

How to do Value Stream Mapping

CONTENTS

Abstract	2
What is Value Stream Mapping?	2
Value Stream Mapping Methodology	4
Investigation	7
Analysis	7
Identifying Improvements	7

Mike Sondalini

Lifetime Reliability Solutions

www.lifetime-reliability.com

Email: info@lifetime-reliability.com

Fax: (+ 61 8) 9457 8642

Mob/Cell: 0402 731 563

How to do Value Stream Mapping

Abstract

Value Stream Mapping has the reputation of uncovering waste in manufacturing, production and business processes by identifying and removing or streamlining non-value-adding steps. A flow diagram showing the process is drawn to reflect the current state of the operation. The non-value actions are identified in each step and between each step by their waste of time and resources. The process is analysed for opportunity to drastically reduce and simplify it to the fewest actions necessary. By reducing wastefulness the proportion of value adding time in the whole process rises and the process throughput speed is increased. This makes the redesigned process more effective (the right things are being done) and more efficient (needing fewer resources). The reengineered process is flow charted in its future state with process steps and information flows redesigned, simplified and made less expensive.

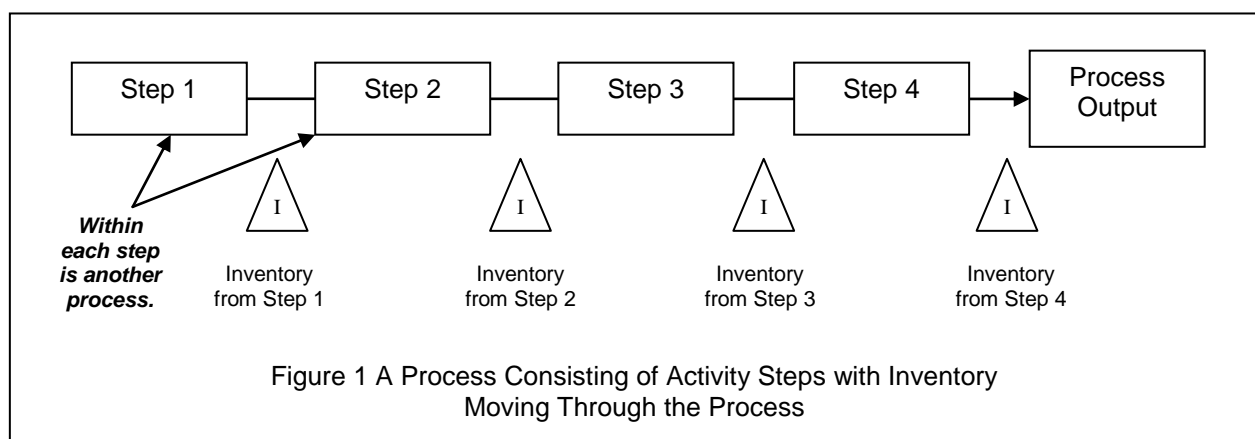
What is Value Stream Mapping?

The use of Value Stream Mapping (VSM) has been attributed to the cause of much of the success that Toyota of Japan has had since the 1980's¹. Developed during the work conducted by Taiichi Ohno at Toyota in the 1960's and 70's, at its basic level VSM is a systematic methodology to identify wasted time and actions in a manufacturing process. In more recent times VSM it has been used to re-engineer businesses because it identifies unnecessary effort and resources to permit simplification and streamlining of operations processes.

In Taiichi Ohno's words - *"All we are doing is looking at the time line from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that time line by removing the non-value-added wastes."* (Ohno, 1988)

It is useful to explain the meaning of several key concepts used in VSM. These are: what is meant by a process, what waste is, what is meant by 'flow', what constitutes value-adding, along with what is needless non-value-adding and what is necessary non-value-adding.

A process is a series of activity steps that move inventory from one step to the next to transform it into the intended output, as shown in Figure 1. The output could be a physical item or a service. A process can be any type or size and cover any period of time. Each step in a process also consists of processes within the step. VSM is used to investigate processes to identify improvement opportunities lying in their wastefulness and lack of fluidity.

