CRITICAL SUCCESS FACTORS FOR THE IMPLEMENTATION OF LEAN THINKING IN SOUTH AFRICAN MANUFACTURING ORGANISATIONS

Thesis by

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ABSTRACT

The point of departure of this study is that South African manufacturing organisations are far from being competitive in world-class terms, and that lean thinking has become a strategic necessity for many South African manufacturing organisations that want to compete successfully in today's globalised economy which is characterised by fierce competition.

However, even amongst the pioneers and advocates of lean thinking there is uncertainty as to the reasons why lean sometimes fail or do not achieve the same results as is the case at Toyota, the organisation that pioneered lean thinking as a business management strategy. Given the former stated problem the primary objective of this study is to identify the critical success factors for the successful implementation of lean thinking in South African manufacturing organisations.

The literature study conducted identified the theoretical critical success factors, the independent variables in this study, as mindset and attitude; leadership; ordinary employees; strategic driver; basic stability; promotion office; lean tools and techniques; and integration. The indicators of lean thinking success, the dependent variables of this study, were identified as cost reduction and customer satisfaction.

A convenient sample was used to collect primary data by means of a self developed questionnaire or measuring instrument. A factor analysis of the data yielded 5 critical success factors, which were labelled as philosophy and principles; people or soft issues; basic stability; strategic driver; and promotion office.

The research further revealed that lean thinking has a very low success rate in South African manufacturing organisations (thereby justifying the reason for this study); that senior leadership has the biggest impact or influence on the sustainable success of lean thinking; and that trade unions are considered to have a limited positive impact on successful lean implementation.

The emerged factors were interpreted and operationalised, and translated into practical recommendations for the successful implementation of lean thinking in South African manufacturing organisations. The most important recommendations relate to the role of people and leadership in a lean transformation; finding of an experienced facilitator; and lean thinking as a strategic driver.

Recommendations for further research include the role of, and skills required by the human resources function and practitioners in a lean thinking organisation; and lean thinking training on tertiary level in South Africa.

The study thus has theoretical, practical and methodological value for successful lean thinking implementation in South African manufacturing organisations.

STATEMENT

I certify that the dissertation submitted by me for the degree Doctor Commercii (Strategic management) at the University of Johannesburg, is my independent work and has not been submitted by me for a degree at another university.

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THEODORUS DANIEL VERMAAK

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“The bravest sight in all this world is a man fighting against all odds.”

- Franklin K. Lane

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CHAPTER 1

INTRODUCTION TO STUDY

1.1 INTRODUCTION

The National Productivity Institute (NPI, 2007) reports that good economic performance, supported by continued productivity growth (3,2% per annum increase in private sector productivity since 1996) has changed the course of South Africa's position in world competitiveness. The turnaround can largely be ascribed to superior economic performance based on sustained productivity growth. It is thus argued by the National Productivity Institute that this continuous rise in productivity performance has laid the supporting structures for South Africa's improved international competitiveness.

It could thus be argued that the South African economy is in a relatively healthy state. So, it could therefore also be argued that there is no burning platform forcing drastic actions, except for some industries like textiles. This argument is however not entirely true as more and more industries are slowly but surely starting to feel the threat from India and particularly China with their low labour cost operations; economies of scale advantages; subsidies; less restricted labour laws; huge trade surpluses; and no corporate and social investment, broad based black economic empowerment and employment equity requirements. The argument should thus be that the total South African manufacturing sector is under threat as import duties, for one, are coming down on a broad spectrum of products.

In support of the latter argument it is clear that despite the growth in productivity mentioned above, the actual level of productivity in South African manufacturing organisations is far from being competitive in world-class terms. Mokopanele (2007) reports that although South Africa is Africa's most competitive country, South Africa has slipped in the 2007 World Economics' Global Competitive Index from 36th position in 2006 to 44th in 2007. He concludes that: "SA's slide down the rankings comes in

spite of the country experiencing its strongest economic growth in decades and what analyst says is a fundamentally sound economy. Yet, the findings suggest SA is failing to keep pace with its rivals." This survey results back the misgivings about South Africa's export competitiveness expressed by Finance Minister Trevor Manual in his 2007 mini-budget statement to Parliament. Manual said: "SA should not try to hide behind protectionist measures."

Further support of the view that South Africa is not competitive is provided by the report of Naidoo (2006) that: "International and local experts is of the opinion that SA was losing the battle to compete with other developing nations in global markets, mainly as organisations struggle with best practice implementation", which is "…harming economic growth and job creation efforts in the country".

There is thus a huge opportunity for improvement in South African manufacturing organisations; it could even be argued that there is a definite burning platform in this regard, requiring immediate and focused action.

