future state map of the wagon refurbishing process have resulted in saving from Transwerk. It was also clear that the takt time that was allocated to this process was not accurate.

Chapter Six

Summary and Conclusions

6.1. Introduction

In this chapter, the researcher summarises the research and offers conclusions and suggestions. Specific benefits derived from this research and future actions are also discussed.

6.2. Summary of the research
The use and benefits of lean manufacturing principles were identified. The rail industry is one of the oldest industries in South Africa. When the researcher conducted this research, it became clear that the rail industry is in desperate need of lean manufacturing principles. The enthusiasm and co-operation that was rendered by labour unions, management and production foremen was a clear indication of the desperation.

The literature study that was conducted in chapter two presented the researcher with a number of lean manufacturing options to choose from. Due to the fact that not all of the options were pertinent to the rail industry, Value Stream Mapping was implemented as it was more relevant.

The results presented to the researcher the benefits of having management and labour buy-in when implementing a new initiative in the organisation. Transwerk Uitenhage was always operating inefficiently, the results suggest. With the involvement of management and labour from the start of the treaties, it became a success.

6.3. Benefits brought about by the research.

The research presented Transwerk Uitenhage with benefits that are still going to be enjoyed by the origination should the Value Stream Mapping process be maintained. This process can only be maintained if there is commitment from management. The research brought about the following benefits:

6.3.1. Cost saving on material
Cost saving initiatives were implemented during the research. Cost savings came from procuring less material, which was only delivered to the production lines as opposed to the stores. Material was wasted as it was procured in bulk and kept in stock. During transportation from stores to the production lines, material was damaged as it was transported on trailers. Due to the fact that material was no more transported in this manner, there were no more material damages.

Cost saving on labour

With the improvements made in the future state map, operators were utilised more effectively and were idling time was eliminated. The combining of welding and inspection stations also led to effective operator utilization. Value add per employee also improved in the financial statements.

**Recommendations**

In order for Transwerk Uitenhage to remain an efficient organisation, the researcher recommends that before any intake of new employees is done, especially in the RFR section, a thorough study must be conducted to ensure that they are really needed and will be utilised effectively. It is also recommended that Transwerk Uitenhage ensures that their suppliers are made aware of the value stream mapping process and material requirements and forecasts are of the process. In all future process improvement initiatives, employees must be informed and trained so that they take ownership of the process.
6.5. Conclusion

This research was conducted in Transwerk Uitenhage. Management and labour was involved throughout the process of implementation of Value Stream Mapping in the wagon refurbishing process. This research focused on the wagon refurbishing process only as RFR is the core business of Transwerk Uitenhage.

The value stream mapping identified inefficiencies in the process of wagon refurbishing where employees were idling for longer period of time, resulting in wasted capacity. Operations that were utilised inefficiently were combined in order to be more efficient and value adding. This was done to address the main problem of Transwerk Uitenhage of how to implement value stream mapping in Transwerk in order to eliminate activities in the refurbishing process that do not add value to the bottom line of the organisation.
REFERENCE LIST


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What is lean manufacturing[Online].2005.Available from :


Appendix A

Value Stream Mapping Icons

GENERAL ICONS

Kaizen
Lightning Burst
Buffer or
Safety Stock
Operator
Supermarket
Withdrawal

MATERIAL FLOW ICONS

ASSEMBLY
Manufacturing
Process
Ryco
Corporation
Outside
Sources
Data Box
300 pieces
1 Day
Inventory
First-in-First-Out
Sequence Flow
PUSH
Arrow
Finished Goods
to Customer
on 30 pieces

INFORMATION FLOW ICONS

Manual
Information Flow
Electronic
Information Flow
Withdrawal
Kanban
Production
Kanban
Kanban Arriving
in Batches
Weekly
Schedule
Signal Kanban
Sequence-Pull Ball
"Go See"
Scheduling
Load Leveling
Kanban Post

Source: (Rother & Shook, 1999)
Picture A2

Wagon Stripping Process. Source: Researcher
Annexure A1

GLOSSARY OF TERMS

Anti-theft box: This is the steel box that is made to protect the valve from theft.

WIP: Work In Progress

CFR: This is a wagon type this is the main product at Transwerk Uitenhage

JIT: Just In Time, a lean manufacturing inventory control system.