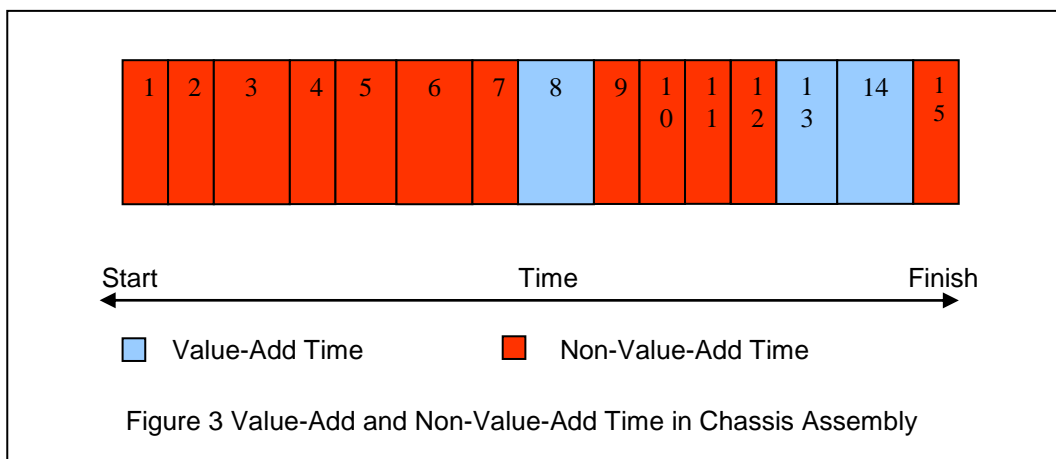
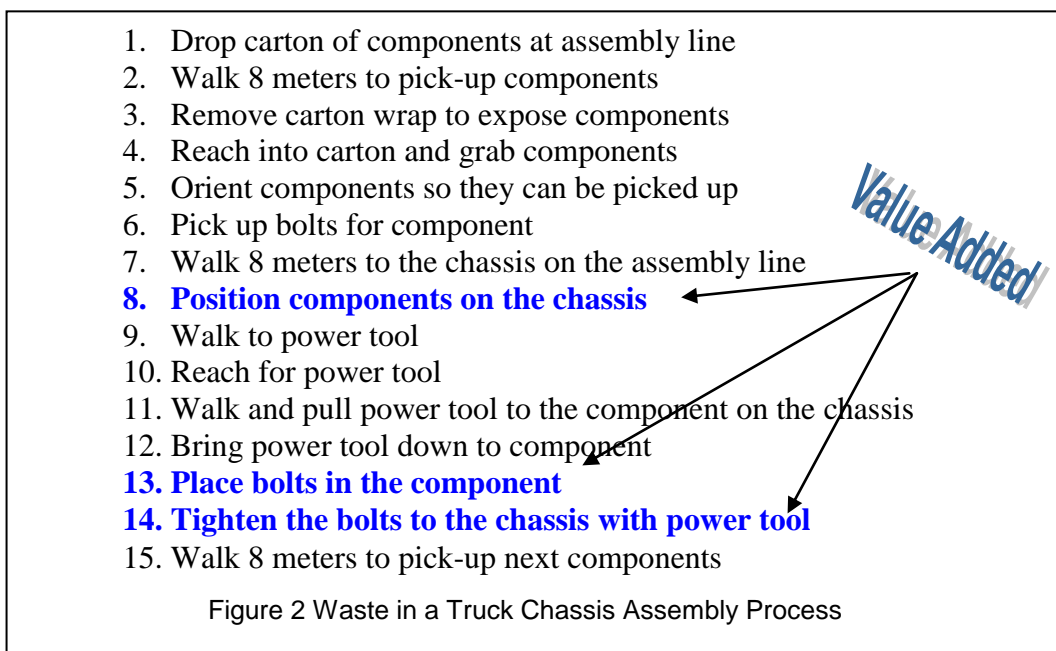


Waste is one of the seven wastes identified by Toyota. These are:

1. *Overproduction*: Producing items for which there are no orders.
2. *Waiting Time*: Employees standing about. Inventory at stand-still.
3. *Unnecessary Transport*: Moving material unnecessarily or long distances.
4. *Over-processing*: Using more steps to produce a product than necessary.
5. *Excess Inventory*: Retaining unnecessary inventory between process steps.
6. *Unnecessary Movement*: Any wasted motion by man or machine.
7. *Defect*: Making incorrect product.