South African manufacturing organisations must furthermore take cognisance of Robinson (1991:185) when he cautions that as long as prosperity continues, the waste within the organisation remains hidden. It is these wastes that add to the costs, and reduce profits and operational efficiency. Collins (2001:1) concurs and state that good is the enemy of great, the vast majority of companies never become great, precisely because the vast majority become quite good.

Wickens (1998:53) warns that mature industrial societies are subject to many long-term and fundamental macro changes – global competition, accelerating technological change, a shift from manufacturing to service and from the collective to the individual, and changing employment status – all of which are having a major impact on the behaviour of organisations. Competitive advantage based on products and technology is rarely sustainable and high quality is now taken for granted. Mature economies, furthermore, cannot compete with the emerging countries on cost and price, and are increasingly producing or buying where costs are lowest while maintaining established brand names. The result is that continued success for mature economies depends

increasingly on quality, price, innovation and speed to the market. Organisations who are contend to continue in the same old way will, with few exceptions, lose out as there is no longer any place to hide. All organisations are subject to the performance of the best, wherever they are in the world.

The above-mentioned warning is very much applicable to the South African economy, and as such to manufacturing organisations within the South African economy. A Grant Thorton survey (Temkin, 2006), for example shows that 21% of South African business owners have attributed the decrease in their output to China's economic growth. China was perceived as the biggest threat to business by 28% of business owners, and 35% of manufacturing sector organisations regard China as the greatest threat.

Davies (2006) believes that China represents the greatest threat to manufacturing in traditional and emerging markets alike as China's export growth routinely tops 20% a year, resulting in the developed world continuously running mounting trade deficits with China. The Department of Trade and Industry (2008) recorded South Africa's trade deficit with China as R32,7 billion for 2006, in 1996 the deficit was a mere R1,6 billion.

Hazelhurts (2006a) adds more fuel to the argument that the South African manufacturing sector is under threat by contending that there has been shifting patterns of consumer behaviour in South Africa – partly driven by lifestyle changes and partly by rapid advances in a wide range of technologies. These changes have furthermore been accompanied by the opening of South Africa's economy to global competition. Goods made locally now have to compete with those made in all parts of the world, and many South African manufacturers have been unable to rise to the challenge.

The Kaufman Global Group (2003b) is of the opinion that every industry in the world is facing the same challenge of providing superior quality products or service, at a competitive cost, and in a shorter delivery interval than their competitors. The product or service should also have the operational capabilities that satisfy a specific

customer's need.

Whereas in the past in the closed or protected South African economy price was equal to cost plus the margin desired by the organisation (in other words the organisation could to a large extend determine the price and profit margin), in the new open and largely unprotected South African economy the equation now reads profit is equal to price (as determined by the market and competitors) minus costs. The organisation's only sphere of influence or control in its efforts to survive thus relates to costs, of which manufacturing costs make up a substantial portion.

Given the scenario described above, Donovan's (2005b) opinion that manufactures must become faster and more nimble than was needed in the past is as applicable, if not more, to South African manufacturing organisations. Offshore competition is getting fierce and customers have become much more demanding and have higher expectations than in the past. Many organisations are now feeling the pressure to "… more aggressively pursue lean thinking or world best practices to avoid the risk of losing business to lower cost and faster performing competitors. As a result, more manufacturers are returning to lean thinking techniques to drive out waste and to dramatically improve on cycle time, productivity, inventories and delivery". The essence of the concept lean is defined and discussed in more detail in the Chapter 2.

The above notions that lean as a business management strategy is the answer for the Western World (and as such also South Africa which competes in the same markets) to compete in the global market, is supported by a number of authors.

Wickens (1998:46 & 57), for one, reports that Japanese production systems (which is lean) have over the last thirty years or so achieved higher quality and productivity levels than those of the Western World, but in many respects the Western World have now learned from the best of Japanese practices and is catching up, and concludes that lean is a valuable concept from which the Western World can greatly benefit.

The pioneers of lean, Womack and Jones (2003:28, 245, 269 & 245) states that lean is spreading rapidly to all regions of the world as lean and the lean enterprise is the

solution immediately available that can produce the results on the scale required to compete in the global market; especially as lean has shown to dramatically boost productivity, while dramatically reducing errors, inventories, on-the-job accidents, space requirements, time-to-market for new products, production lead times, the cost of extra product variability, and costs in general.

Rink (2005b), in a similar vain, submits that there is little doubt that lean will continue to spread in the years to come as many manufacturing organisations are just starting to see the benefits of lean and even those that are considered lean leaders today realise that they have just scratched the surface of opportunities offered by lean.

The Kaufman Global Group (2003a) is of the same opinion in stating that as world markets continue to heat up and competition among over-capacity industries becomes even more brutal, lean will remain in the forefront of business strategies for years to come. By 2010 organisations will either be embracing lean in all its manifestations, or they will have been left behind. As such: "While almost all organisations are moving at their own pace towards lean thinking in some way or another, many organisations are wasting valuable time: time that can never be recovered if the competition is moving even a little faster and smarter towards lean thinking."

