Application of lean manufacturing tools in cash centres to improve operational efficiency

By

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Declaration

This treatise is submitted in partial fulfilment of the requirements for the degree of Master in Business Administration, in the Faculty of Business and Economic Sciences at the Nelson Mandela Metropolitan University. The work has not been previously accepted in substance for any degree and is not being concurrently submitted in candidature for any other degree. The research contained in this document is a result of my own independent work and investigation, except where otherwise stated. All sources consulted are acknowledged and referenced.

Signed: R. E. Smith

Date
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<td>5S</td>
<td>Seiri (organise), Seiton (orderliness), Seiso (cleaning), Seiketsu (Standardise), Shitsuke (discipline)</td>
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<tr>
<td>AQL</td>
<td>Acceptable quality level</td>
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<tr>
<td>ATM</td>
<td>Automatic teller machine</td>
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<td>CIT</td>
<td>Cash-in-transit</td>
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<td>JIT</td>
<td>Just-in-time</td>
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<td>JPF</td>
<td>Jefferson Pilot Financial</td>
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<tr>
<td>MIT</td>
<td>Massachusetts Institute of Technology</td>
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<tr>
<td>OTED</td>
<td>One touch exchange of dies</td>
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<tr>
<td>PPM</td>
<td>Parts per million</td>
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<td>SARB</td>
<td>South African Reserve Bank</td>
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<tr>
<td>SMED</td>
<td>Single minute exchange device</td>
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<tr>
<td>SPC</td>
<td>Statistical process control</td>
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<tr>
<td>TAKT</td>
<td>Total allocated cycle time</td>
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<td>TPM</td>
<td>Total productive maintenance</td>
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CHAPTER 1

PROBLEM STATEMENT AND OUTLINE OF THE STUDY

1.1 INTRODUCTION

Cash centres, also commonly known as count houses, are used by certain financial institutions to process bulk cash deposits primarily from retailers. Although some financial institutions have outsourced this function to third party providers, it still forms part of their value proposition to their customers.

A simplified explanation of this value proposition could be explained as the process of receiving bulk cash deposits, counting the cash, passing credit to the respective customer’s account, and in many instances reconciling customer’s accounts. The entire value proposition, however, must make business sense for the customer as well the financial institution. In other words, it is only common sense that such a proposition has to be profitable for the institution, as well as, be cost effective for the customer, who is making the bulk cash deposit. Due to large amount of revenues generated by cash management services, the industry has become very competitive (Hines, Hurt & Langsam, 2000: 15).

The cash centre therefore has to be run as cost effectively as any other business that is competing to sell their services or products. In the manufacturing trade, lean was one of the major enablers that helped manufacturing companies become more cost effective. Lean provides a way to do more with less – less human effort, less equipment, less time, and less space – while coming closer and closer to providing customers with exactly what they want (Womack & Jones, 2003: 10).

There are no clear-cut guidelines as to how lean manufacturing should be implemented; rather, implementation should take into account the environment and requirements of the production system (Papadopoulou & Ozbayrak, 2005: 788). This paper explores operations in a cash centre, and how, like
manufacturing companies, it is applying lean methodology in order to become more cost effective.

Fourier Approach (2008) emphasise that the cash centre industry in SA has come under enormous pressure to process and redistribute cash quicker and more effectively. This is in line with international trends where renewed focus is placed on cash handling and redistribution in an attempt to reduce the overall cost for the processing of cash.

1.2 MAIN PROBLEM

Can a lean manufacturing philosophy by applied in a cash centre in order to improve operational efficiency?

1.3 SUB – PROBLEMS

In an effort to reduce the cost of handling and recycling cash, financial institutions have to look at the approach that manufacturing companies, and more specifically, automotive manufacturers, took in order to stay competitive. However, it is clear that an automotive manufacturer has a lot more in common with a pharmaceutical company, or even a clothing manufacturer, than it would have with the service industry, and more particular, with a cash management operation. One can therefore deduct that the transfer of lean competencies from the automotive manufacturer, where lean originated from (Papadopoulou & Ozbayrak, 2005: 786) to a cash centre environment, could be more of a complex task than transferring those same competencies to another manufacturing operation. This does not insinuate that the implementation of lean methodology to a pure manufacturing operation is a simple task, but it does imply that the approach required and the methodology might vary with regard to a service operation.
Therefore, in order to apply lean methodology to cash centres, two sub-problems exist:

1. How is lean manufacturing currently applied in cash centres?
2. What are further opportunities to apply lean manufacturing concepts, tools, and philosophy within cash centres?

1.4 OBJECTIVES OF THE RESEARCH

Central to this research is the need to answer the question, what are the lean elements that could be applied to a cash centre, how can they be applied, and what, if any, will be the benefit for the centre?

The above objective is against the backdrop that lean manufacturing principles, or at least some lean manufacturing principles can be applied to every industry (Soriano-Meier & Forrester, 2002: 108).

“Lean elements” in this context refers to tools, techniques, methodologies or practices that can be implemented in the framework of the adoption of lean manufacturing.

The objectives and principles of lean manufacturing are primarily adapted from the Toyota Production System (TPS). Lean practitioners such as Womack and Schonberger, or institutes such as the Massachusetts Institute of Technology (MIT), and the Lean Enterprise Institute have over the years added enhancements to the system (ReVelle, 2002: 171).

Taiichi Ohno, the founder of TPS, states that when an organisation wants to implement lean production, all the company must concentrate on doing, is to look at the time line from the moment the customer gives the order to the point when the cash is received (Liker, 2004: 21). Ehrlich (2006: 42) concurs with Ohno that the order-to-cash (time from receipt of order to receipt of payment) cycle needs to be shortened through the removal of waste or non-value adding
activities. This research is aimed at applying Ohno’s philosophy to the cash centre environment.

Research Methodology:

1. Identify and evaluate by means of a literature review lean tools and implementation strategies as used in both the manufacturing and service industry that could be applied in the cash centre.
2. Explore the current state of cash centres in the context of the literature review by means of an empirical study.
3. Formulate a model that could be applicable to cash centres that address cost and improved customer service by using lean manufacturing methodology.

1.5 DEMARCATION OF THE RESEARCH

Although it is probable that the results of the research could be of use to similar environments (such as cash centres from other financial institutions), the research contained in this paper is confined to the cash management practices of one particular financial services company within South Africa.

According to Levitt (1972: 41-42), all industries are in “service”. The only difference is the degree. Levitt states that even companies that are considered product or manufacturing industries, have a reliance on service. Often companies such as automotive manufacturing, rely heavily on their service components (after-sales, repairs, display rooms, warranty fulfilment etc.) in order to meet their sales and thus their profitability objectives. However, it cannot be stated that all organisations are in the product industry. The cash centre environment is a combination of product and service. The research done in this paper therefore will focus on lean methodology and application based on a product and manufacturing industry, as well as industries that are pure service.
1.6 DEFINITION OF SELECTED CONCEPTS

Cash Centres are often referred to as a count house. Cash centres are normally owned by financial or cash management services.

Customer Referencing: Often cash deposits made to a financial institution will also bear referencing. The referencing enables the depositor to reconcile their financial entries. Cash centre customers often setup pre-defined referencing parameters (e.g. date, store number, cash number etc.) with the cash centre. This referencing often becomes critical for customer reconciliation and is therefore critical to quality.

Retail Customers: These are customers in the form of businesses. These include large corporate companies as well as small to medium concerns, irrespective of sector.

Cash in transit (CIT) refers to cash management services contracted by retail customers to deliver bulk cash deposits to cash centres, or any branch of a financial institution.

Floats are packs of cash in a combination of notes and coin that is ordered mainly by retailers to be used by their cashiers as change for retail customers who pay for their goods in cash.

External customers are those customers who are external to the financial institute being researched.

Internal customers are departments or divisions within the financial institute being researched. Typically, these departments or divisions receive some sort of internal service from the cash centre.

Lean elements in this context refers to tools, techniques, methodologies or practices that can be implemented in the framework of the adoption of lean manufacturing.
Handoffs refer to the passing along of work from one set of hands to another set of hands.

1.7 ASSUMPTIONS

Although the research is based on one particular financial institutions in South Africa, it is assumed that the value proposition offered by other financial institutions, even if they are outsourced, is similar enough to apply the same principles of lean methodology. It cannot be assumed that the processes are the same, but merely that the intrinsic cash cycle, or value chain, is in principle the same.

This assumption of the cash cycle or value chain is as follows:

- Cash from retailers is sent to cash centres.
- Cash centres process the cash in the form of deposits, with which they then credit the retailer’s bank account.
- The cash from these deposits are recycled primarily for the replenishment of ATM machines.

1.8 THE SIGNIFICANCE OF THE RESEARCH

Financial institutes, typically banks, that derive funding from the collection of cash deposits, could derive benefit from the research. In addition, companies who act as outsourced suppliers to such institutes, and therefore process cash deposits on behalf of the banks should derive a similar benefit.

Notably, some financial institutes outsource their cash management services. The advantages of outsourcing, such as freeing up staff, and getting the organisation to focus on its core activities, has to be weighed against the challenges that it provides. Hines et al. (2000: 17) note that outsourcing often means a heavy reliance on third party for service, the reliance on third parties
for the managing of funds, as well as the risk of securing customer confidentiality.

Referring to a survey done by Ernst and Young in 1999, Hines et al. (2000: 15) revealed that revenue from cash management had grown from $7 billion in 1993, to $10 billion in 1999. It would thus be hard to overstate the significance of this industry, or the importance of gaining a competitive advantage.

This research aims to provide some guideline on how the banks could become more competitive through pricing and service without cross-subsidising their bulk cash processing divisions.

Competitiveness, in turn, would be derived by improving productivity through the application and transfer of lean tools from manufacturing and the service industry.

Although the lean approach is well established in the manufacturing sector and certain product-service sectors, evidence of lean in pure service environments is very limited (Piercy & Rich, 2009: 59). Cash centres have a unique combination of service and product environments in the sense that: (1) cash is the commodity and (2) the commodity received from customers is in a sense used as raw material to create products like floats, payrolls, and cash for ATMs. This research could therefore contribute to the way management views the suitability of lean production methodologies in the context of a part product and part service environment such as the cash centre.

1.9 OUTLINE OF THE STUDY

- Chapter 1 contains the problem statement, sub-problems, and the context of the study.
- Chapter 2 is a literature review on lean manufacturing. It includes lean elements or tools, as well as a look at implementation strategies adopted by organisations in the pure service industry and the product industry.
• Chapter 3 creates context of the operations and customer offerings within a typical cash centre.
• Chapter 4 describes the design of the survey and approach taken with the collection of the empirical data.
• Chapter 5 contains the results and the analysis of the empirical data collection.
• Chapter 6 reaches a conclusion and makes recommendations based on the literature review and the results of the empirical data.

1.10 CONCLUDING REMARKS

This chapter created context of the study by defining the main problem as well as the sub-problems. It also provides an overview of the methodology followed in order to understand which lean tools are applicable to cash centres.
CHAPTER 2

THEORY OF LEAN MANUFACTURING

2.1 INTRODUCTION

Chapter 2 is intended to give context to the lean manufacturing philosophy. The literature contains an overview of some of the defining characteristics of lean, as well as the approach taken by organisations that have implemented lean manufacturing. Part of the challenge in identifying the lean tools, is coming to terms with the application of these tools, especially when differentiating between the pure service industry and the manufacturing industry.

The study does not merely look at the benefits of lean manufacturing, but also examines some of the criticisms levelled at lean manufacturing.

2.2 WHAT IS LEAN MANUFACTURING?

In defining lean manufacturing, various practitioners and scholars arrive at different definitions. A common thread, however, is that it pertains to the removal of waste or non-value adding activities during the fabrication of a product or the delivery of a service. Irrespective of the methodology, the end objective still remains the same: eliminate waste or non-value adding activities.

Shah and Ward (2003: 129-132) assert that lean manufacturing combines practices such as just-in-time, quality systems, work teams, cellular manufacturing, supplier management etc. to achieve high quality systems that produces finished goods according to customer demand.

A key principle of lean manufacturing is continuous flow as opposed to the traditional approach of mass batch production where work is processed in large batches before moving on to the next step in the process (Swank, 2003: 124; Liker, 2004).
In terms of the application of lean practices, Karlsson and Åhlström (1996: 25) emphasise the fact that it is not confined to the physical manufacturing practice, but that it also includes product development, procurement, and distribution.

2.3 HISTORY OF LEAN MANUFACTURING

According to Papadopoulou and Ozbayrak (2005: 786), it was Krafcik who first coined the term “lean” in 1988. Krafcik had been a quality engineer at a Toyota-General Motors joint venture plant in California, before coming to MIT for MBA studies. Krafcik used the term to describe a production system that uses fewer resources than the traditional mass production philosophy (Papadopoulou & Ozbayrak, 2005: 786).

Although Krafcik only coined the term lean in the late 1980s, it is important to understand that the concept of lean manufacturing evolved from various management sciences. According to Strategos (2002), lean manufacturing can be dated back to Eli Whitney in 1799, who is famous for the concept of developing interchangeable parts in an assembly line after being awarded a US Army contract for the manufacture of 10,000 muskets.

At about 1910, Henry Ford focused his manufacturing strategy on the arrangement of people, machines, tooling, and material, in a continuous system for manufacturing the Model T automobile. Ford is considered by many to be the first practitioner of just-in-time, lean manufacturing, or Toyota Production System (TPS) (Krafcik, 1988: 42; Strategos, 2002:1).

After World War I, Taiichi Ohno and Shigeo Shingo, from Toyota Motor Company, began to incorporate Ford production and other techniques into an approach called Toyota Production System or just-in-time (Strategos, 2002). Ford’s system of manufacturing was based on mass producing a single product. One could argue that Ford took this approach in order to overcome the delays caused by changing from one product to another. Ohno, on the other hand, overcame this obstacle by focusing on reducing setup times from hours, in
some cases, to seconds. The reduced setup times allowed for small batches and increased flexibility.

By the 1980s, terms such as World Class Manufacturing, Continuous Flow and Stockless Production were identified with the Toyota Production Systems (Piercy & Rich, 2009: 55).

Because of its inherently dynamic nature, leaness has undergone and still is undergoing a process of continuous and never-ending evolution, the current state of which is expressed in the form of the lean enterprise model (Papadopoulou & Ozbayrak, 2005: 784).

2.4 IMPACT OF LEAN MANUFACTURING PRINCIPLES ON ORGANISATIONS

Parry, Mills and Turner (2010: 6-8) state that lean needs to be implemented without compromising the organisation’s core competencies. They define core competencies as “......a skill / asset / technology that underpins the growth of the business and differentiates the business from its current and future competitors.” By adopting this approach, it can be stated that lean implementation should improve the delivery of value to the customer by enhancing its core competencies. The ability to enhance processes and core competencies does not exclude any organisation or industry – on the contrary, it means that the lean philosophy should be applicable at least to some degree to every organisation. Part of the objective of this research is to determine to what degree the lean philosophy can be applied to cash centres.

In defining the characteristics of lean manufacturing, Bowen and Youngdahl (1998: 211) mention how flexibility, that was compromised during the age of mass production, is replaced by flexible worker teams that strive towards smaller batch sizes by reducing key restraints such as setup times, or product change-over times. Highly automated and specialised equipment is traded for general purpose tools used for the production of multiple products on single assembly lines.
2.4.1 Customer impact

Lean methodology has to take into account the impact on the customer. The critical starting point for lean is understanding value as defined by the customer - who will ultimately pay for the service or product (Womack & Jones, 2003: 17; Ehrlich, 2006: 43). If processes are made more efficient through the adoption of lean, it is only logical that customers should derive a tangible benefit as well.

One of the reasons that encouraged manufacturing companies to pursue the lean manufacturing approach was due to the necessary shift away from mass production which prevailed at the start of the 20th century. Mass production served its purpose when high volumes and low variety could satisfy customers. However, post World War II saw customers demanding more in terms of quality, service, and variety. This paradigm forced manufacturing companies to focus on identifying and reducing waste within their production system while still satisfying customers that are continuously seeking greater variety. Lean enterprises should deliver a high state of agility and responsiveness, and at the same time continuously seek for ways to reduce consumption of resources in their struggle to deliver value to their customers (Papadopoulou & Ozbayrak, 2005: 795, 797).

Finally Power, Sohal and Rahman (2001: 260) confirm that companies with a higher focus on customer, and adapting to customer needs, place greater emphasis on continuous improvement as opposed to the more inwardly focused companies that see this as being a function of the type of technology they have and how they utilize it.

2.4.2 Impact on cost

Percy and Rich (2009: 72) claim that the lean approach can be relatively easily applied with minimal investment in training, and very rapidly generating major improvement gains for adoptive companies. The demanding customer marketplace is requiring that better service be provided while at the same time there are managerial pressures for cost reduction. The benefits on offer from
lean improvement are based on achieving these seemingly opposing goals. However, in his introduction to the term “lean”, Krafcik (1988: 44-45) describes it as a high risk approach, as apposed to the buffer approach which employs more resources just-in-case. Examples of buffer included high inventory levels in case of unexpected quality delays, or built-in buffers to keep production moving in case equipment broke down. The lean approach, however, does have great potential financial gains.

2.4.3 Impact on efficiency & quality

It is important to measure performance in order to see where the organisation is at present. The best way of doing this is to measure the performance of the operation in terms of quality as well as efficiency. Harvey (1998: 585) defines quality as not only the ability to provide customers with what they want, but that it also pertains to the process that they need to go through in order to get an agreed upon standard of service or delivery. This view concurs with Mason and Antony’s (2000: 233) definition of quality as “…the ability to fulfil specific needs, or conform to and ideally exceed customer expectations”. Chandra (2001: 1) defines quality with terms such as “fitness for use, satisfying customers, and conformance to requirements”. Mason and Antony state their definition in the context of today’s consumer markets that are increasing their demand for better products and services, while continually paying less and less. Therefore, in order to stay competitive, companies need to focus on producing quality products as well as delivering quality service.