Sub frames: These are components used to build a bogie for the wagon.

Draw gears: This is a component used to control the speed and control of the wagon.

Airbrake system: This is a system used by CFR wagons for brake application

Production Control Plan: This is a document used to plan production for all production lines based on the capacity of each line.

Shunting unit: This is the machine used to carry wagons from production lines to the spray shop.

Capstans: These are hydraulic equipments used to pull wagons by rope.

Business Review Meeting: This is meeting where all Transwerk Business Managers discuss their business performance and plant important issues.

Shop orders: This is a document used to build a wagon. It explains the type of work to be done on a wagon as well as material and labour hours required for the work.

Centre Manager: This manager manages the entire plant

Operations Managers: These are managers that are responsible for operations in their respective departments.

Single car testers: These are machines used to test wagons.
Rolling stock: These are all Spoornet products namely, wagons, coaches & locomotives

Appendix B

RMQA1 Certificate

**TRANSWERK** QUALITY ASSURANCE UITENHAGE

**RMQA-1** CERTIFICATE

**SERIAL No:**

TRANSWERK HEREBY CERTIFIED THAT:

WORK ON THE LOCOMOTIVE/VEHICLE/COMPONENT HAS BEEN COMPLETED SATISFACTORIALLY AND IN ACCORDANCE WITH THE SPECIFICATION STATEMENT OF WORK AND ALL OTHER CONDITIONS INCLUDED IN AGREEMENT:

TRANSWERK SERTIFISEER HIERMEE DAT:

WERK AAN DIE LOKOMOTIEF/VOERTUIG/KOMPONENTE BEVREDIGEND VOLTOOI IS OOR SPESIFIKASIE, BESKRYWING VAN WERK EN ALLE ANDER VOORWAARDES VERVAT IN DIEN

SHOP ORDER

CLIENT NO.

OLD WAGON NO.

NEW WAGON NO.

BATCH/ITEM ACCEPTED

J

Y

TYPE OF

CONTRACT / ORDER

DATE
Appendix C

Check List
**CHECK LIST FOR:**
BA/CA/DZ to CFR CONVERSION

**WAGON No:**

**BOGIE Type:**  
**Serial No:**  
**Serial No:**

**Side Frame Serial No's:**

**READ/USE IN CONJUNCTION WITH** the applicable work list and CP-024.

<table>
<thead>
<tr>
<th>OPER.</th>
<th>ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.1</td>
<td>Headstocks bent more than 25mm were repaired</td>
</tr>
<tr>
<td>10.2</td>
<td>Flame cutting marks repaired and dressed.</td>
</tr>
<tr>
<td>20.1</td>
<td>All loose scale, rust and paint removed from under frame</td>
</tr>
<tr>
<td>30.1</td>
<td>All loose rivets/Huck bolts replaced with Huck bolts.</td>
</tr>
<tr>
<td>30.2</td>
<td>No rust build-up between coupler guides and headstocks.</td>
</tr>
<tr>
<td>30.3</td>
<td>Draw gear pocket inspected and repaired to spec. RW/TE/PRO/0007</td>
</tr>
<tr>
<td>30.4</td>
<td>Longs strengthened and modified as per Drg. RSA 044_001_920A.</td>
</tr>
<tr>
<td>30.5</td>
<td>Camber set to 0±10mm</td>
</tr>
<tr>
<td>30.6</td>
<td>Mating faces painted before fitment</td>
</tr>
<tr>
<td>30.7</td>
<td>Sole bars and head stocks not corroded more than 50%</td>
</tr>
</tbody>
</table>

**HOLD POINT:** Sign: __________________ Date: __________________

| 40.1  | New components (except castings) were blast cleaned and prime coated before fitment. |
| 40.2  | Cracks in headstocks repaired and welded as per drg. CME 219/12-393 |
| 40.3  | Existing welding found to be cracked were rewelded. |
| 40.4  | Holes on longs modification are reamed. |
| 50.1  | Top Centre casting inspected and conform to letter ref. S.RM(WE) 15/8/1/2/3 dated 1993-09-09 |
| 50.2  | Side frictions conform to gauge no CME 3272/0-100 |
| 50.3  | Under frame modified as described in CP-024 |
| 60.1  | Drawgear has been replaced with **Miner SL-76 or RF 361** drawgear. |
| 60.2  | Operation (apply and release) of hand brake checked and found correctly |
Appendix C : Checklist

Appendix D

Not To Go Card
Appendix E

Interview Questionnaire – Centre Manager

Value Stream Mapping Implantation Questionnaire

Candidate : Malusi Mabaso

Position in Transwerk Uitenhage : Acting Centre Manager

Date of Interview : 17 September 2006-11-23

Purpose of Interview : To understand the candidate’s honest opinion about the current wagon refurbishing process at Transwerk Uitenhage.