Womack, Jones and Ross (1991:8 & 225) concludes that in the process of researching their seminal work *The Machine that Changed the World* they've become convinced that the principles of lean can be applied equally in every industry across the globe and that the conversion to lean will have a profound effect on human society – it will truly change the world, and "…it follows that the whole world should adopt lean thinking, and as quickly as possible".

Willats (2005) goes one step further and submits that today the effectiveness of lean has been well established. Organisations from different industries in every corner of the world have proved that the lean principles are well founded. By posting record profits, while laying the basis for further growth, these organisations, led by Toyota, reveal the promise of lean. Jones (2003a) is of a similar opinion, stating that lean has stood the test of time. Despite the passing fashions of business reengineering in the

early 1990's, total quality management and agile manufacturing in the mid 1990's and more recently, enterprise resources planning and the e-bubble, manufactures and consultants keep returning to lean as a business management strategy.

Ultimately, the effectiveness of lean is proved beyond any reasonable doubt by Toyota, the organisation that pioneered lean. In 2005 Jones (2005b) predicted that in 2006 Toyota will almost certainly overtake General Motors to become number one in the global car industry, eclipsing what was once the largest industrial enterprise in the world. Such a triumph by Toyota will have a huge effect on every industry across the respective industries. Toyota's triumph will accelerate the growing interest in lean; triggered by the endorsement from General Electric in 2005 that lean is the way forward for General Electric. Jones's prediction proved to be correct as Greimel (2007) reports that in the first quarter of 2007 Toyota for the first time overtook rival General Motors as the world's top car seller. It is claimed by Ahrens (2006:10) that lean has helped Porsche to increase its operational results from a negative €122 million in 1994 to a positive €933 million in 2004.

The Aberdeen Group (2006a) is also of the opinion that lean has revolutionised the way that many leading organisations deliver products to their customers and manage their supplier relationships, and that over the past few years the use of lean has expanded well beyond the automotive industry to delivering dramatic results into other sectors including aerospace, consumer goods, and industrial equipment, among others.

It thus appears that lean (as defined in the next chapter) has become, for many organisations, a competitive necessity, which, if correctly executed, can produce impressive results. In short, lean has in recent times gained recognition as a business management strategy to achieve a competitive advantage for many organisations.

Lean thus holds great potential to achieve a competitive advantage for those organisations that effectively apply the lean principles, tools and techniques; conversely, there are deep pitfalls for those organisations that attempt to use this powerful strategy without a thorough knowledge and understanding of the success

factors, especially the critical success factors, of lean. Willats (2005) agrees and states that while some leaders appear enthusiastic and confident, for many others the reality of practicing lean is a daunting task.

It is thus submitted that the key to the growth and success of lean in South African manufacturing organisations is a scientific and professional approach to the implementation and operationalisation of lean, which should, inter alia, be based on a good body of knowledge of the critical success factors for sustainable lean transformation particular to the South African situation.

1.2 PROBLEM STATEMENT

A research question or problem should indicate a specific query that needs to be addressed by the research project. The question than sets the parameters of the project and suggests the methods to be used to gather data and the analysis thereof (Strauss & Corbin, 1998).

Balle (2005) states that one of the most vexing and enduring puzzles of lean is that, although many organisations try to go lean, few succeed, especially in the way Toyota did. Drew, Mc Callum and Rogenhofer (2004:7&47) asks that if lean is such a powerful approach and Toyota models it so well, why is it that so few organisations are able to implement lean successfully? Operational performance programmers have earned a bad reputation as they tend to fail. Many deliver temporary gains, but few succeed in sustaining the early benefits, and fewer still manage to establish a genuine culture of continuous improvement. In most cases, operational performance either slips back to the old levels or stagnates to history, joining a host of previous efforts in the organisation's archives. The former begs the question, why is this?

Donovan (2005b) concurs that lean, in most cases, never achieved what it could and should have, in other words the lean implementation was never effective at all. On a lean success scale of one (not successful) to ten (successful), 90% of the organisations with lean implementations would not score higher than three and only

10% would score eight or higher. Donovan (2005a) further states that in many cases, despite heavy investment, organisations have failed to achieve the benefits from lean they should have, based on the investments made.

The above stated views that there are many unsuccessful lean implementations have been noted by a number of other authors.

Rink (2005a), for example, reports that 90% of the 3000 organisations in an Industry Week Consensus survey conducted amongst United States manufacturers reported that they had lean implementations underway. However, only 10% felt that they were achieving the desired results. Research conducted by the Aberdeen Group (2006b) concurs with the above findings in that about 20% of the 292 respondents to their research were actually succeeding with lean implementation.