Efficiency on the other hand is a function of the ability of the organisation to deliver the customer’s expectation in the most cost effective manner. Efficiency is therefore an expression of how well input resources (labour, material, money, and machines) were utilised in order to deliver a service a product for the customer which can be seen as the output. Efficiency is therefore expressed as a ratio of outputs to inputs. Typical examples include earnings per square metre, parts produced per employee etc. (Shafer & Meredith, 1998: 52).
Piercy and Rich (2009: 70) advocate the movement away from narrow and rigid efficiency measures to focus on value and effectiveness. If we take the example of the cash value proposition, the perceived value for the customer was:

- Accounts credited within a specified period.
- Correct value is credited to the customer’s account.
- The correct customer account is credited.

The above can be clearly measured in a quantitative manner. The assumption can also be made that non-conformance of the above customer expectations will lead to customer dissatisfaction. Similarly one can now measure all the other sections in the value proposition and determine the level of satisfaction at each of the various stages.

### 2.4.4 Staff impact

The journey towards lean implementation undoubtedly has an impact on staff morale. The importance of getting everybody on board cannot be underestimated. Letting people know how things will be changing is as important as letting them know why things are changing (Swank, 2003: 128).

Spear and Bowen (1999: 103) confirm that all of the organisations that they studied, and which are managed according to the Toyota Production System, share an overarching belief that people are the most significant corporate asset, and that investments in their knowledge and skills are necessary to build competitiveness.

Papadopoulou and Ozbayrak (2005: 800) emphasise that the process of change towards leanness does not merely concern the adoption and implementation of a number of lean tools and techniques. They also refer to the necessary changes in the company culture, the determination and commitment of the senior management in achieving the lean transformation, its role in encouraging and empowering the workforce as well as in providing the required means for sustaining the change towards lean manufacturing. Underlying these
practical issues are several paradigmatic shifts in organising logic. Key issues revolve around the movement away from a top-down control of workers in narrow job-roles with rigidly enforced efficiency measures, to a cross-skilled workforce, trained and rewarded for customer service by a supportive rather than controlling management hierarchy (Piercy & Rich, 2009: 66).

Although activities, connections, and production flows in a Toyota factory are rigidly scripted, their operations are enormously flexible and adaptable due to the fact that those same activities and processes are constantly being challenged and pushed to a higher level of performance, enabling the company to continually innovate and improve (Spear & Bowen, 1999: 97). The ability for an organisation to move its people to constantly challenge and drive continuous improvement, should speak to the fact that the lean journey is more than the implementation of kanban cards and quality circles, instead it speaks of people being given the scope to identify opportunities for improvement by constantly challenging the status quo.

In analysing the response from 962 Australian manufacturing companies, Power et al. (2001: 259) find a strong correlation between the “more agile” companies’ level of customer satisfaction and a participative management style – speaking to a lean management style that promotes engaging their employees in a meaningful way.

Lean manufacturing philosophy is committed to empowering line workers. A typical example is the considerable responsibility provided to line workers through the use of tools such as andon cords, thereby giving workers the authority to stop production lines when abnormal conditions occur. By stopping the production line, it forces everybody to get involved in finding out why the line was stopped, and addressing the cause of the abnormality. This same type of responsibility should be extended to the service providers (Maleyeff, 2006: 687). Empowering of workers, however, does not mean that any deviation from standard work processes is allowed, but rather that process variation is tracked against standardised work practices with expected work results (Bowen & Youngdahl, 1998: 213). Similarly a lean system has a high level of
standardisation of commonly performed activities. However, the benefits of standardising should be well balanced against the gains of flexibility. While flexibility resulting from standardisation may seem paradoxical, it is only with a standard approach that the service provider can understand precisely what should happen under normal circumstances and thus recognise atypical situations.

In their study of high performing automotive component manufacturers and their correlation to lean manufacturing, Oliver, Delbridge, and Lowe, (1996: 42) maintain that the soft issues of team work and operator responsibility is necessary, but not enough to precipitate high performance, or to create order out of chaos.

2.4.5 Competitive advantage / operational lift

The Toyota Production System has long been hailed as the source of Toyota's outstanding performance as a manufacturer (Spear & Bowen, 1999: 97; Jozaffe, 2006: 3).

Considering the impact on cost, quality, and service, it is no surprise that Soderquist and Motwani (1999: 1107) view lean strategically as a formidable weapon in increasing competitive markets.

2.5 LEAN MANUFACTURING TOOLS / CONCEPTS / ELEMENTS

In his review of lean tools and techniques, Pettersen (2009: 129) identified the most frequently mentioned characteristics of lean manufacturing. Pettersen grouped the various lean tools into nine interdependent bundles. Although others such as Shah and Ward (2003: 130) had different bundles, the concepts which comprised the bundles were very similar. This section of the literature aims to:

- Explore the individual concepts, in their respective bundles, as identified by Pettersen and supported by various other literature.
Where possible, identify literature that supports the transfer or application of these concepts to pure service industries.

2.5.1 Just-in-time (JIT) practices

Liker (2004: 23) describes JIT as a set of tools aimed at producing and delivering products in small quantities and at frequent intervals. Besides the benefits such as increased flexibility and reduced work-in-process, JIT promotes continuous flow.

2.5.1.1 Production levelling (heijunka)

In order to prevent the waste of _mura_ or "unevenness", Kasul and Motwani (1997: 278) describes heijunka as a production planning method intended to evenly distribute the variety of products over any given time. The even distribution or levelling prevents processes from experiencing uneven workloads and eases the production planning process. Heijunka boards are often used in combination with kanban cards as a way of distributing work load (Zangwill, 2002: 4).

2.5.1.2 Pull system (kanban)

Another characteristic of the lean organisation is that products are _pulled_ from customers. This pulling effect is proliferated through the entire supply chain or value stream. Womack and Jones (2003: 24) refers to this as a step in the lean journey, but also a characteristic of the organisation that only produces what the customer consumes. Maleyeff (2006: 676) asserts that, technically the principles discussed by Womack and Jones do not always apply to the service industry, since most service systems are by default a pull system because the customer initiates all the work.

Ohno (1988: 40-41) describes the kanban card as a method for controlling inventory and work in progress, which generates the biggest waste in a factory. No work is transported, produced, ordered or delivered without a kanban card.
attached. This also allows inventory levels to be reduced by reducing the number of kanban cards in circulation.

2.5.1.3 Takted production

Referring to a German word for pace or rhythm, takt time is the maximum time required to produce a single component or an entire product in order to still meet the customer’s volume demand. It follows a relatively simple calculation of dividing the total available time for production by the number of parts required by the customer. If a single component or completed product takes longer than the takt time, than the customer’s demand will not be met. An adjustment of either the available time, or the cycle time has to be made in order to fulfil the customer’s demand. Takt times should be visible at workstations in order for staff to understand the hourly requirements (Kasul & Motwani, 1997: 276; Seth & Gupta, 2005: 51).

2.5.1.4 Process synchronization

Bicheno (2000: 65-66) describes the need to keep materials on the move as more important than to keep people or machines moving, but also that the material should not move faster than the customer demand.

2.5.2 Resource reduction

2.5.2.1 Small lot production and setup time reduction

Toyota uses excess capacity in equipment such as die presses to their advantage by reducing lot sizes even further. Coupled to the reduction of lot sizes is the issue of reducing machine setup time, and therefore avoiding the continuous flow of a single item or product in large quantities. This idea is contrary to the mass production philosophy as well as the perceived benefits under the banner of economies of scale (Ohno, 1988: 56, 95-96).
2.5.2.2 Waste elimination

In order to eliminate waste and improve customer service, lean principles are increasingly being applied to service companies (Bowen & Youngdahl, 1998: 207). Waste or non-value adding activities, is any process or action that customers are not willing to pay for. Waste therefore, increases cost without deriving revenue for the organisation concerned (Karlsson & Åhlström, 1996: 27).

In an attempt to gain insight into the management of an internal service system from a lean management perspective, Maleyeff (2006: 675) states that manufacturing organisations are primarily concerned with creating physical transformations. The transformations that take place in service systems are broader, and include:

- physiological such as an employee assistance;
- exchange such as a company store;
- informational such education and training;
- location such as distribution service; and
- storage, such as warehousing.

Often service organisations will include a combination of two or three transformations. Information, however, remains the most likely component of an internal service system (Maleyeff, 2006: 675). Therefore, the most efficient system of document control could fall short of satisfying customer requirements if the information contained is incomplete or misinterpreted.

Ehrlich (2006: 41) describes manufacturing industries' transition from wasteful mass manufacturing ideals to a lean operating model. Long production runs with inflexible machines in the mass production environment leads to waste such as long cycle times, high inventory, and complex scheduling and distribution methods. This in effect also leads to high defect rates and high cost. Similarly, “Mass Servicing” prevails in the service industry. A typical example is poorly trained call centre operators that are incentivised to churn out as many
phone calls as possible. This contradicts customers’ expectation of getting queries resolved the first time and results in “...repeated contacts, more work-in-process, and complex scheduling systems...” (Ehrlich, 2006: 41).

Ohno (1988: 129) identified seven kinds of waste:

1. Transportation.
   Transportation or movement of parts, work-in-progress (WIP), or finished goods is waste. Moving parts or products waste time, while no value is being added during the transit. These include any parts that need to be moved from one destination to the other, whether that destination is a few millimetres or millions of kilometres.

2. Inventory.
   This refers to parts or finished products that are not immediately needed by an upstream process or customer. Inventory can occur with too much raw material, work in process, or finished products.

3. Motion.
   This refers to the movement of people or machines. Excess motion can occur when looking for tools, bending, stretching, or walking.

4. Waiting or idle.
   This occurs when people, machine, or material have to wait or queue. Causes of waiting can be because of queuing (normally because of over-production), quality delays, or unplanned machine downtime.

5. Over-Processing the product with extra steps.
   This occurs when additional processing takes place despite the fact the prior processing has already complied with the requirements of the customer.

6. Over-Production of products not needed.
Often in production environments, there is a tendency to produce more than what is needed. This tendency is usually derived from a notion of “just-in-case”, but leads to both resources and inventory being tied up, that could have been more optimally used.

7. Defects in the product.
   Defects or errors in the product normally lead to scrap, reworks, or customer dissatisfaction.

Maleyeff (2006: 683) states that while connections can be made between these types of waste and those found in internal service systems, many of these types of waste would be much less important in a service system. In order to accommodate the service industry, Maleyeff tabulated and categorised seven kinds of waste to address non-value adding activities in an internal service system.

1. **Delays** include time wasted either directly in queueing or waiting for information to be transmitted.

2. **Reviews** are activities that inspect completed or partially completed work for errors or omissions. Examples include confirming that standard accounting procedures are being used, checking technical accuracy of an analysis, or creating a presentation to obtain management approval before proceeding to the next phase of a project.

3. **Mistakes** include errors or omissions. Once these errors or omissions are discovered it causes work to be redone. Errors found by customers may also lead to loss of reputation. A secondary result of mistakes is the disruption and delay they cause to “normal” work activities.

4. **Duplication** includes activities that are also done elsewhere in the system or can be done more easily in another part of the system. A typical examples of duplication occurs when the same data is entered onto a form at two difference locations in the same system.

5. **Movement** includes the physical transport of information, personnel, or equipment which is often unnecessary.
6. **Processing inefficiencies** includes the ineffective use of resources to perform specific tasks. Generating reports without a standard template is a typical example of “reinventing the wheel” every time a report is generated.

7. **Resource inefficiencies** occur when personnel, equipment, materials, or capital are managed wastefully. Examples would be holding meetings that do not result in enhanced value for customers or creating a work schedule that did not coincide with customer demand.

Notably Maleyeff reasons his seven kinds of waste from an internal service system, while Ehrlich (2006: 42) argues from a customer facing service perspective, typically a call centre environment. In it, Ehrlich also cites seven kinds of waste as he relates to Ohno’s manufacturing’s seven kinds of waste.

1. Overproduction takes place in the form of excessive screens, asking customers for unnecessary proof of claim, or asking customers to call back during operating hours.
2. Inventory or work-in-process is likened to call transfers, backlogs of customer request, or excessive emails.
3. Transportation is likened to non-value adding movement of information, data and documentation,
4. Unnecessary motion such as walking to printer, requesting handoffs, or travelling from desk to desk.
5. Idle or waiting time occurs as request or calls that are queued before they can be serviced.
6. The waste of errors occurring in manufacturing is likened to inaccurate information provided, error-prone online and manual forms with excessive fields, outdated customer databases, or any kind of general rework.
7. The waste of “unused creativity” taking place in the form of lack of adherence to standard operating procedures, high absenteeism, low morale, and human resources or any other asset not being utilised.
2.5.2.3 Setup or changeover time reduction

Schonberger (1982: 18, 66) emphasises the point that small lot production is one of the most logical ways of cutting carrying cost, simply because large batch production incurs more inventory as well as the associated cost. A common misperception is to run larger batches in order to reduce the need to perform change-overs. Smaller lot sizes also aid in early detection and reduction of defects.

Setup or changeover time is defined as the time it takes from producing the last good part of one type, to the time it takes to produce the first good part of another type. Various strategies are employed to reduce this time. The most commonly cited is: single minute exchange dies (SMED), one touch exchange of dies (OTED), as well as synchronising the total time of the changeover into internal (activities that can only be performed while the production line is stopped) and external time (activities that can be performed while the line is still running e.g. preparatory activities) (McIntosh, Culley, Gest, Mileham, & Owen, 1996: 6-7).

2.5.2.4 Lead time reduction

Both customers and suppliers benefit from reducing lead times. For customers it means faster delivery or quick response. For the supplier it means reducing the order to cash cycle, lessened impact of cancelled orders, reduced WIP in the system, and less management resources as there are fewer jobs to track simultaneously. Hopp, Spearman, and Woodruff (1990: 78-79) suggested strategies for reducing lead time are:

- reducing WIP;
- keep parts or components moving (reduce the product or the components being idle as it waits to be moved);
- synchronise the production;
- smooth the work flow; and
- reduce or eliminate variation.
2.5.2.5 Inventory reduction

In his study of 52 Japanese manufacturing companies, Lieberman (1997: 24) found a direct correlation between inventory reduction and productivity. Lieberman found that productivity gains of about one percent were made for every ten percent reduction in inventory, and that the productivity gains normally lagged about a year after the inventory gains. Lieberman also noted that the reverse also applies: productivity gains tended to stimulate inventory reductions.

2.5.3 Human relations management

Although Pettersen (2009: 132) places team organisation, cross training, and employee involvement under the banner of human relations management, Shah and Ward (2003: 137) only places flexible cross-functional work force, and self directed work teams in a bundle called human resource management (HRM). They state that all other practices are a subset of the above mentioned concepts (flexible cross-functional work force and self directed work teams). For example, cross functional training and job rotation fulfils the need to have a flexible cross functional work force. Similarly team organisation, team problem solving, and employee involvement forms part of the self directed work teams.

In their study of Japanese based team systems’ application in the US, Cutcher-Gershenfeld, Nitta, Barret, Belhedi, Bullard, Coutchie, Inaba, Ishino, Lee, Lin, Mothersell, Rabine, Ramanand, Strolle, and Wheaton (1994: 58) identify three team approaches. Firstly they identify the lean system which is focused on flow through the manufacturing plant, but has reduced worker autonomy. Secondly, they mention the socio-technical system (STS) which encourages worker autonomy by optimising the balance between social and and technical sub-systems, but often at the expense of efficiency and operating cost. Lastly, they mention the Off-line team, which uses specific problem solving tools for specific issues, but does not address daily work operations. Although variation of the team approach may occur within a given facility, each organisation needs to choose the specific team approach in line with desired outcomes.
Although ergonomics is not mentioned in Pettersen’s (2009) list of the most commonly cited lean production characteristics, Shah and Ward (2003: 130) list safety improvements as the least frequently referenced characteristic. Human beings in the production process means ergonomics. Therefore, as long as human beings directly influence production, quality and productivity will be impacted by ergonomics (Drury, 2000: 4007-4008).

2.5.4 Improvement strategies

2.5.4.1 Improvement circles

Improvement circles also known as Productivity Improvement Circles (PIC) is an adaptation by the Philippines’ National Productivity and Development Centre (NPDC) of the Japanese Quality Control Circles (QCC). The improvement circles are small groups of workers from the same work area whose objective it is to promote self or mutual development, as well as problem solving activities. Staff participate on a voluntary basis and are grouped in small teams of between three and ten team members. Using a scientific and systematic approach, the circle take on task or projects that are within the control of the group or circle, and support the organisation’s objectives. Typically these tasks include projects such as reducing waste, improving quality, simplifying work and even morale boosting initiatives. The circle progresses from one project or task to another, and the concept could be applied in any environment (Prokopenko, 1987: 94-95).

2.5.4.2 Continuous improvement (Kaizen)

Karlsson and Åhlström (1996: 29) list continuous improvement as the second most important principle behind a lean philosophy (waste removal being first). In a drive to seek perfection, new ways to remove waste from the system needs to be a management perogative. Although continuous improvement is driven by a management philosophy, it involves all employees, typically through quality circles that give adequate attention and feedback to employees about improvement suggestions.
2.5.4.3 Root cause analysis

Root cause analysis and elimination ensures that problems do not continually re-surface, in both the manufacturing as well as the pure service industries (Ehrlich, 2006: 43). One has to distinguish between causes and root causes. Causes can be viewed as symptoms and often seen as superficial. Root cause identification involves drilling down to the least common organisational, personal and/or activity denominator. Root cause analysis can therefore be used as a tool to improve quality, productivity, and even customer service (Yavas & Yasin, 2001: 446-447).

2.5.5 Defects control

2.5.5.1 Autonomation (Jidoka)

Jidoka is another term that was derived from Toyota, and describes a level of automation that stops the production process once a defective or an abnormal condition occurs. Although various definitions exist, such as autonomation or automation with a human touch, its roots are derived from Sakichi Toyoda, who invented a simple mechanism that detected a broken thread and shut off an automatic loom. The concept flourished because it made controlling abnormal conditions a lot easier since defects are caught early on in the process (Sugimori, Kusunoki, Cho, & Uchikawa, S, 1977: 554; Rosenthal, 2002).