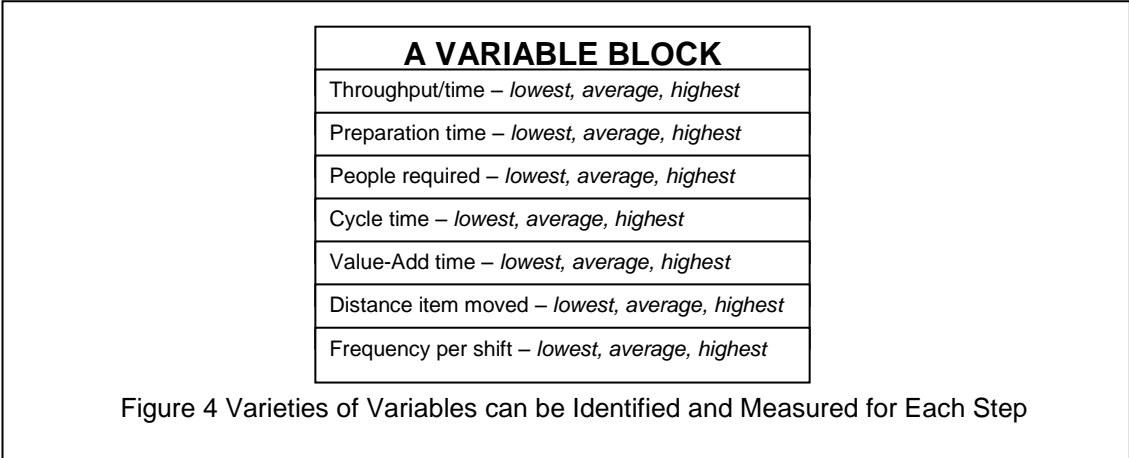
Flow is the continuous movement of inventory from step to step in a smooth, steady pattern and level rate. Toyota says that when the process is right production ‘flows like water’.

Value is from the customer’s perspective, the customer being the person who uses the output. Value-adding actions and resources are those which create value for the customer. Non-value-adding is everything done in the process which contributes no value for the customer but which they are forced to pay for when they buy the product or service. Figures 2 and 3 shows a situation in a truck chassis assembly process where value is added and lost for the customer. Necessary non-value-adding are those actions in a process that must be done to make the product but create no value for the customer. Unnecessary non-value-adding is removed and necessary non-value-adding is minimised to the least possible.



Value Stream Mapping Methodology

In VSM we follow a process from start to finish monitoring and measuring what happens within, and between, each process step. For each process step we record the variety of resources used in the step, the amount of their usage and the range of times each resource is in use as a block of information specific to that step. The measured variables are collected together in a ‘variable block’ as shown in Figure 4. Note the spread, or variation, of the variables is recorded and not just the average. The presence of variability offers great opportunity for improvement.



From the information collected during data gathering the process is drawn as a flow diagram showing the times and resources used at each step and the time delay between each step. This diagram is called the ‘current state map’, an example is shown in Figure 8.

The ‘current state map’ of Figure 8 is the straight bar manufacturing process for steel reinforcing bar used in strengthening concrete structures. Bundles of straight steel bar are off-loaded from trucks into storage racks and wait to be cut. When bar of a particular diameter is needed the steel is taken to the cutting machine shown in Figures 5, 6 and 7 and cut to length. It is then conveyed and fed into the collection pockets. Once the required numbers of steel bars are in the pocket they are wire-wrapped together into a bundle to stop bars sliding about for reasons of safety and ease of moving. The bundle is then removed from the pocket and stored in a rack until loaded on a truck to be taken to the construction site early each working day morning.

Figure 8 shows the use of ‘variable blocks’ to capture relevant information about each step. Inventory movements between steps are identified by the ‘I’ inside a triangle. Under the triangle is noted the range of times (quickest, average, longest) the inventory can take to be moved. A visualisation of the location of value-add and non-value-add steps is presented as a line across the bottom of the page which jumps up during a value-adding step and stays low for all other times. The current state map is scrutinised step by step to identify which of the functions and actions performed in the step/process add ‘customer-value’ and which do not.

The non-value-adding actions and resources are analysed to find where they can be minimised through time-saving and cost-saving improvements. A secondary benefit of timing the process steps and measuring the rate of throughput is identification of the bottleneck step(s). The bottlenecks can be redesigned to lift their capacity and so increase the output rate of the whole process. The reengineered process is drawn on a new flow chart known as the ‘future state map’. It shows all the steps and information flows in a redesigned, simplified and more efficient process. A basic future state map block diagram for the bar cutting process is shown in Figure 10.