The Kaufman Global Group (2003a) submits that while few managers are experts in all the tools and techniques of lean, most are familiar with the meaning and mechanics of many of the lean tools and techniques. Yet, despite this familiarity, comparatively few organisations are implementing lean successfully.

Alukal (2006) came to the conclusion that it would appear that lean is easily understood, but sustainable implementation is more difficult to accomplish. Anderson-Ackerman and Anderson (2002a) state that business process reengineering (under which they classify lean) is an organisation wide solution that carries high expectations for cost savings, productivity increases, and significant business results - yet lean fails to produce its intended return on investment.

In a similar vain Smalley (2006) reports that despite the well published triumphs, many organisations get stuck in the initial lean implementation efforts.

Finally, Balle (2005) concludes that many lean implementations are disproportionately rich in lean information and theory, and equally poor in sustainable shop floor results, employee involvement and financial performance.

From the above stated it would appear that there is still uncertainty as to why there are so many lean implementation failures, also that the critical success factors for the successful implementation of lean are not fully understood, or worse not identified at all.

As mentioned in the previous section, the lean business case is definitely there to be made, and substantial benefits can rapidly accumulate. Parker (2003) states that: “One way or another, the concept of lean thinking appears to be here to stay, and now the issue is how best to understand and utilize it.” Donovan (2005a) concurs that, done right, a lean transformation can reinvigorate and strengthen an organisation to its core, but, the key significant success with lean implementation is to do it right, quickly and complete, and to do it that way the first time.

Mecer Management Consultants (2006) cautions that there are different ways to implement lean, and taking the wrong path can severely disrupt an organisation without yielding an appropriate return: “If we get it right, it can be amazingly powerful, but it’s also terribly fragile. If we break it, we won’t get a second chance.”

Jones (2005b) sums up the above stated problem in submitting that organisations still have a lot to learn about implementing lean, and asks why, when the benefits are so demonstrably significant is more organisations not making faster progress with lean, and what have organisations learned over the years about what works and what does not? Passionate and experienced lean advocates are also deeply frustrated as many of their efforts disappeared into the sand. Jones (2005b) concludes that time has come to begin to debate what still have to be done to roll lean out across the world much faster and more successful: “Seeing the possibilities opened up by lean thinking is one thing – making it happening is another.”

The problem thus is that even amongst the pioneers and advocates of lean, there is uncertainty as to the reasons why lean implementations sometimes fail, and as such what are the critical success factors for the successful implementation of lean.

Given the above stated as well as the apparent low rate of successful lean

transformation in organisations, the identification of the critical success factors for lean implementation becomes critical, especially in the light of the statement by Faull and Whelan (2003): "What is clear is that the increasingly competitive environment demands that organisations increase their track record in implementing operations strategy."

Womack and Jones (2003:281) raise a secondary problem by asking if it is actually possible to apply lean anywhere in the world, as after all "…the various industrial traditions are very different". Taiicho Ohno, the pioneer of lean at Toyota, could develop the general case for flow and pull thinking by applying Ford's special case ideas to all types of economic activity, and it can be seen that the ideas themselves work everywhere, but is it really reasonable to propose universal organisational rules for creating value by means of lean? Womack and Jones (2003:281) think it is and that it's essential to try, but cautions that the examples of lean implementations have shown that the transitional problems will be different in different places.

It is thus argued that customisation of lean is needed for each country and organisation, in other words the unique circumstances or needs in South African manufacturing organisations must be determined and also considered in an attempt to identify the critical success factors for lean implementation in a South African manufacturing context.

The Kaufman Global Group (2003b) seems to support the above stated problem as it contends that: "Each lean thinking implementation must be developed on-site, adapted by the people to mesh with all the nooks and crannies of the organisation." It would appear that while the basic principles of lean (as discussed in Chapter 2) are the same in any organisation, each implementation is unique. An example cited by Womack and Jones (2003:189) is where lean was combined with the German tradition, embodied by the concept of superior technology, or *technik*, a remarkably competitive hybrid emerged.

There are, furthermore, no authoritative statistics on the scope and size of the application of lean in South African manufacturing organisations, nor on the success

and failure rates of lean implementations in the South African manufacturing sector.

From the above stated it is clear that despite lean's size and growth it is unfortunately true that many lean implementations are not successful or sustainable. The reasons why organisations implement lean, the benefits to be derived from lean, as well as the tools and techniques of lean have been well researched and documented. However, little is known about the reasons for failed lean implementations, how to avoid the pitfalls and what to do to ensure the success of lean in a South African manufacturing context.

Based on the above premises the identified problem statement of this study is that there is still uncertainty as to what are the critical success factors or variables that will ensure the success of lean as a business management strategy in South African manufacturing organisations.