2.5.5.2 Failure prevention (poka yoke)

Failure prevention through poka yoke is a method of preventing defective parts to be produced, or detecting that they are defective at the source. A process that has poka yoke built into it will therefore not allow the operation to complete if it is defective (Fisher, 1999: 264). The word poka yoke is derived from Japanese meaning mistake or error (poka) and prevention (yoke). A close association of the term is baka yoke, meaning fool-proof. Defects come about as a result of errors or mistakes; the intention of poka yoke devices was to ensure 100% inspection by letting all parts pass through a poka yoke (Shingo, 1985: 25).
Shimbun (1988: 10-11) cites ten types different of errors. Based on the illustrations that he uses, Shimbun makes no distinction between errors made in a factory or production environment and that of a pure service environment. Errors such as forgetfulness, errors due to misunderstanding, errors due to wrong identification, or errors due to a lack of understanding could all be applied to service industries equally well.

2.5.5.3 Hundred percent inspection

Traditional Western inspection techniques, derived from the US defence during World War II subscribed to the concept of lot acceptance sampling. This practice meant that an entire lot would be judged based on the quality of a sample. Japanese manufacturers noted three objections to this approach. Firstly, it went against the JIT and single piece flow principle of low inventory, where, it is preferable to inspect immediately, piece by piece, so as to avoid producing large quantities of defects. Secondly, the sampling tables used required the acceptable quality level (AQL) expressed as a percentage of defects, i.e. parts per 100. Japanese at this stage were already measuring defects as part per million (PPM). Thirdly, the Japanese considered quality serious enough to measure or inspect every single part (Schonberger, 1982: 62).

2.5.5.4 Line stop (andon).

The andon board serves as part of a visual indicator of the status of the production line. Typically it is in the form of a green light signifying that production is running normally. Additional colours such as red, yellow, or blue, indicate abnormal conditions or even that the line has stopped producing due to a problem that should be rectified before production can continue. Critical in this system is that operators in the production line have no fear of activating the andon. Another important factor is that andon creates awareness for the entire shop floor as well as management that there are problems that need to be addressed (Ohno, 1988: 121).
2.5.6 Supply chain management

2.5.6.1 Value stream mapping or flowcharting

Both Value stream mapping (VSM) and process mapping is a means of making work flow visible with the objective of improving communication and understanding (Damelio, 1996: 1). Seth and Gupta (2005: 47) describe VSM as the visualisation of station cycle times, inventory buffers, manpower deployment, uptime, utilisation of resources, and information flow within a given area. Generally speaking VSM takes a “bigger picture” approach, including also the flow of information, not just the movement of the product and the individual parts or components. Practitioners use this tool to track the flow of the product from the customer (downstream) all the way to the supplier, with the intention of identifying non value adding activities or waste.

The benefits of removing the non-value adding activities include reduced lead time and reduced inventory, which in turn has a knock-on effect on issues such as quality and cost (Rother & Shook, 1998: 3-4).

In their case study of a manufacturing firm, Lasa, Laburu and Vila, (2008: 50) confirm that the main strengths of VSM is that it shows up waste within the current order fulfilment process, but that the tool is heavily reliant on correct data flow regarding the production flow. The availability of data or information, speeds up the process of drawing up the current state map. Once a current state map is drawn up, it should highlight current waste or potential for improving and thus drawing up a future state map.

2.5.6.2 Supplier involvement

Bicheno (2000: 69) emphasises the importance of supplier relationship by using the analogy of a marriage. The partnership of mutual respect and trust culminates in a major force for competitive advantage. Bicheno focuses on five aspects of supplier expectation.
Firstly, is the principle of cost. Bicheno suggests that organisations need to initiate cost reduction activities for their suppliers, setting target cost for their components. Target cost = market price – profit, as opposed to the traditional view of Market price = cost + profit. A common practice in Japan is to use cost information to control cost, as opposed to a Western approach that makes a decision about pricing based on the cost and desired profit. Toyota for instance, sets goals for cost reduction, and then achieves the goal by making design changes in order to meet the cost goal (Alvarez, 2001).

Secondly Bicheno stresses that quality components need to be delivered to the point of need without the need for inspection. Quality could also mean getting involved with suppliers’ designers.

Bicheno cites delivery as the third aspect of the metaphorical marriage. Lean deliveries are those that are done in smaller batches, more frequently (preferably by kanban), and as close to the point of use as possible.

The fourth aspect of supplier relationship is a combination of quality and delivery, i.e. the reliability of the supplier. Quality cannot be used as a trade-off for delivery, and vica versa, instead, the two can be combined to form the basis of a rating scheme to highlight good suppliers.

Finally, information management is key to bringing all previous aspects together. Schedule visibility (e.g. electronic via web), common bar code standards, computer sytems, even packaging or containers, and problem resolution are just some of the possibilities that exist to eliminate waste of resources (Bicheno, 2000: 73).

2.5.7 Standardisation

2.5.7.1 Housekeeping (5S)

A method of workplace organisation through standardised and visual controls is 5S. It is a Japanese acronym for the words seiri, seiton, seiso, seiketsu, and shitsuke. Translated, these words mean organisation, neatness, cleanliness,
standardisation, and discipline, respectively. Organisations have translated these words slightly differently in order to blend with their corporate culture, while still keeping sight of the original Japanese intention (Warwood & Knowles, 2004: 347-348).

A common misunderstanding is that 5S is a tool for housekeeping. In the case of Pranckevicius, Diaz, and Gitlow (2008: 71), 5S was used to improve the defect rate and thus quality of thermoforming during the production of plastic cups. Pranckevicius et al. used Seiri (organise) to remove unwanted items in the workplace, and leaving those items most frequently needed, in close proximity. Next they applied Seiton (orderliness) by placing items in dedicated places where they could easily be found, or replaced after use. Seiton could be used for material, work-in-process, finished goods, equipment (jigs, bits, carts, dies, etc.), and even walkways. Seiso (Cleaning) is used to promote routine cleaning in the workplace. Besides using seiso to sweep or mop, its intention is also to find the root cause of grime or oil leaks, with the intention of eliminating them through preventative maintenance (PM). Seiketsu (Standardise cleanup) is the development of standardised practices or methods for performing the first 3Ss (Seiri, Seiton, and Seiso). A good way to describe Seiketsu, is that it is the formation of habits that culminated in the adoption of policy and procedure. Lastly Shitsuke (discipline) sees the first 4Ss becoming a “systemic disciplined approach to management” (Pranckevicius et al., 2008: 74). In other words, the last principle is realised when the first four principles are adopted in all aspects of the business, and where management leads by example.

2.5.7.2 Standardised work

Shingo (1985: 220) identified three elements of standardised work:

- cycle time;
- operation routing; and
- standard storage.

Shingo uses the term cycle time and takt time interchangeably, referring to the required time for an operation to produce a part. The time is measured in minutes or seconds. Personal time differences between workers comes about
as a result of wrong routings or movements. Supervisors or foremen therefore have to train workers to perform the process exactly as stipulated in the standardised work instruction. Sequence of the process is thus as important as the cycle time. Similarly Wittenberg (1994: 12) describes standardisation as the process of setting a standard, maintaining it, and then focusing on improving that standard.

Storage of work-in-progress (WIP) must be clearly defined. The ideal amount of WIP between workstation is one, which includes the WIP inside the machine or process being worked on.

The standardised work instruction must be done by the people who will be doing the actual work. Shingo does not agree that the cycle time should simply be timed and taken as an average – even if a method study has been performed. Instead, the real standard operation should be derived from understanding *What* needs to be done, *Who* needs to do it, *How* will it be done, *Where* will it be done, and *When* will it be done. Each of the above questions needs to be answered after repeating *why* to each of the above five times – only then, does one derive at a standard operation (Shingo, 1985: 223).

### 2.5.7.3 Visual control and management

Visual control also commonly known as management by sight, is a key component of lean manufacturing. The intention is to make waste and even variation of any kind visible – thereby highlighting an abnormal condition. Although the abnormal condition is highlighted to all staff including management, it is the perogative of the source of the abnormal condition to normalise the situation again. 5S, as part of work place organisation is a good example of a tool used to highlight abnormal conditions (BusinessKnowledgeSource.com, 2008). In addition to ensuring everything is in its place, visual controls are also used in inventory control (e.g. kanban), defect detection, performance measurement (e.g. target production rate per hour), customer feedback, safety, work status (e.g. idle, machine breakdown etc.) and document control.
2.5.8 Scientific management

2.5.8.1 Policy deployment (Hoshin Kanri)

Hoshin Kanri, also known as Policy Deployment, Hoshin Planning, or Policy Management is a method of setting strategic direction. It was developed in Japan in the 1960s as a derivative of Management by Objectives (MBO). The objectives of each manager or work group are derived from higher organisational goals, spelling out the contribution to attainment of company goals (Tennant & Roberts, 2000: 78, 81).

2.5.8.2 Time and workstudies

As part of the scientific management movement started in the 1880s in the United States, Frederick W. Taylor, Frank and Lillian Gilbreth, and a number of other scientific management pioneers perfected workstudy techniques. Workstudy revolved around setting standard methods of work by conducting method and time studies, which in turn were used for job scheduling, supervision, and control. This scientific approach gave the United States the upperhand in productivity and production management for most of the first half of the twentieth century (Schonberger, 1982: 8-10; Van Niekerk, 1982: 77; Aft, 1983: 134).

2.5.8.3 Multi skilling, work force reduction, and layouts

The arrangement of equipment and workstations is vital for ensuring the continuous flow of inventories and material. The traditional batch and queue approach, where similar processes or equipment are grouped together, meant that parts were transported to where they were to be processed. A layout adjustment to a leaner approach, often translates into a cellular layout. Cellular layouts facilitate the flow of products from one piece of equipment to another in batch sizes as small as one piece (SiliconFarEast.com, 2005). A key ingredient of cellular manufacturing, is that it caters for workforce flexibility. Workforce becomes the variable that gets adjusted as the demand fluctuates. This does not necessarily mean the staff are retrenched or rehired everytime the demand fluctuates, but rather that staff are allocated to the product lines with increased
demand, and reduced from the lines that have a drop in demand. Key to multi-manning of course is upskilling of staff in multiple processes (Bamber & Dale, 2000: 297).

2.5.9 Bundled techniques

2.5.9.1 Statistical process control (SPC)

“SPC is a statistical technique used to control processes and to reduce variation” (Mason & Antony, 2000: 233). Common causes (causes inherent to the process e.g. raw material fluctuations) and special causes (causes that are not inherent to the process e.g. machine setup) are the two main causes of variation. SPC aims at reducing or even eliminating this variation. At the beginning of the century, quality control was achieved primarily by inspecting finished products at the end of the production line. The fact that defects were only detected after full or sometimes partial assembly meant that completed products had to be either scrapped or reworked; both incurring cost and waste. Today SPC is used inside of the process to monitor, control, analyse, and improve the process by eliminating causes of variation (Mason & Antony, 2000: 234).

As an example of applying SPC to the service industry, Jones and Dent’s (1994: 22) case study on a catering company had some interesting revelations. The study plotted customer feedback on a daily basis on control charts. The feedback from the customers was obtained by selecting a sample number of customers every day, and then asking them to rate the experience from one to ten. The rating was also based on key performance measures that were obtained from customers in an earlier study. Besides having a positive impact on service delivery and delighting customers, it also had a noticeable impact on staff morale. Jones and Dent conclude that the boost in morale is attributed to:

- Positive discussions between managers and employees about performance.
- A better understanding of “the big picture” as opposed to the narrow scope of their own job.
- Removed staff complacency due to perception that they are already doing a good job.
- A greater sense of involvement and control.
- Creating clear standards (consistently) for especially new employees.
- It helped to identify problems as well as understandable trends.

2.5.9.2 Total productive and preventive maintenance

Preventative maintenance is advanced scheduling or calendar based activities relating to maintenance procedures. Preventative maintenance is performed irrespective of breakdown, and hopefully before the failure. The problem with preventative maintenance is that if it is done too far in advance, it translates to extra cost. If the preventative maintenance is done too late, it poses the risk of untimely breakdown. Total Preventative Maintenance (TPM), by comparison, is a programme or approach aimed at eliminating machine downtime by fostering a partnership with operators, engineers, service technicians and even machine suppliers. Operators form the first line of maintenance, attending daily to issues such as cleaning, minor adjustments, lubrication, and minor part changes (Chaneski, 2002: 46).

Ahuja and Khamba (2007: 340) describe TPM as considering and involving everything and everyone from the top down (total); that it must minimise interruption to production (productive), and that a level of autonomy and ownership is given to production operators to perform maintenance.

2.5.10 Conclusion to Pettersen’s list

This section of the literature reviewed some of the concepts that have been used in manufacturing industries and to a lesser extent the pure service industries. In addition, it also reviewed how in some cases these tools have been adopted and modified for the pure service industry.

Although Petersen’s list provides a well-summarised report, Spear and Bowen (1999: 104) maintain that Toyota does not consider any of the tools and practices (such as listed above) fundamental to the Toyota Production System.
Instead, they are considered as merely temporary responses to certain problems. They are referred to as "countermeasures", rather than "solutions", because that would imply a permanent resolution to a problem. By implication then, whether a company uses a specific tool or not, is no indication of whether a company is truly applying Toyota’s rules of design and improvement.

2.6 IMPLEMENTATION STRATEGIES

The following section reviews some of the implementation philosophy as well some case studies of companies that have achieved relative success in adopting and applying certain tools as well as the philosophy behind the tools.

Based on the fact there is no consensus about the definition of lean manufacturing, Pettersen (2009: 127) assert that there will be variation in the implementation process. It is important that the organisation seeks to adapt the philosophy to suit its needs.

2.6.1 Lean manufacturing models

Although the intention of implementing lean is to enhance productivity, improve quality, reduce cost, etc., certain actions need to be taken in order to achieve these objectives (Karlsson & Åhlström, 1996: 25). This section of the literature examines some of the holistic approaches adopted by some of the companies in both manufacturing as well as the pure service industries.

2.6.1.1 The Toyota way

In their outline of what makes the Toyota Production System (TPS), so successful, Spear and Bowen (1999: 98) emphasise a scientific approach to controlling production:

The Toyota Production System creates a community of scientists. Whenever Toyota defines a specification, it is establishing sets of hypotheses that can be tested. In other words, it is following the scientific method. To make any changes, Toyota uses a rigorous problem-solving process that requires a detailed assessment of the current state of affairs and a plan for improvement that is, in effect, an experimental test of the proposed changes. With anything
less than such scientific rigor, change at Toyota would amount to little more than random trial and error - a blindfolded walk through life (Spear & Bowen, 1999: 98).

One might expect that this unambiguous control is rigid, and creates a command and control environment, instead it creates very clear boundaries for staff to operate in, which can then be constructively challenged. In addition staff have a very clear picture of what their work looks like, and can quickly recognise situations that are outside of the norm. Being able to challenge constructively, means that staff are able to engage their managers in the kind of experimentation (designing of production processes) that is the cornerstone of a learning organisation.

According to Spear and Bowen (1999: 98) Toyota’s success is not as much about the specific tools and practices, such as kanban and quality circles, but rather a set of rules. “These rules guide the design, operation, and improvement of every activity, connection, and pathway for every product and service”. Spear and Bowen (1999: 98-103) define the rules as follows:

**Rule 1:** All work shall be highly specified as to content, sequence, timing, and outcome. This rule implies that, as far as possible nothing is left to chance. Every activity, regardless of their functional speciality or hierarchical role, will be specified. That specification is something that you would expect everybody to understand and be able to follow easily. Without such clear specification, learning and improvement in the organisation is hindered because the variations hide the link between how the work is done and the results.

Having all work activities structured as a highly specified sequence of steps would test a hypothesis through action. By performing the activity, two hypotheses are tested implicit in its design: first, that the person doing the activity is capable of performing it correctly and, second, that performing the activity actually has the expected outcome.
When activities are not done in a specified way, or defects occur, it could be an indication that the process capability can be challenged, or that the rule is simply not being applied in the organisation.

**Rule 2:** The second rule states:

Every connection must be standardized and direct, unambiguously specifying the people involved, the form and quantity of the goods and services to be provided, the way requests are made by each customer, and the expected time in which the requests will be met (Spear & Bowen, 1999: 100).

While the first rule concentrates on how people perform their activities, rule 2 explains how entities or individuals within and outside the organisation connect with each other. Rule 2 creates a supplier-customer relationship between any two parties or entities, where one party needs to provide either a service or product to the other. If a worker needs parts from a material handler, the worker immediately assumes the position of a customer, while the material handler would assume the position of supplier. During this interaction, the requirements of the customer, need to be clear and unambiguous. In the case of the material handler, clarity is by means of a kanban, a laminated card that specifies the part's identification number, the quantity of parts in the container, and the locations of both the part supplier and of the worker.

Time or duration is an additional factor that can add to variation. Therefore, even the time it takes to fulfil a service has to be done within the worker’s cycle time. For instance, a worker encountering a problem is expected to ask for assistance at once. The designated assistant, which could be a supervisor, material handler, maintenance technician etc., is expected to respond immediately and resolve the problem within the worker’s cycle time. Therefore, if the worker is installing a seat every 55 seconds, then a request for help must be answered and dealt with, within 55 seconds. The inability to obtain a resolution in less than 55 seconds, immediately challenges the hypotheses in this customer-supplier connection for assistance. Testing the hypothesis could reveal issues such as a request signal that is ambiguous; perhaps the designated assistant has too many other requests for help, is busy, or is not a capable problem solver. “Constantly testing the hypotheses in this way keeps
the system flexible, making it possible to adjust the system continually and constructively” (Spear & Bowen, 1999: 101). The converse of this theory is sometimes argued that managers do not want to immediately help workers with problems. The most commonly cited reason being that workers need to learn to solve problems themselves. However, this practice may lead to problems being hidden, and therefore not shared, nor are they resolved company wide. The problem can be made worse when workers solve the problems themselves and then arbitrarily decide when the problem is big enough to escalate.

Signs of problems pertaining to this rule include idle suppliers waiting for orders, or suppliers not being able to cope with the pace of request.