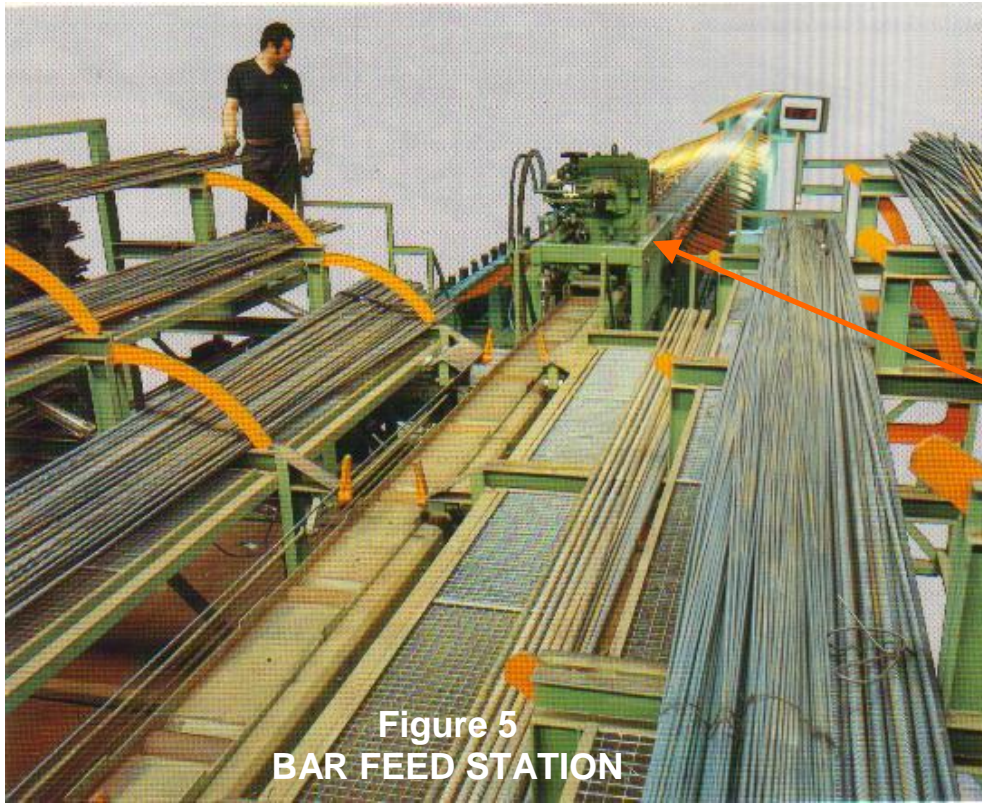


Figure 5
BAR FEED STATION

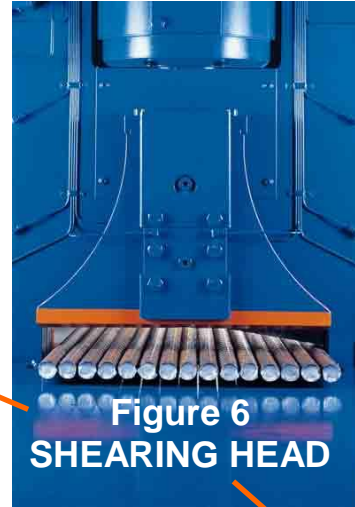


Figure 6
SHEARING HEAD



Figure 7
SHEARING LINE WITH
STORAGE POCKETS

STEEL REINFORCING BAR SHEARING LINE

STEP VARIABLES
Tonne/shift thru step
Prep'n Time for step
People required in step
Cycle Time for step
Value-Add per job
Distance item moves
Frequency per shift