1.3 OBJECTIVES OF THE STUDY

The business environment poses many challenges to business leaders. These challenges can only be responded to in a meaningful manner if management has available sufficient and reliable information. Research forms a very important source of such valuable and reliable information managers need to set strategic direction and make sound business decisions.

Emanating from the problem statement formulated in the previous section, the primary objective of this study is to identify and empirically assess the critical factors or variables that influence and eventually determine the successful implementation of lean as a business management strategy in South African manufacturing organisations. In other words, the question to be answered is what are the critical success factors for sustainable lean implementation?

The focus of this study is on the manufacturing sector only as other sectors, services and health for example, may due to the nature of the sector, have different critical

success factors.

It is accepted that there are a large number of factors or variables that are necessary for successful lean implementation, however, only a few are critical. These factors must be addressed and addressed correctly or the lean implementation will not be successful, they are not optional. Liker and Meier (2006:142) is in agreement, defining critical as something that must be followed with a high degree of accuracy, failing which a defect will occur. The key to successful lean implementation is thus to identify the critical factors and to take special care to ensure they are fully complied with. The primary objective is thus to not only identify the general success factors but to correctly identify the critical success factors for successful lean implementation.

Based on the empirically tested critical success factors and the result of the literature study a secondary objective, namely to make practical recommendations for the successful implementation of lean in South African manufacturing organisations, will be pursued.

As part of the exploratory research three more secondary objectives, namely the general success of lean in South African manufacturing organisations, the impact of the various employee groupings on successful lean implementation, and the impact of trade unions on successful lean implementation will also be assessed.

1.4 CONTRIBUTION OF THE STUDY

This study attempts to identify the critical factors or variables that influence and eventually determine the successful implementation of lean as a business management strategy in South African manufacturing organisations. As such the most important contribution of this study is that the critical factors or variables that determine the likely success of lean in a South African manufacturing context are identified and their relative influence on the success of the lean implementation process quantified. In so doing the study adds to the established body of knowledge, more specifically as applicable to the South African manufacturing sector. The results

of the study will allow for viable conclusions to be drawn, which should help manufacturing organisations to successfully implement lean.

Secondly, practical recommendations, based on empirically tested research, are made for the successful implementation of lean in South African manufacturing organisations. These recommendations should lead to more successful lean implementations in South African manufacturing organisations, resulting in these organisations being better able to compete globally, and as such contribute to the growth of the South African economy.

Furthermore, the general success of lean as a business management strategy in South African manufacturing organisations, as well as the impact of trade unions on lean implementation, is measured and quantified, providing empirically tested statistics in this regard.

It is anticipated that insights developed in this study will have theoretical, practical as well as methodological value for the successful implementation of lean in South African manufacturing organisations.

1.5 LEAN IN A BUSINESS MANAGEMENT CONTEXT

This study is conducted in the study field of Business Management. As such it is necessary to define the scope of the subject Business Management in order to establish how lean contributes to the realisation of its core concept, namely the economic principle.

1.5.1 The scope of Business Management

Business Management has been described as the subject that scientifically studies how an organisation can operate in the best way, in order to provide the customer with the desired goods and services so that the organisation can also achieve its financial

(and other) goals (Marx, Van Rooyen, Bosch & Reynders, 2001).

The subject of Business Management encompasses all the activities that are related to the management of all types of organisations. The core principle of Business Management is to transform so-called inputs by means of functional business processes to outputs in a value chain approach. This statement offers a very broad demarcation of the discipline, and encompasses various types of businesses and various forms of business ownership. Business Management, as a field of study is thus concerned with the management aspects of inputs, the conversion process, and the outputs (Nieman & Bennett, 2002:40).

The above descriptions place the concept of lean within the study field of the subject Business Management, as lean impacts on the functional business processes that convert inputs into outputs, aimed at realising the economic principle. The most efficient way in which economic value is added at every stage of the conversion process is the focus of lean. It is in this value adding context where lean fits into the field of Business Management, as lean is a management strategy designed to ensure that the potential value of the output is maximised, as well as the elimination of all forms of waste and non-value adding activities (thus maximising the use of scarce resources).

1.5.2 The functional areas of Business Management

The management of an organisation, whether uncomplicated or sophisticated, involves various functional areas of management. Each of these areas should receive careful managerial consideration, although they are not all of equal importance in all organisations. Typical functional areas are purchasing and materials management, production and operations management, marketing management, financial management, general management, human resources management, corporate communication and e-management (Nieman & Bennett, 2002:4).

These functional areas, although identifiable separately, cannot be separated as

independent silos. They work together in an integral manner to achieve the goals and objectives of the organisation, by each playing a role in the value chain. It is in these functional areas, and especially in the production or operations management function, that lean impacts on the management of the organisation, and thus the study field Business Management.