**Rule 3**: Goods and services flow along a specified path or line. Goods and services do not flow to the next available person or machine, but rather to a specific person or machine. If for some reason that person or machine is not available, it will be seen as a problem that might require the line to be redesigned. The stipulation that every product follow a simple, pre-specified path doesn't mean that each path is dedicated to only one particular product, but rather that a specified path or line can handle a variety of products or services. Contrary to popular belief, this rule also stipulates that resources do not get pooled so that the first available resource available will be used. Instead only the specified resource will be used even if others are available.

**Rule 4**: Any improvement must be made in accordance with the scientific method, under the guidance of a teacher, at the lowest possible level in the organisation. This rule then implies that the way changes or improvements are made, is just as important as the actual change or improvement being made. The lack of applying this rule often results in the impact or benefit that is predicted at the start of an improvement activity is only partially met.

The application of the above four rules is the vehicle that drives Toyota to its “ideal” operating environment. This ideal state is very clearly articulated by Toyota’s workers, and it pertains to any person, group, or machine as follows:
every part is defect free (that is, it has the features and performance the customer expects);
all parts can be delivered one request at a time (a batch size of one);
yany part can be supplied on demand in the version requested;
parts can be delivered immediately;
parts can be produced without wasting any materials, labour, energy, or other resources (such as costs associated with inventory); and
parts can be produced in a work environment that is safe physically, emotionally and professionally for every employee.

In the final analysis, Toyota's ideal plant would indeed be one where a Toyota customer could drive up to a shipping dock, ask for a customized product or service, and get it at once at the lowest possible price and with no defects. To the extent that a Toyota plant - or a Toyota worker's activity falls short of this ideal, that shortcoming is a source of creative tension for further improvement efforts (Spear & Bowen, 1999: 106).

Toyota's view is that the main method of lean is not the tools, but the reduction of three types of waste: muda (non-value-adding work), muri (overburden), and mura (unevenness) (Liker, 2004: 114).

Toyota exposes these wastes systematically and then applies the necessary tools in order to achieve the ideal state. Thus, the tools are workarounds adapted to different situations, which explains any apparent incoherence of the principles above.

2.6.1.2 Womack and Jones’s theory on Lean Thinking

Womack and Jones (2003) outline five key steps that are universal in the implementation of lean philosophy:

1. Value.

Organisations need to understand what is it that customers value. By value, Womack and Jones (2003: 29-36) are specifically referring to the part of the service or product for which the customer is willing to pay. Everything that gets done to the product or the service that the
customer is not willing to pay for, or to pay extra for, is considered non-value adding, or waste.

2. The value stream.
   Process mapping and value stream mapping is a good basis for identifying and eliminating waste.

3. Flow.
   Bottlenecks or buffers will hamper continuous flow of products, material and information. Various lean tools can be used as enablers to remove these bottlenecks or buffer zones.

4. Pull.
   Only produce or deliver at the rate of consumption. This implies that every process only produces to satisfy the demand of the immediate downstream process, right through to the customers. If one process stops or even just slows down, the immediate process, which feeds into that one, adjusts its tempo as well.

5. Perfection.
   Cycle through steps 1 to 4 on a continuous improvement cycle – improving on each step again and again.

It is important to note that Womack and Jones’s theory does not contradict Toyota’s approach, but should be seen as complementing it.

**2.6.1.3 Automation**

A common perception is that lean manufacturing is achieved through automation. However, the need for automation has to be carefully examined and tested against the advantages as well as the disadvantages. From a lean perspective, automation should be applied for improving quality and reducing variation, not to automate wasteful activities. Dull, dirty, dangerous, hot, heavy, and hazardous environments are ideal for automating, and still the intention
should not be to get rid of people. Machines or robots are not good at making improvement suggestions (Bicheno, 2000: 35).

Automation that deprives a process of flexibility becomes a handicap for the process, and therefore, also for the organisation. Economies of scale through automation can only be maintained for as long as volume demand from customers are in place. Replacing flexible staff with inflexible automated processes does not make sense when markets have moved from being satisfied by mass production, to requiring mass customization (Kottler, 2003: 282). A case in point is General Motors’ strategy of investing heavily in automation during the early 1980s; it had a negative impact on the company’s ability to offer a greater variety of products to their customers. The ability to offer greater variety was especially relevant since product life cycles were significantly shorter (Bowen & Youngdahl 1998: 211).

Although Taiichi Ohno was initially impressed with Ford Motor Company’s use of continuous flow, the same could not be said about the wasteful activities associated with mass production such as the use of expensive single-purpose machinery used by semi-skilled workers, and churning out standardised products at high volume. Ford ran on mass production principles, meaning big production runs with few change-overs in order to obtain a perceived benefit of economies of scale. The truth is that it resulted in wasteful activities such as long cycle times, high inventory with complex scheduling and distribution.

Expensive monumental equipment that must be kept at capacity through large batch runs for multiple products, and the resulting inventory build-up, introduces complexity that ensures long lead-times and wasteful activities (Ehrlich, 2006: 41-42).

Automation is often seen by organisations as a solution for inefficiencies in their current production systems. Swank (2003: 127) advises that automation should not be implemented into a process unless lean principles and process stabilisation has occurred. A similar view is echoed by Krafcik (1988: 42) when he states that poor manufacturing performance is seldom fixed with high technology, but that it requires “suitable production management policy”, and that it is a concept applicable in any industry.
Toyota only introduced robots in large numbers in the 1980s. Taiichi Ohno initially viewed automation with scepticism due to its lack of flexibility and the rigidity that it introduced into the production system (Cusumano, 1992: 4).

2.6.2 Transferring lean to the service industry

In exploring the historic context of Levitt’s approach, Bowen and Youngdahl (1998: 208), assert that in the early 1970s, the service sector had largely been ignored by management scholars, who were long accustomed to basing their research and models of management on studies of manufacturing firms.

This made sense, because the economy had, to that point, been dominated by manufacturing. However, in the 1970s, services were on the rise, as were frustrations with the inefficiencies, poor quality, and low productivity characteristic of the sector. Unfortunately, services management models were emerging much more slowly than the sector, itself (Bowen & Youngdahl, 1998: 208).

In considering the transfer of lean manufacturing to the construction industry, Jørgensen and Emmitt (2008: 392) suggest that “…some of the most critical arguments are not relevant to a construction context…”. However Womack and Jones (2003: 16) states that value is defined in the context of the customer, this seems to be a problem in the construction industry where built artifacts will last for hundreds of years and have a number of owners. The notion that lean manufacturing cannot be wholly transferred to construction cast a doubt on the scalability of some of the tools and techniques commonly associated with lean manufacturing.

In their analysis of customer’s hierarchy of value, Parry et al. (2010: 16-18) found that, transparent costs, the need for single point of contact, rapid response, and regular communication, as factors that customers appreciated the most and therefore enhanced their relationship. Transparent costs meant that customers wanted prices that were accurate and consistent. The fact that suppliers whose prices were rejected could immediately return with a radically reduced price, cast a doubt on the overall pricing mechanism of the supplier. In addition, a “single point of contact and rapid response referred to the desire for
a rapid response during interaction between customer and supplier; 24-hour response and a known person to contact increase perceived value.” Parry et al. (2010: 222) emphasise the value and strengthening effect that regular feedback to the customer has on the relationship, and that an organisation that communicates by giving the customer updates on their work, reinforced the customers’ confidence in the relationship.

Refering to the Taco Bell company as an examplar of the lean production line approach to service, Bowen and Youngdahl (1998: 214) describe the company’s ability to reduce performance tradeoffs between internally focused efficiencies and customer defined flexibility. Power et al. (2001: 259) describe “more agile” and “less agile” companies respectively as companies as more customer focused and able to adapt changing customer demands, versus companies that are more internally focused.

Bowen and Youngdahl (1998: 214) attribute the following principles to service companies that have adopted a lean production line approach:

1. A well balanced or reduced trade-off between service delivery and internal operational efficiency.
2. Flow production and JIT pull that reduces setup time in order to allow smoother flow.
3. Apply a value chain that focuses on service but also on value to the customer. Value analysis is done with the intention of reducing non-value adding activities.
4. Increase customer focus by involving customers in early stages of design, training staff on dealing with customers, but also educating customers in how to contribute to quality service. A key consideration in transferring lean methodology to the service industry, is that it takes place in the presence of the customer, whereas lean manufacturing, typically does not. Therefore lean service providers need to leverage off customer contacts through well trained employees.
5. Invest in employee empowerment through the use of skills, teambuilding and participation.
7. Typical problems.

2.6.2.1 A non-humanistic approach

The humanistic approach to the service industry is largely responsible for the resulting failures in this industry. Improvements, attaining better results, and problem solving is driven by exerting pressure on individuals to push or try harder. This can take the form of personal or group motivation, training, or even negative re-enforcement. Thus the service industry depends on improvements in the skill and motivation of the performers of that service. In contrast, manufacturing approaches are not aimed at improving personal performance but rather to look at improving the task, or even for completely new ways of performing the existing task (Levitt, 1972: 43). Levitt suggests that service industries therefore have to move away from this humanistic approach to solving problems and focus on task or process re-design. This view concurs with the Toyota method of a scientific approach to improvement or problem solving, as well as Wittenberg (1994: 12) who states that “processes must be improved before improved results are obtained...”.

2.6.2.2 Customer Centric Work Cells

Ehrlich (2006: 43) refers to the concept of customer centric work cells. All knowledge and task pertaining to a customer’s order or request are grouped together within a dedicated work cell of employees. Cross functional training in order for employees to multi-task becomes imperative as focus is shifted from a functional approach to an approach that is built around customer requirements. An important aspect of this methodology is that emphasis is no longer on keeping employees fully utilised, but rather to optimise on the profitability of the customer across the entire value chain. Some of the advantages of customer centric work cells, is that certain types of waste, such as hand-offs, queues, bottlenecks, and lack of ownership is reduced if not eliminated.
2.6.2.3 Continuous Improvement

Together with a strong lean culture is the lean organisation’s ability to continuously improve. This means a reduction in repeat process failures by using problem solving tools such as root cause analysis, waste identification, and Kaizen teams. Literature also suggest that the key to unlocking an operational lift through continuous improvement, lies in the organisation’s ability to harness the skill, knowledge, and experience of the employees to drive the process (Ehrlich, 2006: 43).

Ehrlich identifies an organisation’s ability to rid itself of waste by delivering as quickly as possible to the customer’s demand, as the cornerstone of lean service. This is accomplished by identifying value flow. It means servicing one customer at a time from start to finish, i.e. avoiding the waste of work-in-progress or inventory. Pure service industries often struggle to create continuous flow, therefore a flexible, level servicing system is required to meet fluctuating levels of demands. Wastes such as inefficient processing, excessive inventories, and associated costs (through capable processes) needs to be eliminated to allow for rapid cycle times and quick response. When waste is eliminated and the order-to-cash cycle time is compressed, profit margins and cash flow increase (Ehrlich, 2006: 43).

2.6.2.4 Bowen and Youngdahl’s production-line approach

In taking on a production line approach to service, Bowen and Youngdahl (1998: 209) identified the following key characteristics:

- Limited discretionary action of personnel. Employees perform well defined tasks. This results in standardisation and quality, i.e., consistency in meeting specifications, a valued outcome of the production line approach in manufacturing. McDonald’s, is able to promise customers a consistent service package across geographically dispersed operations.

- Division of labour. The total job is broken down into groups of tasks which allow specialization of skills. The entire process is divided into routine tasks. This narrow division of labour makes possible limited spans of control and close supervision. It also minimises both worker skill requirements and training time.
• Substitution of technology for people.
   At the time Levitt wrote his seminal pieces, the systematic substitution of
equipment for people had been a source of progress in manufacturing.
Systematic substitution of equipment for labour aligned with well conceived
use and positioning of technology led to efficient, high-volume production at
acceptable quality levels. Technology eliminated the need for skilled labour.
Just as Fordism relied on applying industrial engineering to rationalize each
step in the production line, McDonald’s applied similar technocratic scrutiny
to all phases of its production line. Lights and buzzers pace hamburger
production just as the moving assembly line set the pace of mass production
of automobiles. Such technology combined with a well defined division of
labour, clear rules, and limited span of control resulted in consistent quality
and efficiency.

• Service standardisation. The mass production-line approach produces only
limited offerings. Standardisation also allows predictability, preplanning, and
easier process control which, in turn, provides uniformity in service quality
(Bowen and Youngdahl, 1998: 209).

2.6.2.5 Performance Feedback

Lean practitioners should always measure performance and productivity from
the customer’s perspective. Having the correct measures is also an effective
way of convincing the sceptics who will accompany the lean journey of any
organisation. This is why Swank (2003: 127-129) emphasises the the use of the
correct metrics that are readily available, or made public in the work area.

Ehrlich (2006: 43) encourages the use of value stream mapping, not only to
identify waste such as excess inventory, but also to help identify where critical
performance metrics are lacking. “Bringing visibility to transactional processes
through the use of visible metrics is perhaps one of the quickest and most
effective steps in the lean journey” (Ehrlich, 2006: 43).

2.6.2.6 Other strategies on applying lean in a pure service context

In their review of transferring lean tools to the service industry, Piercy and Rich
(2009: 56-72) examined two types of industry. The first was in the retail industry
which is considered part product and part service. The primary tools suggested
were:

1. Supply strategies.
This activity focused on bringing suppliers closer together to reduce stocks throughout the retail supply chain. “Benefits have included a reduction in the costs of holding stocks, reduced write-off costs on perishable items and an increased ability to pull products quickly through the supply chain based on unpredictable customer demand” (Piercy & Rich, 2009: 56).


These tools were relatively easy to transfer from the automotive industry to the service sector.

The second industry that Piercy and Rich (2009: 56) consider, is the application of lean in the healthcare service. Although healthcare is a service industry, the application of lean is applied by viewing patients the same as material or product moving through the value stream, and the output being a person cured or otherwise ready for discharge. This perspective allowed the use of process mapping and identification of waste and non-value adding activities (Piercy & Rich, 2009: 57). This initiative is clearly aligned to the Womack and Jones application of lean methodology of identifying value as a first step in the cycle of lean implementation.

In reviewing the lean journey of Jefferson Pilot Financial (JPF), Swank (2003: 125-126) cites the creation of continuous flow by placing “linked” processes in close proximity to each other as a first step in moving towards a lean production system, thus moving from a functional layout to a process orientated layout. Swank continues by adding process standardisation, eliminating errors or “loop-backs” as she refers to them, setting a common tempo (TAKT time), balancing loads (line balancing), segregating complexity, and posting performance results, as distinct milestones in JPF’s lean journey.

By segregating complexity, JPF increased turnaround time by simply grouping task with similar complexity, and thus giving them their own performance goals. This principle could be used in a cash centre environment since there is a high degree of deposit variation and complexity.
Whatever the implementation strategy, the introduction of a lean system should allow for minimum disruption to the existing operations and the customer. Some lean manufacturing advocates prescribe the “model cell” rollout. This approach is based on the premise that one area, or production line, will be developed as a “microcosm” of the entire process (Swank, 2003: 124; Anderson, 2006: 67). The advantage with this approach is that it allows the managers to fine tune as well as make “mistakes” on a smaller scale and thus reduce the impact on customers.

Ehrlich’s (2006: 43) approach to a lean service model starts with customer-centric work cells that reduce cycle time and offer seamless one-stop service. This entails servicing a customer from start to finish, thus reducing the order-to-cash time. She also refers to a level servicing system that pulls customer demand and is maintained through visible metrics, however, Ehrlich does not expound on how to achieve this objective.

Ehrlich draws a parallel between the pitfalls of mass production and mass servicing. The approach taken in mass production of using semi-skilled workers to operate on expensive single purpose machines is paralleled to mass servicing, in which low paid, poorly trained staff interact directly with customers. The result is longer queues (work-in-progress), more reworks (repeated contacts), and complex scheduling systems (Ehrlich, 2006: 41). She also refers to decreasing cycle time in order to reduce inventory and associated costs, while building quality controls into the service process though standard work, 5S, and poka yoke.

2.6.2.7 Maleyeff’s lean approach to internal service systems

In his exploratory study, Maleyeff (2006: 676) reports the results of a meta-analysis applied to a number of internal service systems. Maleyeff focuses on common features that could be expected in an internal service system. Some of the areas that Maleyeff identifies as possible areas for improvement are as follows:
Importance of information.
Maleyeff (2006: 680) emphasises the importance of information flow, and equates it to manufacturing part flow. Information flow, whether on documents or any other format, should convey the necessary information in a clear, complete and unambiguous way that is easily understood by all personnel and even customers.

Significant task variability.
Based on the study, tasks performed by internal service systems have high variability in terms of processing times. This makes the application of lean techniques such as TAKT time and process mapping that includes activity setup and process times, not only difficult, but also impractical.

Process flow across departments or functions.
Due to high cross-functional dependence, Maleyeff (2006: 680) suggests that improvement teams should similarly also be made up of cross-functional members that engage in Kaizen activities.

Many handoffs of information.
A common source of errors is numerous handoffs. It has even been noted that data is often interpreted differently between different departments. The result is that when information is passed between departments within internal service systems, handoffs could be a likely source for variation leading to errors.

Hidden cost and benefits.
Unlike a product manufacturing environment, the intangible nature of services, as well as each step in the process, makes quantifying the cost of the services extremely difficult. The reason seems to be associated with the ability to define value adding activities. For instance, in building a product such as a car, an example of a process step such as fitting the engine, can easily be valued in terms of the customer’s willingness to pay more or less based on the value
associated with that particular engine i.e. perhaps the customer will pay more for a 2 litre engine than he is willing to pay for 1.3 litre engine. If we take an example of homeloan approval process, the customer does not willingly pay more for security checks that the bank needs to do in order to secure the loan, nor the time it takes to load the loan onto the bank’s system. Thus, the identifying of value adding in a service industry becomes more challenging than a product industry.

Maleyeff (2006: 676) continues by drawing a comparison with the work of Spear and Bowen (1999: 98), who assert that there are four fundamental principles that would constitute a lean approach:

- “All work should be highly standardised in terms of content, sequence, timing, and outcome.
- Every internal customer-supply contact must be direct and unambiguous.
- The flow of every product and service must be simple and direct.
- Improvements should be accomplished in a structured, scientific manner.”