CURRENT STATE MAP Per shift

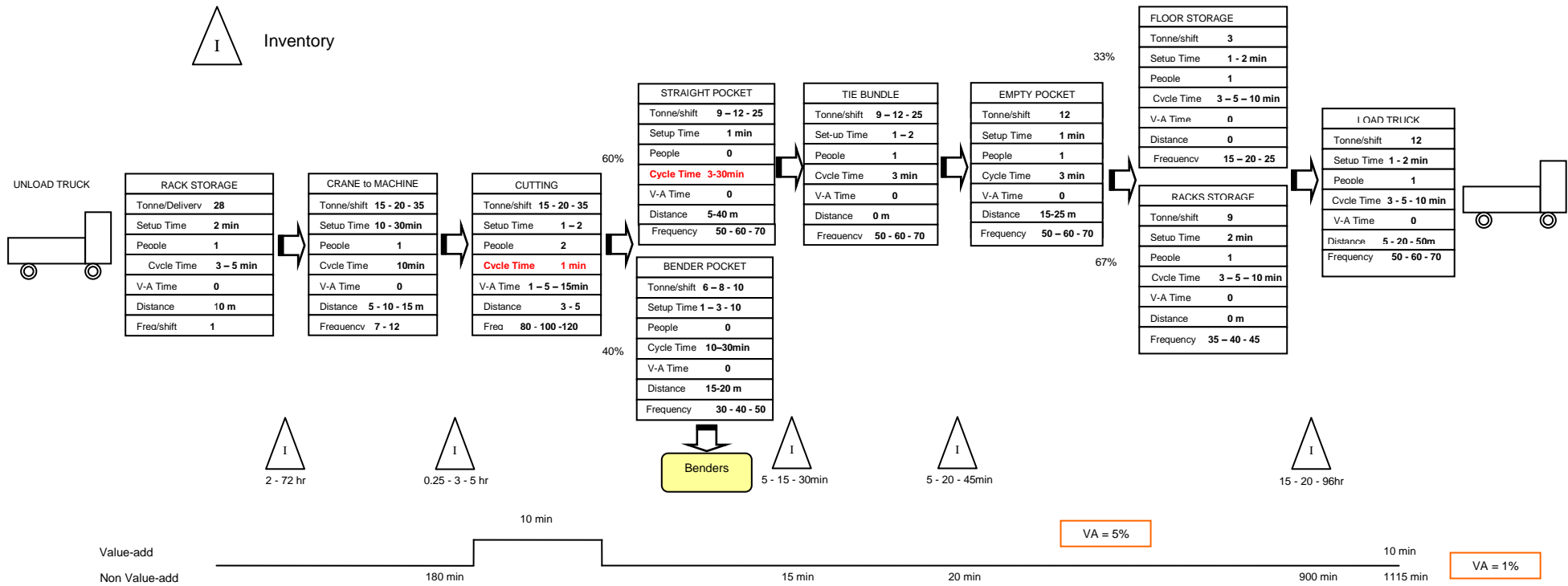


Figure 8 Bar Cutting Process Current State Map

Investigation

VSM requires spending time in the workplace recording the details of people, product, equipment and information movements. It is necessary to record and time the range of variables that occur in each process step during the operation. It also requires viewing written records related to the process in order to record dates, quantities, delays, stoppages, breakdowns, operating decisions, absentees, etc that impacted on the performance of the operation during the period being analysed.

The believability of the analysis is only as good as its completeness of its content and the truthfulness and honesty it contains. When there are provable facts extracted from documented evidence and recorded site observation there can be belief in the findings from the investigation.

Analysis

The worth of VSM becomes self-evident during the analysis phase. Once a business or manufacturing process is drawn as a series of steps and described in numerical terms, the inherent oddities and inconsistencies become evident. The first analysis performed is to compute a ratio of total customer-value-adding time to total process time to see how customer-effective is the process. Often this figure is in the single digits. A low customer-value-adding ratio indicates a process design without the customer's wishes being considered. The fortunate aspect of non-customer-oriented processes is the great scope offered to cut big amounts of waste and cost from them.

Other important factors to identify during the analysis are the variability between good and poor performance in each of the process steps and the time that inventory is standing still between steps. Poor inventory speed is an indicator of too much work-in-progress not levelled to the bottleneck rate. Variability indicates inconsistent and uncoordinated practices which need to be streamlined and proceduralised. The good aspect of variability is that without spending money improvements are made by discovering what causes the good and the poor performance and changing practices and procedures to do more of the good, and less of the poor.