NB : PLEASE PROVIDE HONEST AND OBJECTIVE ANSWERS
Question 1

Why do you think it is important for Transwerk Uitenhage to meet and exceed customer demands?

Question 2

Can you perhaps tell me, what will happen if Transwerk Uitenhage does not meet the targets set by Corporate Office, especially profits?

Question 3

Can you share with me the current Year To Date plant sales, Net Working Capital, Profits, Labour costs and fixed and variable costs? (The plant income statement and balance sheet was presented).

Question 3.1

What do you think are the reasons for these results?

Thank you very much for your time.
Appendix F

Operations Managers Interview Questionnaire

Number of Candidates interviewed : Two

Position in Transwerk Uitenhage : Operations Managers

Date of Interview : 17 September 2006-11-23

Purpose of Interview : To understand the candidate’s honest opinion about the current wagon refurbishing process at Transwerk Uitenhage.

NB : PLEASE PROVIDE HONEST AND OBJECTIVE ANSWERS

Question 1

Why do you think it is important for Transwerk Uitenhage to meet and exceed customer demands ?

Question 2

Can you perhaps tell me, what will happen if Transwerk Uitenhage does not meet the targets set by Corporate Office, especially profits?
Question 3

Can you share with me the current Year To Date performance in terms of wagons delivered by RFR against the daily set targets? (RFR production plan was presented).

Question 3.1

What do you think are the reasons for targets not being met, especially on your main lines (CFR Lines)?

Thank you very much for your time.

Appendix G

Production Foremen Interview Questionnaire

Number of Candidates being interviewed: Three

Position in Transwerk Uitenhage: Production Foremen

Date of Interview: 18 August 2006

Purpose of Interview: To understand the candidate’s honest opinion about the current wagon refurbishing process at Transwerk Uitenhage.
NB: PLEASE PROVIDE HONEST AND OBJECTIVE ANSWERS

Question 1

Why do you think it is important for Transwerk Uitenhage to meet and exceed customer demands?

Question 2

Can you perhaps tell me, what will happen if Transwerk Uitenhage does not meet the targets set by Corporate Office, especially profits?

Question 3

Can you share with me the current Year To Date performance for your line? Record of refurbished wagons presented.

Question 3.1

What do you think are the reasons for you not meeting your daily targets on this line?

Thank you very much for your time.
**Appendix H**

Value Stream Mapping Implementation Plan

<table>
<thead>
<tr>
<th>Seq.</th>
<th>Action</th>
<th>Goal</th>
<th>Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Meet all Production Foreman and Operations Managers Implements</td>
<td>Get buy-in and commitment</td>
<td>Jan Feb Mar Apr May Jun Jul Aug Sep</td>
</tr>
<tr>
<td></td>
<td>5S</td>
<td></td>
<td></td>
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<tr>
<td>---</td>
<td>-------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Meet CFR line staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Get buy-in and commitment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Update PCP to reflect new times and staff requirement per line.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Implement the line changes successfully.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Train CFR line staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Make staff aware of their new roles and responsibilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Implement network for VSM</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Link Supermarket to stores and production planning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Train CFR staff on &quot;Supermarket &quot; and &quot; competenc on</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&quot;Withdrawal and Production Kanban&quot; concepts.</td>
<td>VSM</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Train Inventory stores staff and Production Planning on VSM</td>
<td>Ensure staff competency on VSM</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Liase with customer on new lead times and delivery points per item.</td>
<td>Deliver to CFR line required components</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Implement VSM.</td>
<td>Use VSM on CFR and the rest of the lines.</td>
<td></td>
</tr>
</tbody>
</table>
LIST OF APPENDICES