In supporting the above view, Maleyeff (2006: 679) list the most popular ideas for improvement as:

- the standardisation of task to reduce variation;
- the removal of wasteful activities by means of process redesign;
- the implementation of enhanced customer demand forecasting; and
- the design of a customer complaints handling process.

Maleyeff (2006: 687) encourages the use of Kaizen teams as a vehicle to lead improvements. The Kaizen team should find ways to ensure that every service provider understands the operation of the entire system and knows the relevance and importance of the task they are expected to perform. By gaining an understanding of what goes on beyond their own job, service providers become far more effective in performing their own duties. This again reflects on
the usefulness of standards. Firstly, standard procedures or work instructions could be documented and displayed in order to educate the workers throughout the system. Secondly, workers will have a better understanding of customer perception and expectation when their knowledge extends beyond their narrow range of job responsibilities.

2.6.2.8 Lean Supplier Basics

Third party vendors should be carefully selected based on their performance as well as commitment to ongoing continuous improvement. Issues such as cost, turnaround time and the quality of the service or product provided should be assessed and ranked amongst suppliers (Swank, 2003: 127).

2.7 KARLSSON & ÅHLSTRÖM’S MEASURE OF LEANNESS

In an attempt to assess the degree of leanness of a production company, Karlsson and Åhlström (1996: 26-41) review some of the underpinnings of lean, as well as the organisation’s management of those lean factors. The objective is to find the determinants that are able to reflect changes in an effort to become lean.

Understandably Karlsson & Åhlström (1996: 41) do not set specific benchmarks, the value of their research lies in guidance that it provides for companies seeking to implement lean manufacturing, especially as they note that the objective of lean manufacturing is not to reach a certain point within a certain time, but rather continuous direction that is followed. The emphasis should therefore be on the specific changes that are achieved in each determinant rather than reaching a particular value or ratio.

Lastly, the tool that Karlsson & Åhlström (1996: 41) provide gives perspective to performance improvement or operational lift. In theory, customer satisfaction, cost, quality and even staff morale should improve as the degree of leanness improves.
2.8 CUSUMANO’S LIMITATIONS OF LEAN MANUFACTURING

Cusumano (1992: 1-5) states that there are limitations to the implementation and transferability of Toyota’s lean manufacturing philosophy. Firstly he argues that the concept of JIT through kanban promotes frequent and thus more deliveries to their points of consumption. These frequent deliveries increase traffic congestion and thus place pressure on the environment by means of increased pollutants. Related to this point are the geographic dispersions of suppliers. Component suppliers are often dispersed across continents, which make hourly or even daily deliveries impractical. However, Wu (2003: 1370), found that lean suppliers spend less on emergency shipping. He also notes that lean suppliers do not spend more on routine shipping.

Secondly, Cusumano (1992: 3-4) cites suppliers as a barrier. Suppliers need to conform to lean approaches to quality, small lot sizes and frequent deliveries. Manufacturing companies often have limited ability to get their suppliers to conform to these approaches.

Thirdly, Cusumano (1992: 4-5) states that the opening up of world markets has negated companies’ need to produce in small lots. Additional markets have seen companies return to mass deliveries of single product types, simply due to a growth in customer base.

2.9 CONCLUSION

Chapter 2 concluded the literature review on lean manufacturing. It started by looking at the history of lean and how it evolved. The approach taken was to gain a good understanding of the philosophy of lean as it emerged from the automotive industry, spread into other manufacturing industries, and finally becoming a universal philosophy that could be applied in any industry.

Included in the literature review are some of the most common tools and techniques that have been applied in the manufacturing sector. These tools and techniques were often cited as Best Practices in the pursuit of removing waste
or non-value adding activities. The last part of the review focused on some of the implementation strategies, particularly in the service industry.

Having explored the concept of lean manufacturing, chapter 3 attempts to create context of the cash centre environment. The intention is to understand how cash centre operations can apply the lean methodology.
CHAPTER 3

CASH CENTRE OPERATIONS

3.1 INTRODUCTION

This chapter intends to outline what the operations inside a cash centre entail. It is based on the operations of a financial service provider within South Africa.

This chapter also defines cash centre customers as well as to determine value from a customer perspective. Womack and Jones (2003: 16-19) states that value is created by the producer, therefore as far as a customer is concerned, the producer exists purely for the purpose of creating something which is of value to the customer. Womack emphasises that the first step in lean thinking, is to understand value through the eyes of the customer.

3.2 THE FUTURE OF CASH (THE CASHLESS SOCIETY)

Many have speculated about the future of cash, and therefore the relevance of investing in the management and physical infrastructure of cash management. Even though the card payment market in South Africa is growing significantly, cash is still king for the majority of South Africans. According to a survey by FinScope released in 2007, 91% of groceries, 80% of clothing and 21% of large appliances and furniture are still bought cash (Fourier Approach, 2008)

In his annual report, South African Reserve Bank Governor, Mr T.T. Mboweni states:

The actual performance of the 2007/08 operational costs was slightly above the budget due to a substantial rise in the number of consignment deliveries made to meet an increased demand for new banknotes. This resulted in the distribution costs being higher. The numerous increases in the fuel prices also contributed to the higher costs (South African Reserve Bank 2008: 78).

Cash transactions were estimated to reach 172 billion transactions in 2009, with an annual growth rate of three percent. Furthermore, 98% of the banked
community of SA use the bank mainly for cash withdrawals, with the majority relying on cash from ATMs.

Mike Lee, CEO of the ATM Industry Association, (Lee, 2008: 2) states some of the inherent qualities of cash that makes it so “durable and popular”, as follows:

- “Cash is valuable in itself, and can function as a store or ‘shelter’ of value.
- It is fee-free for consumers.
- It is the most tangible and liquid form of money.
- It carries certainty of acceptance as legal tender.
- Its settlement is immediate – there is no settlement risk.
- It has no credit risk attached to it.
- It is a public asset regulated by the central bank, generating public tax (called seigniorage).
- It is anonymous and cannot be tracked.
- It is easy to access and easy to use - it does not require technology or infrastructure for person to person (P2P) payments.
- It is universal.
- It is interchangeable with other cash, unlike most plastic cards which cannot be interchanged.
- It has a fast transaction speed.”

It can therefore be assumed that cash, despite challenges like cheques, credit and debit cards, still remains the preferred method of payment.

3.3 THE CASH VALUE PROPOSTION

The principle function of the cash centre is to take in bulk cash, recycle the cash, and then distribute the cash again. This simplified stream of work can therefore be identified as: receiving, recycling and sorting, and distribution. We will refer to this stream of work as the cash cycle. Figure 3-1 shows the general flow of work through the cash centre.
Two challenges are derived from the cash cycle. Firstly, from a time frame perspective, the cash cycle also has to be as short as possible in order to minimise funding cost. Excess cash should either be invested in real assets or be distributed to shareholders in the form of dividends. The second challenge is the unpredictability of cash inflows, which generally do not match the outflows (Hines et al., 2000: 16).

### 3.3.1 Receiving

This is the start of the *cash cycle* within the cash centre. This is the process of receiving *work* from external customers. *Work* in this context can be defined as the actual cash and associated paperwork required to process a customer’s cash deposit. Although the work is sent from various customers, it is received at the cash centre via a cash-in-transit (CIT) company. CIT companies are responsible for collecting the cash from their customers, who are also the customers of the relevant financial institute where the deposit will be processed.

After the deposit has been received by the cash centre staff from CIT, it is counted (verified) by bank tellers and the applicable customer’s account is credited.
Womack and Jones (2003: 32-33) illustrate that value as defined by the customer, often flows through different firms. Each firm defines value in a different way to suit their own needs. In the case of cash depositing customers, it is easy to understand why a CIT company would only define value as the service of bringing a cash deposit to the cash centre – after all that is what they are contracted to do. At the same time, the cash centre defines value for the customer as crediting their accounts once the deposit reaches the bank. In understanding lean methodology, both the cash centre and the CIT need the realisation, that value for their common customer, from the time a deposit is collected at the customer’s premises, is to get the credit value reflected in the account. This point is critical for both parties (CIT & cash centre) to understand i.e. the same value proposition flowing through two separate suppliers, and either one can affect the overall level of satisfaction of the customer. In measuring the performance of the cash centre as well the CIT, it makes sense to measure the performance from a customer perspective (Swank, 2003: 127). Therefore, value for the customer can be defined as getting their specified account credited with the correct amount and referencing, and within a specified period of time (measured from time of collection at the customer’s premise), and then to have a copy of their deposit slip returned to them for reconciliation.

The specified time varies from customer to customer, and is based on the contract between the CIT and the retail customer, or the bank and the retail customer, or a combination of the two. This value proposition for the customer is very clear, and experiencing a time delay, will lead to customer dissatisfaction. Unfortunately for both the cash centre and the CIT company, this dissatisfaction will be directed at both parties irrespective of the cause of the failure in service delivery.

### 3.3.2 Recycling and sorting

The next phase in the cash cycle is called recycling and sorting. This process serves two purposes. Firstly it acts as a second verification for cash that was previously counted before customers’ accounts were credited, and secondly,
notes are recycled as well as sorted, to determine whether or not they are fit for redistribution into the public domain.

It is also possible that a third function exists within this area. The third function relates to certain bulk deposit types, of both notes and coins. These bulk deposits would bypass the receiving tellers, and move straight to the bulk note and coin operation and be done as part of recycling as well as serving the requirements of retail customers. This function or sequence of operation is not always the norm, but when it does occur, the requirements, from a retail customer perspective, are the same requirements as set out in the receiving teller section.

The process of establishing which notes are fit for public distribution is determined based on factors such as the quality of the notes e.g. soiled notes, torn, de-faced etc., as well as counterfeit detection. The South African Reserve Bank has a vested interest to ensure that all banknotes in circulation are at an acceptable level of quality and that counterfeiting of currency is combated. One of the ways of doing this is through monitoring of compliance of cash recyclers (cash centres) with the minimum standards issued by the Reserve Bank to the operators of banknote recycling machines – South African Reserve Bank Annual Report 2007/2008 (2008: 46).

This leads one to conclude that this part of the cash cycle has a different customer compared to the receiving stage where retailers were the customer. In the recycling stage, it is the South African Reserve Bank that acts as a customer. We can also conclude that as a customer, SARB’s expectation (value) is that notes are recycled according to SARB’s own minimum standards.

An alternative argument to the above states that the public who draw cash from ATMs might have an expectation of the minimum standards, however, this argument can be negated on the grounds that the SARB acts on behalf of the public.
3.3.3 Distribution

Just as cash flows into a cash centre, it naturally needs to flow out again in the form of a product. We refer to this as distribution. Distribution from a cash centre takes place in three forms:

3.3.3.1 Payrolls and floats

Payrolls and floats are customised packs of money containing different denominations of cash. The packs are either customised according to the customer specifications or according to a set menu specified by the relevant institution, and allowing the customers to select from this menu.

The value proposition for payroll and float customers is:

1. The packs are accurate as per specified or chosen breakdown, which includes value, and quantity of each denomination.
2. On time delivery of the specified pack to the customer.

In summary this translates to delivering the correct product at the correct time in the correct quantity.

3.3.3.2 ATMs

Part of the function of recycling is also to supply notes to the ATM network that is under the control of the respective cash centre. The ATM department can therefore be considered as an internal customer with the following expectation:

1. To receive the correct value and denomination of notes – this also implies not too much neither too little.
2. That the notes are available at a specified time.
3. That the notes meet SARB minimum quality standards, which is a requirement set on behalf of the public using the notes.
4. Notes are bundled according to denomination.
3.3.3.3 SARB Clearance

Any excess cash that exceeds the requirements of ATMs and Payrolls is returned to SARB. The process of clearance to SARB is to avoid or reduce funding cost, and by this same token, cash is ordered from SARB when customers’ deposits are not enough to meet ATM and Payroll demand.

In the context of ordering and clearing to SARB, this research views SARB not as a customer, but rather as a supplier.

Table 3-1 illustrates in tabular form the various stages within the cash cycle as well the perceived value proposition at each stage.

<table>
<thead>
<tr>
<th>Stage in Cash Value Cycle</th>
<th>Customer</th>
<th>Perceived value Proposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiving</td>
<td>Retail customers</td>
<td>Account credited within specified time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Correct value credited</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Correct account credited</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Correct Referencing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receive a copy of stamped deposit slip</td>
</tr>
<tr>
<td>Recycling</td>
<td>SARB</td>
<td>Notes are sorted into fit and unfit based on minimum standards</td>
</tr>
<tr>
<td></td>
<td>Retail customers</td>
<td>Account credited within specified time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Correct value credited</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Correct Referencing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receive a copy of stamped deposit slip</td>
</tr>
<tr>
<td>Distribution</td>
<td>Retail Customers (Payroll)</td>
<td>The packs are accurate as per specified or chosen breakdown, which includes value, and quantity of each denomination</td>
</tr>
<tr>
<td></td>
<td></td>
<td>On time delivery of the specified pack to the customer</td>
</tr>
<tr>
<td></td>
<td>ATM Department</td>
<td>To receive the correct value and denomination of notes – this also implies not too much neither too little.</td>
</tr>
<tr>
<td></td>
<td>That the notes are available at a specified time.</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>That the notes meet SARB minimum quality standards, which is a requirement set on behalf of the public using the notes.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Notes are bundled according to denomination</td>
<td></td>
</tr>
</tbody>
</table>

3.4 THE VALUE STREAM

The next step after specifying the value for the customer is to identify the value stream (Womack & Jones, 2003: 37-49). This is the set of all the specific actions required to bring a specific product or service to completion. During this phase, steps are identified in terms of:

- Value adding – all steps that contribute to the process that the customer is willing to pay for, or to pay additional fees or cost.
- Non-Value but necessary – these are steps in the process that need to be completed even though they do not add any value, neither is there an expectation that the customer will pay additional fees or cost for such steps.
- Non-Value and unnecessary – these are steps of pure waste. These steps do not create value for the customer and should be completely eliminated or minimised.

3.5 PROCESS FLOW COMPARISON

Figure 3-2 refers to a simplified value stream of a typical manufacturing plant that operates on a push system.
The process flows illustrated in Figure 3-2 and Figure 3-3 compares the flow or value stream of a traditional manufacturing plant operating on a push system with that of a cash centre. The figures illustrate that the process starts with the customer, and ends off again with a slightly different customer; the flow of material in a cash centre is in almost reverse to that of a traditional product manufacturing plant. The traditional product manufacturing starts with individual components or even raw material, received from suppliers, which is gradually built up to form a finished product which is ready or near ready to be consumed or accepted by the customer. In the case of the cash centre, the completed deposit is received from the customer, and is then broken down into its smallest elements i.e. cash notes. The notes are then prepared for use by another customer i.e. the ATM department or alternatively the South African Reserve Bank.
Another way to view the cash value chain in terms of the customer is to split the entire chain into two distinct parts. The first part is providing a pure service to the customers by crediting retail customers’ accounts according to their deposit advice. The second part of the value stream, satisfies a different set of customers by providing them with a tangible product that flows off a production line (ATM notes and floats). By making this distinction, the application of lean methodologies for a service industry could be applied to the first part of the value chain, whilst the application of lean methodologies as applied in the manufacturing or production trade, can be applied to the second leg of the value chain.

One of the cornerstone tools of a lean manufacturing system is the use of pull instead of push systems to regulate the flow of work, work-in-progress and inventory (Likier, 2004: 8; Womack & Jones, 2003: 67-89). Although the flow of material might remain the same, the feedback loop of demand planning and forecasting would be exchanged for smaller feedback loops between a point of consumption and its immediate upstream operations. Figure 3-4 is a rough illustration of what such smaller feedback loops would look like.

![Figure 3-4 A typical manufacturing concern using a pull system](image-url)
3.6 CONCLUSION

Chapter 3 created context of the cash centre environment. The chapter outlined the value proposition as well as the flow from one set of customers to another set.

Having gained an understanding of the cash centre environment, the next chapter aims to establish the most appropriate methodology for determining which lean tools are present and applicable in a cash centre.
CHAPTER 4
RESEARCH METHODOLOGY

4.1 INTRODUCTION

In chapter two, the theory of lean manufacturing, as well as its application in the service industry was investigated. Chapter three, also forming part of the literature review, described the operating model found in a typical cash centre. It highlighted operational requirements that are based on the customer’s value proposition.

The purpose of this chapter is to describe the research methodology used for this study. This chapter includes an analysis of the respondent’s biographical data.

4.2 PILOT STUDY

A pilot study was conducted by means of interviewing five managers from cash centres across South Africa. The study was to gauge what are some of the typical problems experienced by cash centres. By identifying these problem areas it gave guidance in terms of some of the opportunities that could be addressed through lean philosophy. A summary of the problems are as follows:

- Increased number of issues that were being referred for special processing. Cash centre management are often at pains to make exceptions to customers. These exceptions take the form of deviated or special processes to accommodate customer request, and come about as a result of a highly competitive market. What it entails is that certain customer deposits are either fast tracked, receive extra services, or some other type of special treatment. Undoubtedly, these sorts of exceptions or special treatments are not sustainable, and are
continually pushing up cost as it requires higher levels of complexities to manage.

- **Third party providers in the form of CIT.** Cash in transit companies own a portion of the customers. The cash centre has very little formal influence over CIT, yet they have a significant impact on the satisfaction level of the shared customer.

- **Rigid infrastructure due to associated risk profile.** One of the tenets of lean philosophy is the ability to respond rapidly to requirements from the environment, or to adapt quickly enough to address any concern that impact customer satisfaction or cost. However, most cash centres have strict blueprint control, for both physical design and process design. Making changes to either of these designs can be cumbersome.

- **Fragmented value chain with different customers and different end products.** A typical example is the fact that retail customers’ value is fulfilled as deposits are captured into their accounts, yet the process needs to continue as the cash is now used to meet the next customer, namely the ATM department or SARB.