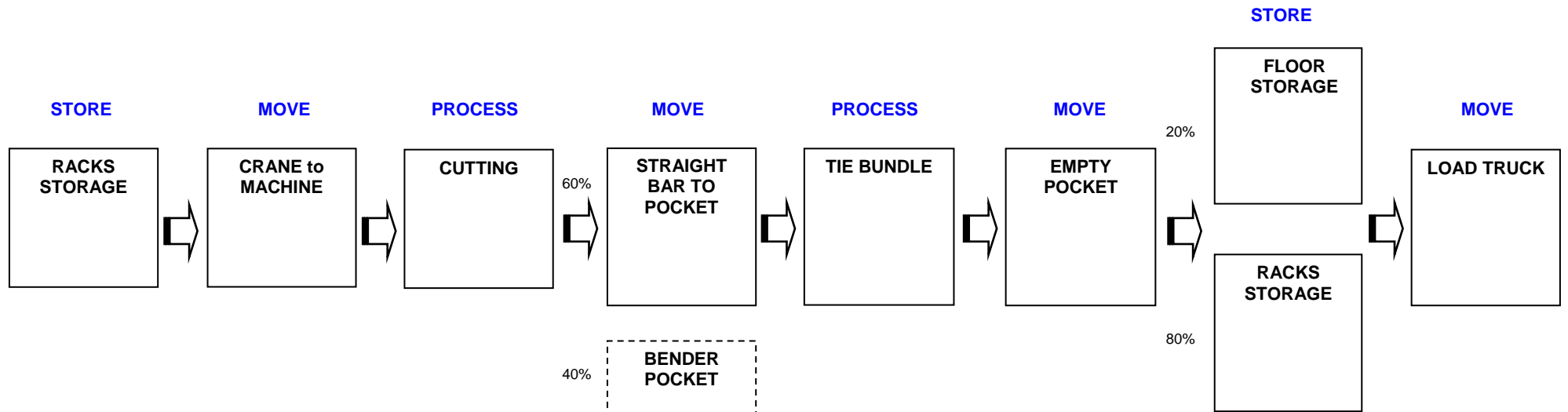
Numerous simple statistical techniques are available to analyse the data produced during the investigation. Scatter plots, Pareto charts, pie diagrams, cause and effect diagrams and the like are easy tools and methods to apply in analysing data for its hidden information. The problems identified in the process are quantified in terms of the costs and customer-non-value-adding time they take. By giving a money value to the waste and the non-value we have a powerful business motivator to make changes.

Identifying Improvements

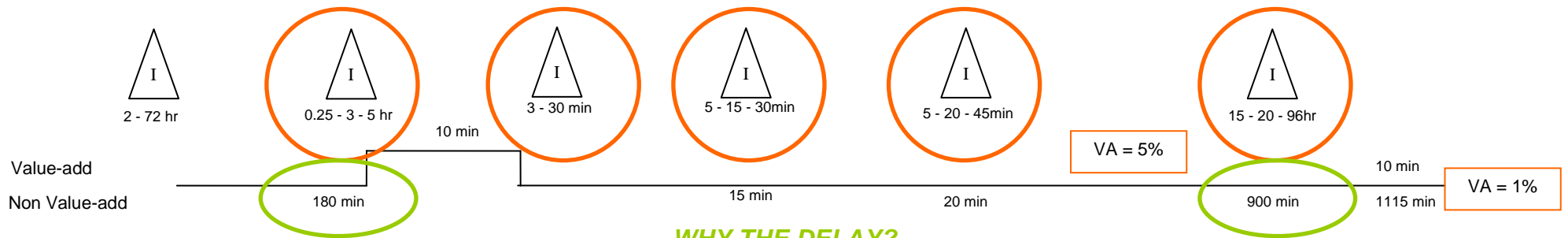
Opportunities for improvement readily present themselves as the analysis is conducted. When developing proposals it is ideal if that the users of the process are included in identifying the solutions so they take ownership for the future implementation. During the analysis simplifications in process steps are identified, procedural changes to stop wasted actions show themselves, and equipment and process modifications needed to increase throughput rates become evident. The selected improvements are included in the redesigned 'future state map' of the process.

Identifying less obvious improvements is helped by simplify the process into function blocks with single word function descriptors as shown above the variable blocks in Figure 9. By taking the process back to its most basic components it is possible to redesign the process by removing, combining and overlaying its basic functions to arrive at a simplified and higher customer-value-added operation. Figure 10 shows the steel bar cutting process with increased value-added and inventory speed achieved by halving the early morning deliveries and introducing a second late morning delivery so that the finished steel did not sit in storage a second time after manufacture. A further benefit was 5-6 hours of labour saving.