1.5.3 The concept competitive advantage

In order to survive and prosper in a competitive market an organisation has to obtain a competitive advantage over its competitors. Competitive advantage implies organisations that are able to satisfy customer needs more effectively than their competitors.

Annis (2006) states that in today's global markets, the need to continuously identify and achieve a competitive advantage has never been greater. Sound, practical strategies and methodologies for achieving these objectives have been catapulted to the top of the corporate agenda. And while much has changed on the global business landscape one truth remains: "While an organisation's near-term competitiveness depends largely on economic cycles, relationship management, and product leadership, over the long-term it is the quality, speed and effectiveness of the delivery mechanisms, both internal and external, that separates the good from the great." Simply stated the objective is to generate maximum value from the customer's perspective, while consuming the fewest resources and therefore delivering a premium return to all stakeholders.

The competitive advantage can be obtained by adding value for customers in ways that differentiate the organisation from its competitors. In order to develop a competitive advantage it is necessary to examine all aspects of the organisation (Nieman & Bennet, 2002:14). In other words, all the organisation's functional areas and processes must me examined for their effectiveness and contribution towards customer value with a view to find more effective or alternative ways in which it could be performed.

Considering the philosophy and principles of lean (as described in Chapter 2) lean can, or has the potential to, impact on all functional areas of the organisation, and it could provide the organisation with a competitive advantage, as Toyota has clearly shown, placing lean within the scope of the subject Business Management.

The study of business management entails comprehensive ongoing research and examination of management problems, the testing of approaches and principles, experimentation with methods and technology and continues weighing up of environmental variables (Cronje, Du Toit, & Motlatla, 2004). Given the stated objectives of this study it is clear that this study falls within the domain of the subject Business Management, as described.

1.6 RESEARCH DESIGN AND METHODOLOGY

A research project does not exist in isolation, but must build upon what has been done previously. Therefore, before embarking on a project, a researcher should review previous work in the field. A literature review, used in the widest sense of the word, that involves the identification and analysis of information sources and/or literature related to the research project is conducted. This process includes identifying potential relevant sources, and the construction of an account that integrates and explains relevant sources. The review puts the research project into context by showing how it fits into a particular field. The objectives of such a literature review are to identify knowledge gaps and developing a research problem; to identify a theoretical framework; to identify issues and variables related to the research topic; to identify conceptual and operational definitions; and to identify research methodologies (Terre Blanche, Durrheim & Painter, 2006:19).

This study will accordingly commence with a literature review, which will be reported on in the chapters to follow.

The insight developed in the literature study of lean and related operational improvement initiatives or programmes, as well as the literature study of project

management, change or transformation management, and the empirical study into the reasons why some organisations moved from good to great and others not, conducted by Collins (2001), will firstly be used to identify and compile a list of hypothesized requirements for successful lean implementation in South African manufacturing organisations, that is the perceived critical success factors that could possibly influence the successful implementation of lean as a business management strategy. These factors were modelled as the independent variables.

A number of theoretical indicators of successful implementation of lean in South African manufacturing organisations were identified. These factors are closely related to the advantages or benefits of lean and were modelled as the dependent variables.

The theoretical requirements for successful lean implementation and the theoretical success indicators of lean implementation identified were than used to develop propositions, from which the hypotheses for empirical study were compiled.

The study will thus be done with quantitative methods based on the establishment of a measurable model. Quantitative research, as per Terre Blanche *et al.* (2006:47), collects data in the form of numbers and use statistical types of data analysis. Neuman (1994) submits that quantitative research uses deductive reasoning, and takes universal propositions and generalisations as a point of departure.

Schurink and Schurink (2001) contends that in terms of methodology the quantitative paradigm emulates the physical sciences in that questions or hypotheses are stated and subjected to empirical testing to verify them, in contrast qualitative methodology is dialectical and interpretative.

The research will be exploratory in nature. According to Terre Blanche *et al.* (2006:44) exploratory research is used to make preliminary investigations into relatively unknown areas of research. Exploratory research employs an open, flexible, and inductive approach to research as it attempts to look for new insights into phenomena. Speculative insights are generated, new questions asked, hypotheses set, and casual explanations of phenomena provided. The formulation of the propositions and

hypotheses, as well as other research questions of this study, is dealt with in Chapter 8.

All variables were subjected to an empirical study in a pencil and paper – type survey by asking respondents what their actual experiences are. In other words, a questionnaire was sent to respondents and they were required to indicate, based on their actual experiences, the influence the independent variables will have on the dependent variables.

The survey also assessed three of the secondary objectives, namely the success of lean in South African manufacturing organisations, the impact of the various employee groupings on lean success, and the impact of trade unions on the success of lean.

Sufficient and reliable or credible material from a variety of sources and authors were available for the literature study.