### 4.3 RESEARCH DESIGN

Based on the research done, it is clear that there is no exact footprint that a business can follow in its pursuit of lean implementation. Instead, the implementation will vary according to the needs of the business.

During the literature review, certain best practices were identified in both the service sector as well as the manufacturing industry. The application of these best practices is largely determined by the needs of the organisation. The main research problem was: *Can a lean manufacturing philosophy be applied in a cash centre in order to improve operational efficiency?*
The empirical research was designed to determine:

*What are the lean elements that could be applied to a cash centre, how can they be applied, and what, if any, will be the impact on the performance of the centre?*

By understanding the above factors, one could conclude which lean tools would make the biggest impact in order to improve the overall performance of cash centres.

### 4.4 Conducting the Empirical Formula

The empirical study was conducted by means of an email survey (Annexure B). The questionnaire, accompanied by a covering letter (Annexure A), was emailed to the cash centres in the various provinces of South Africa. Each cash centre was asked to print twenty questionnaires. As per the senior managers of the various cash centres, the respondents formed a representative sample of the population in the respective cash centre.

The completed forms were then couriered back to the researcher for collation and statistical analysis.

### 4.5 The Questionnaire

The questionnaire comprised two sections. The first section of the questionnaire had the express purpose of gathering biographical data about the respondents. The second part of the questionnaire was to gather data that will help answer questions pertaining to the research question itself.

#### 4.5.1 Biographical Data

Biographical data was collected to ensure that the data collected was representative of the general population. The research therefore focused on the following areas:
- That staff in various levels, from non-supervisory to management, were represented in the data.
- That staff working in different departments, and therefore exposed to different day-to-day functions are represented.
- That staff with various years of services are represented.
- That employment status i.e. permanent, labour-broker, and temporary contract staff’s views all reflected in the data collected.
- That the sphere of influence in the form of the number of directly reporting staff is also reflected in the data collection.
- That the data is a representative sample of the entire population.

4.5.2 Survey questions

Forty-two survey close-ended questions with a five-point Likert scale were utilised. Respondents were asked to mark the most appropriate box.

The survey questions relate to the findings from the literature review. The intention of the questions was to gain an understanding of the current state of leaness within cash centres, as well as determining some typical problems or situational issues that could be addressed through the application of lean tools and techniques. Each question therefore assesses either the suitability, or the current state of at least one lean tool, technique, or implementation strategy as defined in the literature review. In order to avoid a biased response the questions were set in random order and were asked in a negative or positive manner.

4.5.2.1 Just-in-time practices (JIT)

The purpose of these questions was to determine if JIT practices such as level scheduling (heijunka), pull systems, takted production, and process synchronisation are applicable. These questions are aimed at assessing the feasibility of producing or processing the right product, at the right time, and only doing the required quantity i.e. only doing what is required when it is
required (Karlsson & Åhlström, 1996: 32). The following questions related to JIT practices:

- **Question 3**: We sometimes get deposits that take much longer to process than normal.
- **Question 5**: Customers are often inconvenienced because of a lack of resources.
- **Question 26**: I am happy that work-load is evenly distributed at all times among staff.
- **Question 35**: Floats / sachet etc. are only produced as per customer demand and orders.
- **Question 36**: Production of floats / payroll is only triggered by customer orders.
- **Question 42**: I understand the required rate of production in order to meet the customer demand.

### 4.5.2.2 Resource Reduction

The questions relating to resource reduction focused on techniques such as waste elimination, setup time reduction, small lot production, inventory reduction, and lead-time reduction. Waste elimination is a means of reducing resources, in order to reduce cost (Liker, 2004: 25). Therefore, these questions are of particular relevance when it come to the research question looking at lean tools in order to reduce cost. In addition, the opportunity to reduce resources (the removal of wasteful activities) is identified by value adding and non-value adding processes.

Questions that fell into this category aimed to identify wasteful practices as identified in the literature.

The following questions were asked to assess the opportunities and practices to reduce resource allocation:
• **Question 4:** The completed documents I receive from others (CIT sheets, feeder sheets, deposits slips, sweeper pages etc.) are always clear and easy for me to understand.

• **Question 5:** Customers are often inconvenienced because of a lack of resources.

• Question 6: My work is often delayed due to equipment breakdowns.

• **Question 7:** Work is often delayed due to long setup / change-over time.

• **Question 25:** I feel the layout of the cash centre is designed for optimal performance.

• Question 28: Information flow from customers, CIT, colleagues, managers etc. is always clear and easy to understand.

• **Question 29:** All work and even queries always follow a specified (documented) flow, which I understand.

• **Question 30:** I participate in team meetings that discuss how to remove work flow obstacles.

• **Question 36:** The workplace is well organised. No time or effort is wasted in searching for things needed to do my job.

• **Question 38:** I am often delayed because of waiting for someone to check or scrutinise my work.

• **Question 39:** I am often delayed in doing my job because of rework (e.g. Tracing differences).

### 4.5.2.3 Human relations management

According to the literature review, lean techniques such as team organisation, cross training, and team organisation fall under the ambit of human relations management (Pettersen, 2009: 132). The following questions thus pertain to human relations management:

• **Question 12:** I received adequate training in order to do my job.

• **Question 13:** I can link my training and my duties to documented procedures.
• **Question 18**: I often participate in team meetings that focus on improving customer service.

• **Question 19**: I understand what is value adding and non-value adding.

• **Question 26**: I am happy that workload is evenly distributed at all times among staff.

• **Question 30**: I participate in team meetings that discuss how to remove work flow obstacles.

• **Question 33**: I am updated at least daily about my team and my own performance.

• **Question 34**: I frequently join other teams (outside my own) to help solve problems.

• **Question 37**: My workstation is comfortable and well designed to perform my duties (no bodily strain).

### 4.5.2.4 Improvement Strategies

The following questions were asked in relation to improvement circles, continuous improvement, and root cause analysis:

• **Question 11**: We constantly improve by understanding the root cause of what went wrong.

• **Question 15**: We do improvement by re-designing / changing our process.

• **Question 16**: We do improvement by motivating each other to do better.

• **Question 17**: Improvement ideas from my team are well received and implemented.

• **Question 18**: I often participate in team meetings that focus on improving customer service.

• **Question 32**: My team responds to customer complaints by introducing permanent fixes.

• **Question 34**: I frequently join other teams (outside my own) to help solve problems.
• **Question 41**: The same mistakes are often repeated, causing repeat customer queries or complaints.

### 4.5.2.5 Defects control

Defects control included Autonomation (jidoka), failure prevention, 100% inspection, and line stop. In addition, this section also included factors that have an impact on variation. “To be able to attain high productivity, it is essential that all parts and products are fault free from the very beginning” (Karlsson & Åhlström, 1996: 30). Therefore, lean companies work towards zero defects in order to control quality. The following questions relate to this section:

• **Question 2**: I can access work instructions from my workstation.
• **Question 3**: I sometimes get deposits that take much longer to process than normal.
• **Question 4**: The completed documents I receive from others (CIT sheets, feeder sheets, deposits slips, sweeper pages etc.) are always clear and easy for me to understand.
• **Question 8**: Procedures are well defined and easily accessible / visible.
• **Question 10**: Procedures are up to date and I can refer to them when in doubt.
• **Question 12**: I received adequate training in order to do my job.
• **Question 13**: I can link my training and my duties to documented procedures.
• **Question 14**: The high variation of customer deposit mix and requirements impacts our efficiency.
• **Question 21**: I am aware of recent customer complaints or queries (if any) pertaining to my area.
• **Question 22**: I know what customers expect.
• **Question 27**: Errors are usually discovered as soon as they happen, and not later or by someone else.
• **Question 28**: Information / instructions from customers, CIT, colleagues, managers etc. is always clear and easy to understand.
- **Question 39:** I am often delayed in doing my job because of rework (e.g. Tracing differences).
- **Question 40:** Production problems are thoroughly solved before we continue work.

### 4.5.2.6 Supply chain and customer management

The literature review revealed that value stream mapping or flow charting, as well as supplier involvement pertain to lean customer and supplier management (Rother & Shook, 1998: 3-5). The following questions relating to the management of suppliers and customers were extended to cash in transit (CIT) companies as well:

- **Question 3:** I sometimes get deposits that take much longer to process than normal.
- **Question 4:** The completed documents I receive from others (CIT sheets, feeder sheets, deposits slips, sweeper pages etc.) are always clear and easy for me to understand.
- **Question 5:** Customers are often inconvenienced because of a lack of resources (people, equipment etc.).
- **Question 9:** CIT co-operates and help us serve our customers better.
- **Question 20:** We communicate with customers to keep them informed.
- **Question 23:** The arrival times of CIT are unpredictable and impact our ability to keep customers happy.
- **Question 31:** Only dedicated staff speak to customers.
- **Question 32:** My team responds to customer complaints by introducing permanent fixes.

### 4.5.2.7 Standardisation

Questions on standardisation covered topics such as 5S, standardised work, and visual control or management. Variation reduction is implied in the word *standardisation*. Therefore, these tools are also closely associated with variation or quality control, which becomes significant from a cost and customer satisfaction perspective. These questions are largely aimed at indicating the
level as well as relevance of having standardised work or standardised procedure (Spear & Bowen, 1999: 98). The following questions thus pertained to standardisation:

- **Question 1**: My work is in accordance to standard (written) procedures or instruction.
- **Question 2**: I can access work instructions from my workstation.
- **Question 3**: I sometimes get deposits that take much longer to process than normal.
- **Question 8**: Procedures are well defined and easily accessible / visible.
- **Question 10**: Procedures are up to date and I can refer to them when in doubt.
- **Question 13**: I can link my training and my duties to documented procedures.
- **Question 36**: The workplace is well organised. No time or effort is wasted in searching for things needed to do my job.

### 4.5.2.8 Scientific Management

In terms of scientific management, questions were asked to assess the feasibility and application of tools such as policy deployment, time and workstudies, multi-manning, work force reduction, and layout optimisation. Scientific management is concerned with applying further scientific tools to optimise existing processes in order to reduce cost (Ehrlich, 2006: 41). The following questions therefore covered scientific management.

- **Question 3**: We sometimes get deposits that take much longer to process than normal.
- **Question 5**: Customers are often inconvenienced because of a lack of resources.
- **Question 24**: I can explain how my daily work helps the bank achieve its goal.
- **Question 25**: I feel the layout of the cash centre is designed for optimal performance.
• Question 26: I am happy that work-load is evenly distributed at all times among staff.
• Question 33: I am updated at least daily about my team and my own performance.

4.5.2.9 Bundled techniques

Bundled techniques only included TPM (or preventative maintenance), ergonomics, and statistical process control (SPC). The following questions related to the bundled techniques:

• Question 6: My work is often delayed due to equipment breakdowns.
• Question 7: Work is often delayed due to long setup / change-over time.
• Question 37: My workstation is comfortable and well designed to perform my duties (no bodily strain).

4.6 CONCLUDING REMARKS

Chapter 4 described the methodology for conducting the empirical research. Central to the empirical research is the survey, and and ensuring that the questions are relevant to both the literature review as well as the research objectives.

Papadopoulou and Ozbayrak (2005: 805) suggest that lean manufacturing should not be regarded as fully-fledged systems but rather as a philosophy with a broad scope. Not every lean element is applicable to every situation, and the proposed model only aims to identify those elements that are applicable.

The right lean elements for each organisation can only be discovered through experimentation in the form of Plan-Do-Act-Check (PDCA), also known as the Demming Cycle (Likter, 2004: 24, 246). Moreover, this requires a dialogue in each organisation about the value-creating work of management and how to merge it with sustainable process improvement, and how to make continuous improvement a core activity of line management (Womack, 2010: 1).
The successful application of lean principles and lean thinking to the cash centre environment is central to this research. The research looked at what are some of the tools used in companies, both manufacturing and pure service industries that have successfully implemented lean methodology.
CHAPTER 5

ANALYSIS AND INTERPRETATION OF THE EMPIRICAL STUDY RESULTS

5.1 INTRODUCTION

The previous chapter described the design consideration of the survey as the chosen research methodology for the empirical study. Chapter 5 consolidates the results of the survey. The results are summarised in two categories:

- Section A of the survey which presents the biographical results.
- Section B of the survey that shows the outcome of the empirical study relating to specific lean tools and techniques and their application in the cash centre.

5.2 RESPONSE RATE AND BIOGRAPHICAL ANALYSIS

A profile of the respondents was obtained from section A of the survey. In this section respondents were required to indicate their years of service, employment status, the nature of their role, which area or department they work in, and their supervisory status.

5.2.1 Geographical dispersion

The researcher approached seven cash centre managers for the survey. Two cash centres in the Western Cape, two in Gauteng, one in Kwazulu Natal (KZN), one in the Northern Cape, and one in the Eastern Cape were approached to participate. This led to 145 responses being received from the various cash centres. Forty five percent of the respondents were based in the Western Cape (See Figure 5-1). Two possible reasons exist for the high response in the Western Cape. Firstly, there were two cash centres in the Western Cape. Secondly, the researcher was based in the Western Cape. Being based in the Western Cape, the researcher had closer access to
respondents, and could personally handout and prompt respondents for completed surveys.

Figure 5-1 Analysis of response by province

5.2.2 Response by area of responsibility

In the survey questionnaire, respondents were asked to indicate their area of responsibility, or in which department they work. Some 22 respondents indicated that they are responsible for more than one department or area (see Figure 5-2). These respondents have been grouped as *Supervises multiple areas*. The majority of respondents (55%) are dedicated only to retail deposit processing.
5.2.3 Response by position held

According to Figure 5-3 only three percent of respondents left this field blank. The majority (53%) of respondents indicated that they work in a non-supervisory role.
5.2.4 Response by years in current position

Thirty nine percent of respondents indicated that they have been in the current position for less than one year (see Figure 5-4). Only one percent of respondents did not indicate their duration in the current role they perform.

![Analysis of respondents by years in current position](image)

Figure 5-4 Response by years in current position

5.2.5 Response rate by employment status

According to Figure 5-5 most of the respondents (78%) enjoyed permanent employment status. Two percent of the respondents left this field blank, while labour brokers and temporary contract staff accounted for 20%.
The majority of respondents (55%) did not have any staff reporting to them. This meant that they were solely responsible for their operational duties and were not required to manage or supervise other staff. Three percent of respondents did not indicate how many staff, if any, report to them. Only three percent indicated that they had more than 29 staff reporting directly to them.
5.3 LEAN TOOLS AND TECHNIQUES

Figure 5-7 Following written procedure

The results from question 1 (Figure 5-7) indicate that work method is standardised.

Figure 5-8 Access to work instructions

Figure 5-9 Well-defined and accessible procedures

The above graphs show that staff and supervisors are comfortable in understanding how and what their work entails. Figure 5-8 and Figure 5-9 indicate that there is a well-established degree of process standardisation.
Although the results show that standardisation is well established within each of the cash centres surveyed, the question posed does not test whether processes are standardised across the centres, neither does it indicate, which of the standardised processes are delivering the best results.

Figure 5-10 Relevance of Procedures

Figure 5-10 shows that procedures are relevant in the sense that they are up to date and that respondents feel confident about referring to them.

Figure 5-11 Deposit complexities

Figure 5-12 Deposit variation
Most staff strongly agree that deposit processing creates delays due to variation in the types of deposits received. This could be an indication that there is a variation in the deposit presentation, which poses a challenge in terms of setting a Takt time (Lasa et al., 2008: 41, 46).

**Figure 5-13 Workflow**

The result of Figure 5-13 indicates a high level of flow standardisation. Typically, value stream mapping and process flow charts are used to obtain such status (Lasa et al., 2008: 50). As stated from previous charts, namely Figure 5-8 and Figure 5-9, the response does not indicate the level of standardisation between cash centres.

**Figure 5-14 Workplace organisation**

According to Figure 5-14 the workplace is not well organised. It seems that 5S or a similar system of standardisation is not in place.
Figure 5-15 Ergonomics

Figure 5-15 indicates that respondents are physically comfortable in their work areas, and that the ergonomics of the cash centre is well designed.

Figure 5-16 Information clarity

As mentioned in the literature review, Maleyeff (2006: 675) describes wasteful activities that occur because of unclear or ambiguous information. Figure 5-16 and Figure 5-17 show that cash centres experience very little delays because of
inadequate information flow. The results of the survey also indicate that there could be room for improving and optimising communication flows.

Figure 5-18 Resource allocation

Although resources in this context could be defined in terms of both human resources and equipment resources, it indicates the need to synchronise customer demand with resource allocation.

Figure 5-19 Equipment breakdowns

Even though there is a significant number of respondents that disagree and strongly disagree with the notion that the equipment breakdowns has an impact on operations, the majority of respondents (46%) acknowledge that this is an area of concern.
Figure 5-20 Machine setup

Fifty-five percent of the respondents either work or supervise in the deposit processing area (see Figure 5-2) which does not have machines that require change-over, which would account for the 24% that have responded neutral to this question. Therefore, although the majority of the responses indicated that changeovers do not cause significant delays (43%), there are still significant proportions (32%) that feel changeovers impact on their time. The data therefore indicate that significant improvements or waste reductions could be achieved by reducing machine setup time (Karlsson & Åhlström, 1996: 28).

Figure 5-21 CIT co-operation
Figure 5-22 CIT arrival times

Figure 5-21 and Figure 5-22 indicate the impact of CIT on the operation, and more particular, the ability to deliver to customer expectation. It appears that there is a perceived willingness on the part of CIT to help better serve customers, but that the delivery or arrival times of the CIT at the cash centre is an obstacle to achieve common customer satisfaction. In particular, the unpredictability of the arrival time of CIT seems to be the important aspect.