CURRENT STATE FUNCTION BLOCK DIAGRAM



**WHY THE VARIATION?
... OPPORTUNITY!**



**WHY THE DELAY?
... OPPORTUNITY!**

Figure 9 Bar Cutting Process Functions

FUTURE STATE BLOCK DIAGRAM

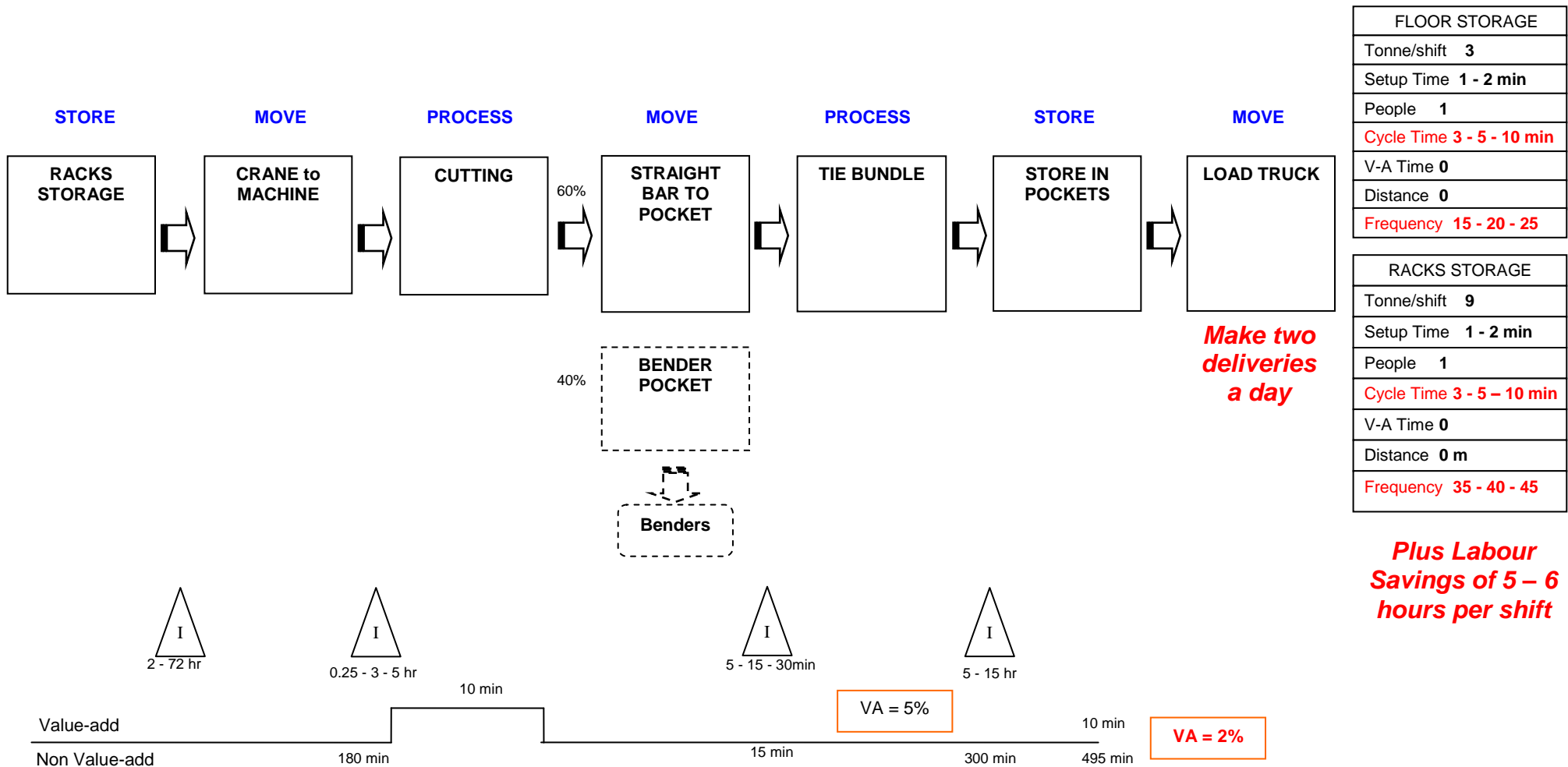


Figure 10 Bar Cutting Process Future State

Bibliography

1. Liker, Jeffery K., *The Toyota Way – 14 Management Principles from the World's Greatest Manufacturer*, Page 27, McGraw Hill, 2004