1.6.1 Sampling

The survey assessed practical experience and knowledge, instead of perceptions; therefore the sample population was required to be knowledgeable and experienced in the implementation of lean in the manufacturing sector.

Womack and Jones (2003:148) is of the opinion that three years is about the minimum time required to put the rudiments of a lean implementation fully in place, and two more years may be required to teach enough employees to see that the lean implementation becomes self-sustaining. Roper (2004) agrees and states that an acceptable level of lean success requires incredible focus and discipline over an extended period of time (50 years for Toyota). For Rink (2005a) the absolute best case for a small, focused organisations that have already started lean would be about one year, a more typical amount of time would be two to three years. As it can thus be argued that it generally takes two to five years to implement lean, only individuals with this length of practical experience were included in the study. For this purpose a

qualifying question was included in the questionnaire. Obviously this qualifying criterion to some extend restricted the sample population.

As the study was conducted in a South African manufacturing context, thus excluding other sectors or countries, the target population was further defined as individuals with two or more years of practical experience in implementing lean in a South African manufacturing organisation. A qualifying question was included in the questionnaire for this purpose. This South African manufacturing sector only focus obviously restricted the sample population even further.

The respondents however included respondents from all the functional areas in the organisation, all levels of management and operational employees, as well as consultants and academics with the relevant experience, which to some extend negated the limitations or restrictions to the sample population mentioned above. Questions to establish the respondent's functional areas and level in the organisation were included in the questionnaire.

In South Africa there are a number of improvement programmes that are based on or very closely related to the lean philosophy and principles, as well as utilising the same tools and techniques. These programmes are used by many organisations as a platform for lean implementation. For the purpose of this study experience in some of these programmes were considered as having sufficient experience with lean for inclusion in the sample population. These programmes are the 20 Keys programme of Iwao Kobayashi and Organisational Development International, the Mission-Directed Work Teams programme of Competitive Dynamics International and the TRACC programme of Competitive Capabilities International.

The names and contact details of potential respondents were obtained from the client base of consulting organisations mentioned above; delegates to the Lean Summit Africa conference in Cape Town; as well as from the persons responsible for the implementation of lean in organisations known to have implemented lean. Questionnaires were sent via e-mail and addressed to the individual by name, which facilitated follow up to ensure a maximum response rate.

1.6.2 Data collection

The measuring instrument or questionnaire developed for the empirical study was a pencil and paper format, asking respondents to indicate their actual experiences on a 7-point Likert scale. The questionnaire items were self-developed and based on the literature study, the theoretical success factors and success indicators identified, as well as the propositions and hypotheses developed.

1.6.3 Data analysis

The particular statistical procedures were selected for their suitability to test the research hypotheses of the study. These procedures include descriptive statistics, factor analysis, analysis of variances and measures of association. The Statistical Consulting Services (STRATCON) of the University of Johannesburg conducted the analysis.

The data relating to the primary objective was subjected to an exploratory factor analysis to assess the discriminate validity of the measuring instrument. The exploratory factor analysis was followed by an assessment of the reliability of the instrument by means of an internal consistency measure, Cronbach Alpha. An attempt was than made to subject the constructs that emerged to a regression model in order to assess the impact of the independent variables on the dependent variables, and as such to test the stated hypotheses. The regression model could, for a number of reasons, not be concluded.

The data relating to the secondary objectives were analysed by way of the recorded mean scores and frequency of the questionnaire items.

1.7 DEFINITIONS OF MOST IMPORTANT TERMS

BUSINESS MANAGEMENT – The subject that scientifically studies how an

organisation can operate in the best way, in order to provide the customer with the desired goods and services so that the organisation can also achieve its financial (and other) goals (Marx *et al.*, 2001).

LEAN THINKING – Lean thinking is an integrated set of principles, practices, tools and techniques designed to address the root causes of operational underperformance. It is a systematic approach to eliminating the sources of loss from entire value streams in order to close the gap between actual performance and the requirements of customers and shareholders. Its objective is to optimise cost, quality and delivery while improving safety. To meet this objective, lean tries to eliminate three key sources of loss from the operating system: waste, variability and inflexibility (Drew *et al.*, 2004:6).

SUCCESS FACTOR – Factor or variable that influences and eventually determines the successful implementation of lean as a business management strategy in South African manufacturing organisations.

SUCCESS INDICATOR – Factor that indicates that the lean intervention in a South African manufacturing organisation has been successful.

1.8 REPORTING – SCOPE OF THESIS

The dissertation consists of a theoretical section, which is the analysis of the theory of lean, and the research section.

In pursuit of the primary objective of the study a number of elements that could possibly influence the successful implementation of lean in South African manufacturing organisations as a business management strategy, as well as the elements that could indicate the actual successful implementation of lean are identified, and indicated as such in all the chapters reporting on the literature study.

Chapter 2 presents the results of the literature study into the scope and nature of lean.