Figure 5-23 Teams improving workflow

Figure 5-23 indicates strong teamwork that identifies flow constraints – typically bottlenecks, process synchronisation, and even inventory reduction, in order to reduce lead times.
Respondents indicate that proper root cause analysis is done on failures. Only 52% do not feel that root causes are determined, while another eight percent are not sure. The fact that processes are changed or re-designed is also indicative that process failures are thoroughly analysed. Figure 5-26 even indicates that production related problems are thoroughly escalated, similar to Toyota’s *andon* approach (Cutcher-Gershenfeld et al., 1994: 47; Kasul & Motwani, 1997: 278; Bamber & Dale, 2000: 296).
Question 41: The same mistakes are often repeated, causing repeat customer queries or complaints

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<td>Total</td>
<td>8%</td>
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<td>18%</td>
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Figure 5-27 Repeat failure

Figure 5-27 is a test of how well root cause analysis and problem solving is done. Although Figure 5-24, Figure 5-25, and Figure 5-26 indicate that problems are resolved, Figure 5-27 shows that 47% of respondents feel to some degree that repeat failures occur, and that they affect the customer.

Question 12: I received adequate training in order to do my job

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<td>Total</td>
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Figure 5-28 Training and process clarity

Question 13: I can link my training and my duties to documented procedures

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<td>Total</td>
<td>22%</td>
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<td>12%</td>
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Figure 5-29 Process clarity
The fact that respondents feel that adequate training has been provided (see Figure 5-28 and Figure 5-29), corresponds to the earlier indication that work is only done according to written procedures. Adequate training could not have taken place if clear instructions are not available.

Improvement through motivations speaks to Levitt’s theory on a humanistic approach. According to Levitt (1972: 43) this approach is common in the pure service industry, whereby continuous improvement relies on motivation (negative or positive), instead of critically looking at the processes and correcting the root cause. Figure 5-30 indicates that 94% of respondents view this approach as a means to drive continuous improvement.
Figure 5-32 Teams focused on customers

Figure 5-31 and Figure 5-32 indicate that teams are empowered to implement improvements. The charts also indicate that staff have an understanding of the customer expectations.

Figure 5-33 Value adding

Figure 5-33 confirms the notion that respondents understand customer expectation as 45% and 47% respectively strongly agree and agree that they understand the concept of value adding. The fact that only a minority (eight percent) is either not sure, disagrees or strongly disagrees, is another confirmation. The question does not test whether or not that understanding is correct.
Figure 5-34 Delays (waste)

Figure 5-34 indicates the amount of waste or non-value adding activities such as delays, reviews, and duplication (Ehrlich, 2006: 42; Maleyeff, 2006: 683) that occur within the cash centre. Although most respondents disagree (43%) to some extent that these are present, the result does show room for improvement. This deduction is confirmed by Figure 5-35, which shows some rework taking place (36%),

Most respondents are comfortable with the concept of “value”. This can be ascribed to the fact that the financial institute has gone through an extensive programme of creating awareness on lean and six sigma to most of its staff. The question and response does not test the accuracy of that understanding.
According to Figure 5-36 cash centres consciously try to keep customers informed.

Figure 5-37 indicates that cash centres have a strong sense of single point of contact with customers, but there are areas where it needs to be improved upon. As stated previously, the question posed does not necessarily reflect the view of the customers.

Figure 5-38 Staff awareness on customer complaints
Figure 5-39 Customer expectation

Figure 5-38 indicates a strong awareness amongst staff about any recent concerns customers may have had about service delivery. The awareness about customer concerns is complimented by an understanding of what customers expect, as shown in Figure 5-39.

Figure 5-40 Policy alignment

Figure 5-40 indicates a sense of policy deployment, and that it is well entrenched at all levels of the organisation.

Figure 5-41 Physical layout
Figure 5-41 indicates that the layout of the cash centres does not negatively influence the operations.

**Figure 5-42 Workload distribution**

Figure 5-42 indicates that the workload is evenly distributed amongst staff. It also indicates that there is a limited need for line balancing and process synchronisation.

**Figure 5-43 Error detection**

The processes are well established to detect errors immediately (Figure 5-43). A possible concern is the 47% of respondents that are not sure, or do not agree to some extent that errors are detected immediately (Karlsson & Åhlström, 1996: 30). A decisive test would be to research consequences of errors, such as losses incurred, customer complaints, or amount of rework done.
Figure 5-44 suggests that teams are actively mobilised to respond to changing customer environments, as well as critically addressing process failures that have affected the customer. Relating also to teamwork, is the need to keep both the team and the individual up to date concerning his or her performance. Figure 5-45 indicates that this practice is well entrenched. Only one percent of the respondents did not answer this question, and left it blank on their survey form. Figure 5-46 indicates the presence of cross-functional teams to help solve problems, but is also indicates a significant portion (46%) of respondents that are not aware (neutral), or disagree to this being a practice.
Figure 5-46 Cross-functional teams

Figure 5-45 indicates that teams and individual are given regular performance feedback, while Figure 5-46 indicates the use of cross-functional teams to perform problem solving.

Figure 5-47 Make to order

According to the response of Figure 5-47, there is a strong perception that floats and sachet is only made in response to customer demand (pull). Notably only 19% of the respondents work with floats, sachet or payrolls.

Figure 5-48 Rate of demand
Figure 5-48 once again acts as confirmation that there is a strong understanding of what the customer's demand is and how to meet it.

5.4 CONCLUSION

Chapter 5 presented the results and an analysis of the survey. Charts were used to illustrate the responses to various questions posed to respondents. The responses gave context to the cash centre operations relative to the literature review. The responses were interpreted in order to identify some of the opportunities for improvement using lean methodology, the focus being to reduce cost and improve customer service by making operational improvements.
CHAPTER 6

SUMMARY OF THE ANALYSIS, CONCLUSION, AND RECOMMENDATIONS

6.1 INTRODUCTION

The objective of the research was to resolve the main as well as the sub-problems. Chapter 6 will re-visit the original objectives and draw certain conclusions that have been derived from the survey results. Recommendations can thus be made based on these conclusions.

6.2 OBJECTIVE AND OVERVIEW OF THE RESEARCH PROJECT

The objective of the research was to investigate which lean manufacturing tools and techniques could be applied in a cash centre environment. A literature review of lean tools and implementation strategies was conducted in order to assess some of the key characteristics of the lean philosophy. After the initial pilot study, a survey was conducted in order to assess:

- The lean tools currently in use within one of South Africa’s financial institutions.
- Establish what are the further opportunities for implementing lean tools in a cash centre.

6.3 OVERVIEW OF LITERATURE

The approach to the literature review was to firstly focus on lean manufacturing, and secondly on cash management. Although ample literature was available on lean manufacturing, literature on cash management in the context of cash centre operations was limited.
As shown in Figure 6-1, the literature on lean manufacturing focused on aspects such as benefits of the system, specific tools and techniques associated with lean manufacturing, and some of the implementation strategies followed by practitioners and organisations. Getting a lean manufacturing perspective from the service industry as well as manufacturing industry, allowed the research to better apply the literature to the cash centre environment. The investigation into the cash centre environment revealed that it consists of neither pure service, nor pure manufacturing, but a unique combination of the two.

Debatably the cash centre operation is defined by two sections. The first section consisted of providing a pure service for customers. This service section culminated in the processing and capturing of customer deposits. Once the customers’ accounts were correctly captured (as well as ancillary services such as reconciliation, referencing etc.), it essentially fulfilled a value proposition.

The second half of the cash centre operation can be considered as manufacturing or production. The product that is to be produced in this second leg is:

- Bundled notes that are fit for ATM consumption.
• Payrolls, changes, and floats mainly for retail customers.

What makes the combination _unique_ is the fact that the _components_ (cash notes and coin) of the above products are derived from the deposits processed during the _service_ section of the operation. Typically production companies would order their material or components necessary in order to produce; in _this_ case, the producer has no control over the amount of incoming _raw material_ that enters the system. The only control available is to clear excess _raw material_ (cash) to the South African Reserve Bank (SARB).

There are a number of reasons that would force one to consider which aspects of lean methodology could apply, and which ones, if any, would not be applicable.

1. _Risk_. Which lean tools can be applied without compromising risk? The consequences of risk are twofold. Firstly, cash in the cash centre, _is_ the commodity; the same as parts, raw materials, or components are the working commodity in a factory environment. Dealing with cash, unlike components or raw materials, means that there is a constant threat of the cash being stolen. Therefore, the handling of cash and the handling of components (or raw materials) cannot be treated exactly the same. A simple illustration of this concept is the fact that cash has to constantly be kept under lock and key – even in a secure facility. People need to take individual ownership of this _commodity_ in a cash centre.

The second aspect to consider in terms of risk relates to secrecy. Cash centre operations are kept out of the public domain as far as possible. The risk of robbery or even physical attack on such installations is always a cause for concern, with the result that knowledge and research in the field is very limited. Institutions that manage cash centres keep a level of secrecy about their operation in respect to dates, times, frequency, values, volumes, risk mitigating procedures...
etc. Risk is therefore one of the key components of cash management (Hines et al., 2000: 15).

2. **Performance measurement.** Very little literature exist with regard to cash management, and consequently, there is very little commonality in the industry of how performance is measured.

3. The lack of performance benchmarking within the industry, could necessitate one to measure the degree of “leanness” within a cash centre. The degree of leanness could then be used to draw a correlation between performance indicators and lean implementation.

### 6.4 SUMMARY ANALYSIS OF EMPIRICAL RESEARCH

The results of the empirical research indicate multiple opportunities for using lean methodology in a cash centres. Firstly, the results show that certain lean elements are already well established within the cash centre. The mere fact that certain practices are already present, dispel the notion that lean manufacturing cannot be applied in a cash centre. Secondly, because not all aspects of lean manufacturing can necessarily be applied to a cash centre, the survey aimed to identify further opportunities for improving operational efficiencies using lean manufacturing tools.

The literature as well as the empirical research was based on the grouping of certain tools. The analysis and recommendations was therefore based on a similar approach. Some of the lean implementation strategies and philosophies were incorporated into the lean groupings.

In making recommendations on the application of lean manufacturing, it is important to note that the business is comprised of two distinct parts: the first part, a pure service industry, primarily concerned with counting, capturing, and reconciliation. We will refer to this part of the business as the service section. The second part is partly service and partly product. The reason the second half is a combination of product and of service, is because it involves the production
of change packs, floats packs, and notes for retail and ATM customers respectively. We will refer to this section of the business as the product section.

What follows is the final analysis and recommendations on the application of various sets of tools and techniques as well as the lean implementation strategies that could be applied within a cash centre.

6.4.1 Just-in-time (JIT) practices

The survey results indicate that certain JIT practices will not be practical in a cash centre.

Takted production time will not be practical until arrival times and customer deposits are stabilised (see Figure 5-11 and Figure 5-12). Seth and Gupta (2005: 51) suggest that staff should understand the hourly requirements from a customer perspective, however, the high variation and unpredictable arrival times of the deposits means that there is no way of setting a standard time for the processing of a deposit.

The results of question five and question twenty-six (Figure 5-18 and Figure 5-42 respectively) indicate that the management of resources is an opportunity to use Heijunka (production levelling). While question five indicates a scarcity of resources, question 26 indicates an even distribution of work amongst staff. Although staff have an even distribution of workload amongst each other, the total compliment of staff and other resources is not always enough to fulfil customers’ demand.

The response to question 35 and 36 (Figure 5-47 and Figure 5-14 respectively) indicate that pull system is in place within the product section of the cash centre. The significance of this question is that it confirms that a pull or continuous flow system, one of the elements of lean manufacturing (Womack & Jones, 2003: 24; Liker, 2004: 108), is applicable to a cash centre, or at least to the product section of a cash centre. The response to question 42 (Figure 5-48) confirms that a pull system is in place as staff understand the required rate of
production in order to meet customer demand i.e. floats and sachets are only produced as consumed by the customer. The use of kanban cards could be introduced as a tool to further reduce and control the stock of floats i.e. a direct pull from customer.

Since the cash received in the service section is used as raw material for the product section, the ability to apply pull systems becomes virtually impossible without controlling the supply of cash from customers who initiate all work (Maleyeff, 2006: 676). However, applying pull systems to downstream operations in the product part of the business is evident as previously stated.

In summary, the results indicate that JIT practices are only present and practical in the product section of the cash centre.

6.4.2 Resource Reductions

Karlsson and Ahlstrom (1996: 27) suggest that everything that does not add value, or that the customer is not willing to pay for, is waste. Lean elements associated with resource reduction focuses largely on the removal of waste or non-value adding activities.

According to Question 4 and Question 28 (Figure 5-16 and Figure 5-17 respectively), only 20% of respondents feel that documents are not always easy to understand, or that the information flow is not clear. This means that the information clarity and flow in the cash centre seems to work reasonably well. If it did not work well, resources would have been wasted on clearing up or correcting errors that resulted from unclear information (Maleyeff, 2006: 680). However, it does seem that that delays occur as a result of not having enough available resources as indicated in Question 5 (Figure 5-18). It seems therefore that matching resources to customer demand remains the challenge. Because the customer in a service environment initiates work (Maleyeff, 2006: 676), the allocation of adequate resources will always be a challenge. There may be peak periods, during which not enough resources are available, and conversely, low periods, during which, resources are underutilised.
Long setup time can cause waiting and delays (Ohno, 1988: 129), which in turn could put a strain on resources. Although only 32% of respondents feel that work is delayed due to setup time (see Figure 5-20, Question 7), there is a strong case to be made for reducing setup time. If staff and management perceive setup time to be too long, the natural inclination would be to run bigger batches and reduce the frequency of changeovers. It is therefore important to find ways of measuring changeover time and finding ways to reduce machine setup time (Bowen & Youngdahl, 1998: 211). Similarly, delays caused by machine breakdowns also seems to have a significant impact on operations. Forty Six percent of respondents’ work is often delayed due to machine breakdowns (Figure 5-19). These equipment related delays experienced in cash centres means that lean tools such as TPM, 5S, and standard work instruction, are relevant, and could have a positive cost and service spin-off for the cash centre.

Both Womack and Jones, (2003: 21-24) and Liker (2004: 108-110) concur that the creation of flow is central to a lean manufacturing system. Womack states that bottlenecks or buffers will hamper continuous flow of material, products and even information. Figure 5-23 (Question 30) indicates awareness and a team approach to identify and improve flow obstacles or bottlenecks.

The lack of workplace organisation, according to Figure 5-14 (Question 36), indicates that much time is wasted on activities such as finding and sorting, as 53% of respondents feel that the workplace is not well organised. Tools such as 5S have proven to be effective in overcoming workplace organisation on factory floors as well as offices (Warwood & Knowles, 2004: 352).

Delays commonly found in the service industry and identified as waste by Ehrlich (2006: 42) and Maleyeff (2006: 683) include reviews, errors, and duplication. According to Figure 5-34 (Question 38) and Figure 5-35 (Question 39) these types of waste has a significant impact on the cash centre. The figures indicate that 41% of respondents are delayed while waiting for some sort of review, while 36% indicate delays due to reworks.
Question 25 (Figure 5-41) was set to determine whether respondents feel that the layout is designed for optimal performance. Although the majority view the layout as optimal (55%), one can conclude that cash centre layout will positively impact operational performance.

The results and analysis of the survey show that there is clear scope for using resource reduction tools to improve cost effectiveness. There is no evidence to suggest that the lean tools associated with resource reduction currently has a significant presence in the cash centres surveyed. Therefore, to argue that these tools are applicable because they are already successfully implemented would not hold true. Instead, this research would argue that resource reduction tools are applicable because of wasteful activities, as well as further improvement opportunities that have been identified from the survey results.

6.4.3 Human relations management

Multifunction teams imply that staff have the ability to perform a variety of task, and thus giving greater flexibility to the operational complexity (Karlsson & Åhlström, 1996: 34). Cash centres can track the percentage of staff able to perform numerous tasks. This is also applicable to supervisory staff that need to perform a series of statutory and procedural checks and scrutinies.

Best practice could be indicated by the frequency employees change task i.e. to move from changing in task less than once per year, to continuously changing. The survey indicate that 39% of staff change jobs at least once per year (see Figure 5-4), and only nine percent have not changed or rotated jobs in the past seven years.

Questions 18, 30, and 34 (Figure 5-32, Figure 5-23, and Figure 5-46 respectively) indicates a high level of participation by various staff members. This participative, or engaging style referred to by Power et al. (2001: 259) improves the agility and customer satisfaction of the organisation. The
questions revealed that cross-functional team members are active in improving customer service and workflow obstacles.

Linked to improving customer service, is customer value. Womack and Jones (2003: 15-28) emphasise the need to understand value from a customer perspective as the first step to the lean philosophy. Therefore, if staff are to be utilised in driving lean improvements, it becomes imperative that they too, understand customer value. According to the survey (Figure 5-33), 92% of respondents understand customer value. An understanding of customer value needs to be maintained in order to maintain a lean culture of continuous improvement.

Although cash centre staff are not customer facing, it still makes sense to take advantage of well-trained staff in order to better serve the customers (Bowen & Youngdahl, 1998: 214-215). The survey results show that cash management is leveraging of well-trained staff as indicated by Figure 5-28 and Figure 5-29 (Question 12 and Question 13 respectively), which shows that staff training is linked to their job, which in turn is linked to documented procedures.

Although ergonomics could be classified as part of scientific management, Figure 5-15 (Question 37) indicates that 27% of respondents feel that their workstations are not comfortable and that it causes them bodily strain. Although this percentage is a minority, it is cause for concern as it might impact quality and productivity of staff (Drury, 2000: 4007-4008). Ergonomics, therefore, has to be considered in current as well as future design of workstation.

With the exception of ergonomics, general indications are that there are very good people or human relations practices in place that support lean transformation. One can therefore assume that the evidence of these practices, justifies the relevance of applying these lean tools. Therefore, based on the combination of responses from the various questions listed under human relations management, there is a presence and awareness of lean tools, but they are not fully utilised or optimised.
6.4.4 Improvement strategies

As indicated in the empirical data, the establishment of teams that generate and implement continuous improvement is well entrenched. Like any organisation that drives a lean philosophy, cash centres can make use of staff to generate ideas for removing waste. The challenge for cash centres is to utilise this resource without compromising on aspects standardisation, specifically in the context of managing the associated risk profile.

By tracking the number of suggestions per employee, as well as the percentage of ideas implemented, provides the cash centre with the ability to track progress in lean implementation (Karlsson & Åhlström, 1996: 29). The survey indicates that cash centres have some sort of organisation for improvement ideas to be implemented; these could take the form of multifunction teams or improvement circles as indicated in Figure 5-31 (Question 17), Figure 5-32 (Question 18), and Figure 5-46 (Question 34).

Although the survey results (Figure 5-24, Question 11) show that cash centres are already making use of root cause analysis, Figure 5-27 (Question 41) indicates a strong likelihood that the same process failures are re-occurring, with 47% of respondents indicating that the same mistakes are often repeated. The results of Figure 5-27 indicate that either root cause analysis as a tool is not effective, or that cash centres are not using the tool in the correct manner. This is despite literature suggesting that various industries have reduced repeat process failures when root cause analysis is properly used (Ehrlich, 2006: 43). Levitt (1972: 43) suggests that improvement should not only take place by motivating employees, but rather that task or processes should be re-designed in order to gain improvement. Figure 5-25 (Question 15) and Figure 5-30 (Question 16) suggest that attempts to make corrections and improvements are done by means of motivation, instead of critically reviewing current processes, and making the appropriate process changes. Cash centres therefore have to move away from the traditional approach of the service industry of using personal motivation (negative or positive motivation) as a vehicle for improving their processes.
Therefore, the combination of literature and survey results indicate that improvement strategies, as a bundled lean technique, including, improvement circles, cross-functional improvement (Kaizen), root cause analysis, and a non-humanistic approach, are all applicable to cash centres. The empirical data also indicate that these tools are present, although they are not being effectively utilised.

6.4.5 Defects control

Information flow in a service system should always be clear, complete and unambiguous (Maleyeff, 2006: 680). Only 20% of respondents feel that this is not the case, while an additional 17% are neutral or not clear on the issue (Figure 5-16, Question 4). Although 62% do not feel information clarity is a concern, this data reveals a possible source of errors or defects. Similarly, the flow of the information also needs clarity since 20% of respondents are not always clear on the flow of information (Figure 5-17, Question 28), which could lead to further delays and defects.

Both Maleyeff (2006: 679), and Spear and Bowen (1999: 97) cite the need to standardise tasks in order to reduce variation and therefore defects. Figure 5-9 (Question 8) show that 87% of respondents are aware of their procedure while 79% can actually link their training to the procedures (Figure 5-29, Question 13). The use of visible procedures or work instructions is a viable means of mitigating the risk of variation, which results in errors. The risk is further mitigated by linking the training to the procedure. Although both of the figures mentioned above indicate that standardised task or operations are well entrenched within cash centres, the high variation in customer deposits complexities (Figure 5-11 and Figure 5-12) could threaten the stability of the process.

Autonomation (Jidoka) refers to the practice of automatically detecting mistakes or errors as they happen, and then shutting down the process immediately in order to prevent further re-occurrences (Sugimori et al., 1977: 554). Although
autonomation is technically an automated stopping process, the principle could be applied in a non-automated fashion. Respondents indicate the presence of some type of autonomation since 52% of defects are immediately discovered at source (Figure 5-43, Question 27). This is confirmed by 36% of respondents who find themselves delayed due to doing their own rework (Figure 5-35, Question 39). Although these delays (correcting errors at source) may seem negative in the short term, it creates and maintains awareness of errors, as well as the opportunity to reduce checking personnel. Karlsson and Åhlström (1996: 30-31) confirm the need for defects to be identified and corrected at source.

Similar to autonomation, is the concept of line-stop, the difference being that workers are given autonomy to stop a production line until such time that problems are thoroughly investigated, and resolved (Ohno, 1988: 121). Although the survey did not check the presence of andon boards, 60% of respondents indicated that production related problem are thoroughly solved before work is continued (Figure 5-26, Question 40). One can consider this practice as a form of line stop as indicated by Ohno.

In order to reduce defective service, Jones and Dent (1994: 23) demonstrated the effectiveness of giving staff feedback from a customer perspective. This practice is well established; 81% of staff are aware of recent customer complaints (Figure 5-38, Question 21). Giving staff this type of feedback creates a greater sense of involvement and control, as well as creating consistent clear standards. This is confirmed by the fact that staff have an understanding of what customers expect as indicated in Figure 5-39 (Question 22).

The conclusion is that all the tools associated with defect controls are applicable to a cash centre. The results also show that certain tools such as Jidoka, although in use, are not fully utilised, but that there is scope to also harness tools such as line-stop, failure prevention, variation reduction and hand-off reduction. Although the use of these tools is limited, and perhaps not formalised within the cash centres surveyed, their presence indicate the opportunity for better defect control.
6.4.6 Supply chain and cash-in-transit (CIT)

Since cash delivered by CIT in the form of cash deposits was also used as material, the CIT companies can be treated as part of the supply chain.

Empirical data strongly suggest that CIT is an integral part of serving the customer. The respondents (47% according to Figure 5-21, Question 9) perceive CIT operators to have an interest in better serving the customer, but Figure 5-22 (Question 23) indicates that the unpredictability of CIT delivery to the cash centre is a barrier to that ideal. The clarity of information received from CIT was initially thought to also be a barrier, but Figure 5-16 (Question 4), which included information received from CIT, indicates that this is less of a problem. Thus, CIT companies have an interest in improving the service offered to a mutual customer, but that their own logistical constraints, interferes with their ability to deliver payrolls and deposits according to schedule.

In treating CIT as a supplier, cash centres need to develop systems that integrate with CIT. Just as manufacturing companies do not develop a lean implementation strategy without involving their suppliers, so too, cash centres’ improvement strategy has to include CIT development.

6.4.7 Customer management

There is a high variation in customer expectation as indicated by the deposit complexities (Figure 5-11, Question 3). There are two logical ways to address deposit complexities. The first is to motivate the customer to choose from a well defined but limited menu how they will be making their deposit i.e. change the behaviour of the customer. The advantage of this strategy is that it lets the cash centre standardise the processing technique according to the set menu item. The disadvantage of this strategy is that it limits the customer, and that it becomes very hard to manage customers who do not conform.

The second option is to work toward extremely flexible operating models that can accommodate variation in customer behaviour. Ehrlich (2006: 43) suggests
the use of customer centric work cells that process the entire customer order from start to finish and thus reduce work-in-process. Another alternative is to apply Jefferson Pilot Financial's principle of segregating complexities (Swank, 2003: 126), i.e. process each deposit according to the varying degrees of complexities by setting up specialised production lines as per the level of complexity. Segregation of complexities in turn, provides credibility for setting standard times for every process type, which in turn will aid resource allocation (see Figure 5-18).

Parry et al. (2010: 222) emphasise the value and strengthening effect that regular feedback to the customer has on the relationship, and that an organisation that communicates by giving the customer updates on their work, reinforced the customers’ confidence in the relationship. Figure 5-36 (Question 20) show that the cash centres have already adopted this as a best practice. However, a concern can be raised about the number of people that speak to customers. Although cash centres are partly service orientated, they remain a back-office function. Only 49% of respondents agree that only dedicated staff speak to customers (Figure 5-37, Question 31). This could mean a breakdown of the ideal of a single point of contact for customers (Parry et al., 2010: 18). Therefore, although, customers are kept informed, the quality of the feedback could be adversely affected by multiple points of contact.

6.4.8 Standardisation

Pettersen (2009: 132) lists standardised work, 5S, and visual control as the enablers for achieving standardisation and basic stability. Jozaffe (2006: 12) cites basic stability as the starting block to building a lean manufacturing system. According to the survey, staff can perform work according to a written (standardised) procedure (Figure 5-7, Question 1) which is accessible (Figure 5-8, Question 2), visible (Figure 5-9, Question 8), up to date, and well-defined (Figure 5-10, Question 10). In addition, staff have received training to match the documented procedures (Figure 5-29, Question 13). We can thus conclude that the cash centres surveyed have a reasonable level of standardised work.
Although standardised work is in place, Figure 5-14 (Question 36) indicate that much time is still wasted due to a lack of visual controls or 5S. Fifty three percent of respondents acknowledge that the work place is not well organised. Workplace organisation means workplace standardisation.

Therefore, standardisation as a tool appears to be relevant in cash centres. The research suggest that there is a strong process governance and compliance, but a lack of workplace standardisation. Without workplace standardisation and organisation, process compliance and governance has the potential to become burdensome (which could lead to waste) and stands the chance of being compromised – which leads to errors. Workplace organisation should therefore be focused on in order to further strengthen process compliance.

6.4.9 Scientific management

In assessing the level of scientific management in cash centres as well as the appropriateness of applying scientific management tools, the survey established the presence and relevance of tools such as policy deployment, time, or work-studies, multi-manning, and facilities layout.

Similar to policy deployment, vertical information system imply that teams and individuals regularly receive information of a strategic nature. This ensures that the team and individual can relate his or her own efforts to broader organisational goals (Swank, 2003: 127). This practice is well entrenched as 95% of respondents agreed to some extent that they understood how their daily work helped the bigger organisation achieve its goals (Figure 5-40, Question 24). Similarly, staff need to get regular feedback on their own performance (Swank, 2003: 127-129; Jones & Dent, 1994: 23). Figure 5-45 (Question 33) reveal that individuals as well as their respective teams are given regular feedback with regard to their performance.

As indicated in earlier text (see section 6.4.8 on standardisation), setting standard times in the service section of the cash centre is virtually impossible as long as customers’ deposit vary in complexities. High variation in cycle times of
deposits (Figure 5-11, Question 3) could lead to an imbalance on resources, and even create the perception that there are not enough resources to support the customers’ requirements as evident from Figure 5-18 (Question 5). The ideal would be to re-organise resources quickly and effectively to match customer demand. Re-organising would require that multi-manning takes place, which in turn would require staff to be multi skilled to accommodate quick changes in their role.

Therefore, although work-study and standard times are a challenge, all other aspects of the scientific management tools are applicable to cash centres.

6.4.10 Bundled techniques

Bundled techniques included tools such as TPM and preventative maintenance. As stated in earlier text, based on the impact of machine breakdown, and setup, these tools become applicable in a cash centre as well.

6.5 CONCLUSION

The research project sought to review what some of the lean practices within one of South Africa’s financial institutes are. The research examined how performance could be further improved by expanding on the existing lean methodology.

The literature review revealed a toolbox and an implementation approach. The toolbox approach, used mainly in the manufacturing or production environment, focuses on specific techniques. The implementation approach looked at the some of the philosophies of companies that have implemented lean manufacturing.

An overview of the cash centre operation revealed that it is a hybrid of the service and product industry, and that the application of lean manufacturing philosophy would thus vary as well.
The empirical study revealed the prevalence of some of the best practices identified in the literature review, in the cash centres. The study also identified certain shortcomings or opportunities to use more lean tools. Although the study confirms that lean implementation is more than the application of a specific set of tools or rules (Spear & Bowen, 1999: 104), the study went about identifying which tools are applicable in cash centres. The study concludes that all the tools reviewed, are applicable in the product part of the cash centre. However, the study also concluded that certain JIT tools such as flow and pull, cannot be implemented without first attaining basic stability in terms of customer deposits and CIT logistics. The study also concludes that there is scope for making improvements to the current environment by using lean tools, and that the application of a lean philosophy would enhance virtually all aspects of the cash centre operation.


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104-109.

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available: [http://www.strategosinc.com/just_in_time.htm] [07 March 2010].

system and Kanban system materialization of just-in-time and respect-for-

129, October.


Womack, J. 2010. *The tipping point*, 09 June, [Online], available: 
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ANNEXURE 1
Questionnaire Covering Letter

September 2010

Dear Colleague

Research Survey: Which lean techniques are most suited in the cash centre environment

I would like to invite you to participate in a survey aimed at investigating some of the issues that could be addressed at cash centres through the implementation of a lean manufacturing methodology. The results of this research will be submitted to the Nelson Mandela Metropolitan University (NMMU) in partial fulfilment of a Master’s degree in Business Administration (MBA)

The survey is strictly confidential and the respondents will remain anonymous.
Should you require any additional information, please feel free to contact Ryan Smith at telephone number 021 918 5100 or on email at ryan.smith2@gmail.com

Your participation is greatly appreciated.

Ryan Smith
Researcher
ANNEXURE 2

Research Questionnaire

Section A: Biographical Data

Please answer the following questions by marking the appropriate block with an “X”

A1. What is the nature of your role?

<table>
<thead>
<tr>
<th>Non-supervisory</th>
<th>Junior Supervisory (has no supervisory staff reporting to me)</th>
<th>Senior Supervisory (has other supervisory staff reporting to me)</th>
<th>Manager</th>
</tr>
</thead>
</table>

A2. Which area or department do you work in, or are you responsible for (if more than one please mark accordingly)?

<table>
<thead>
<tr>
<th>Deposit processing</th>
<th>Payrolls / changes</th>
<th>Coin factory</th>
<th>Note factory (recycling)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treasury</td>
<td>Float / sachet Preparation</td>
<td>Admin</td>
<td>Other (please specify)</td>
</tr>
</tbody>
</table>

A3. How long have you been in the current position?

<table>
<thead>
<tr>
<th>Less than 1 year</th>
<th>Between 1 and 3 years</th>
<th>Between 3 and 7 years</th>
<th>Longer than 7 years</th>
</tr>
</thead>
</table>

A4. Please indicate your employment status

<table>
<thead>
<tr>
<th>Permanent Employee</th>
<th>Labour Broker</th>
<th>Temporary Contract</th>
</tr>
</thead>
</table>

A5. How many staff report directly to you

<table>
<thead>
<tr>
<th>none</th>
<th>Between 1 and 3</th>
<th>Between 4 and 10</th>
<th>Between 11 and 20</th>
<th>More than 20</th>
</tr>
</thead>
</table>
### Section B: Lean manufacturing concepts

Please answer the following question as objectively as possible

<table>
<thead>
<tr>
<th>No.</th>
<th>Question</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain / Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I (my staff) work according to standard(written) procedures or instruction</td>
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<td>2</td>
<td>I (my staff) can access work instructions from my workstation</td>
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<td>3</td>
<td>We sometimes get deposits that take much longer to process than normal</td>
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<tr>
<td>4</td>
<td>The completed documents I receive from others (CIT sheets, feeder sheets, deposits slips, sweeper pages etc.) are always clear and easy for me to understand</td>
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<td>5</td>
<td>Customers are often inconvenienced because of a lack of resources (people, equipment etc.)</td>
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<td>6</td>
<td>My work is often delayed due to equipment breakdowns</td>
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<td>7</td>
<td>Work is often delayed due to long machine setup / change-over time (e.g. sachet machine)</td>
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<td>8</td>
<td>Procedures are well defined and easily accessible / visible</td>
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<tr>
<td>9</td>
<td>CIT co-operates and help us serve our customers better.</td>
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<tr>
<td>10</td>
<td>Procedures are up to date and I can refer to them when in doubt.</td>
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<td>11</td>
<td>We constantly improve by understanding the root cause of what went wrong</td>
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<tr>
<td>12</td>
<td>I received adequate training in order to do my job</td>
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<td>13</td>
<td>I can link my training and my duties to documented procedures</td>
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<tr>
<td>No.</td>
<td>Question</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Uncertain / Neutral</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
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<tr>
<td>14</td>
<td>The high variation of customer deposit mix and requirements impacts our efficiency</td>
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<td>15</td>
<td>We do improvement by re-designing / changing our process</td>
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<td>16</td>
<td>We do improvement by motivating each other to do better</td>
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<tr>
<td>17</td>
<td>Improvement ideas from my team are well received and implemented</td>
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<tr>
<td>18</td>
<td>I often participate in team meetings that focus on improving customer service</td>
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<tr>
<td>19</td>
<td>I understand what is value adding and non-value adding activities</td>
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<td>20</td>
<td>We communicate with customers to keep them informed</td>
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<td>21</td>
<td>I am aware of recent customer complaints or queries (if any) pertaining to my area</td>
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<tr>
<td>22</td>
<td>I know what customers expect</td>
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<tr>
<td>23</td>
<td>The arrival times of CIT are unpredictable and impact our ability to keep customers happy</td>
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<tr>
<td>24</td>
<td>I can explain how my daily work helps the bank achieve its goal</td>
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<tr>
<td>25</td>
<td>I feel the layout of the cash centre is designed for optimal performance</td>
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<tr>
<td>26</td>
<td>I am happy that work-load is evenly distributed at all times among staff</td>
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<td>27</td>
<td>Errors are usually discovered as soon as they happen, and not later or by someone else</td>
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<td>No.</td>
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<td>Strongly Agree</td>
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<td>Uncertain / Neutral</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
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<tr>
<td>28</td>
<td>Information flows from customers, CIT, colleagues, managers etc. is always clear and easy to understand</td>
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<td>29</td>
<td>All work and even queries always follow a specified (documented) flow, which I understand.</td>
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<tr>
<td>30</td>
<td>I participate in team meetings that discuss how to remove work flow obstacles</td>
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<tr>
<td>31</td>
<td>Only dedicated staff speak to customers</td>
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<tr>
<td>32</td>
<td>My team responds to customer complaints by introducing permanent fixes</td>
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<tr>
<td>33</td>
<td>I am updated at least daily about my team and my own performance</td>
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<tr>
<td>34</td>
<td>I frequently join other teams (outside my own) to help solve problems</td>
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<td>35</td>
<td>Floats / sachet etc. is only produced as per customer demand and orders</td>
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<tr>
<td>36</td>
<td>The workplace is well organised. No time or effort is wasted in searching for things needed to do my job</td>
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<td>37</td>
<td>My workstation is comfortable and well designed to perform my duties (no bodily strain)</td>
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<tr>
<td>38</td>
<td>I am often delayed because of waiting for someone to check or scrutinise my work</td>
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<td>39</td>
<td>I am often delayed in doing my job because of rework (e.g. Tracing differences)</td>
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<td>40</td>
<td>Production problems or obstacles are thoroughly solved before we continue work.</td>
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<tr>
<td>41</td>
<td>The same mistakes are often repeated, causing repeat customer queries or complaints</td>
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<tr>
<td>No.</td>
<td>Question</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Uncertain / Neutral</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
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<tr>
<td>42</td>
<td>I understand the required rate of production in order to meet the customer demand (floats, sachet etc.)</td>
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</tbody>
</table>

Please note any additional comments