It covers the scope and definition of lean, lean as a competitive business management strategy, and the basic principles of lean.

The various tools and techniques associated with lean are introduced in Chapter 3.

Chapter 4 deals with the so called soft or people related issues, and includes the role of training and development, mindset and attitude, leadership, trade unions, remuneration and the facilitator or change agent in successful lean implementation.

In Chapter 5 a number of issues and concepts relevant or impacting on lean implementation are considered. The chapter includes issues that are unique to the South African situation.

There are a number of other related or derivative improvement programmes which could also shed some light on the critical success factors for lean implementation, for example change management, 6 Sigma, Theory of Constraints, Total Quality Management and 20 Keys. These programmes are dealt with in Chapter 6.

Chapter 7 presents the various models or guidelines for the successful implementation of lean as a business management strategy as it should further assist with the identification of the theoretical critical success factors or independent variables for the empirical research.

Chapter 8 covers the research design and deals with the compiling of the propositions and the setting of the hypotheses, as well as the development of the questionnaire.

The results of the empirical research, which includes the various statistical procedures followed, and main observations are documented in Chapter 9.

Chapter 10 integrates all the aspects documented in the study by interpreting the results of the empirical research, making practical recommendations for successful lean implementation, and proposing topics for further research.

1.9 CHAPTER SUMMARY

Lean offers solutions to many of the problems and threats faced by South African manufacturing organisations in their quest to become globally competitive, or just to survive in the global market. As such more and more South African manufacturing organisations are considering implementing lean as a strategic business management option. Lean could provide South African manufacturing organisations with a competitive advantage, thus placing the concept of lean in the domain of the subject Business Management.

In pursuit of the primary objective of this study, namely to identify the factors or variables that influence and eventually determine the successful implementation of lean as a business management strategy, it is necessary to understand the scope and nature of lean. The next chapter will consider the concept lean in sufficient detail to identify these potential or theoretical success factors, in other words the basics of lean will be analysed.

CHAPTER 2

SCOPE AND BASIC PRINCIPLES OF LEAN

2.1 INTRODUCTION

Lean has entered the everyday language of operations – so much so that a whole range of operational improvement programmes is, rightly or wrongly, commonly labelled as lean. As a result, lean means different things to different people.

Wickens (1999:77) warns that so often companies undertake a change programme without really understanding what it is about nor what it entails and, as a result, they are surprised at the amount of hard work it takes to implement, and cannot believe that the outcomes of the programme are not what they initially thought it would be.

It would thus appear that a sound understanding of the scope and basic principles of lean, that is the theoretical underpinnings, is essential. For the purpose of this study, however, an in-depth or technically detailed understanding of lean is not considered to be needed as the primary objective of the literature study is to identify the potential or theoretical success factors that could influence successful implementation of lean for empirical testing. The lean philosophy, scope, principles and techniques will thus be described in just enough detail to identify the potential or theoretical success factors, as well as to see how it fit into the broader concept of lean.

In this chapter lean will firstly be defined, where after it will be considered as a competitive business strategy. The basic principles of lean developed by Womack and Jones (2003) in their seminal work *Lean Thinking* will be presented, followed by the model developed by Liker (2004) and the views of a number of other authors.

2.2 LEAN DEFINED

According to Drew *et al.* (2004:6) lean is an alternative to mass production (that is the Henry Ford way), not a complement to it. Lean calls for a completely different way of operating, and for a completely different way of thinking about operations. Lean is not compatible with large-batch production; instead the pace, mix and quality of production is set by the customer. Mass producers set themselves limited goals: an acceptable number of defects, a tolerable level of inventories, and a narrow range of standardised products. Lean producers, on the other hand, aim for perfection: continually declining costs, zero defects, zero inventories and endless product variety.

What Toyota did was to develop an operating system that didn't depend on the economies of scale of huge economic markets. Instead Toyota developed a culture, organisation and operating system that relentlessly pursue the elimination of waste, variability and inflexibility. To achieve this end, Toyota focuses its operating system on responding to demand, and nothing else. Which in turn means that the systems have to be flexible; when there are changes in demand, the operating system must respond immediately. Put simply, as per Drew *et al.* (2004:6), "…lean is an integrated set of principles, practices, tools and techniques designed to address the root causes of operational underperformance. It is a systematic approach to eliminating the sources of loss from entire value streams in order to close the gap between actual performance and the requirements of customers and shareholders. Its objective is to optimise cost, quality and delivery while improving safely. To meet this objective, it tries to eliminate three key sources of loss from the operating system: waste, variability and inflexibility."

Womack and Jones (2003:6&15) describes lean as: "The most powerful tool available for creating value while eliminating waste in any organisation". Lean provides a way to specify value, line up value-creating actions in the best sequence, conduct these activities without interruption whenever someone request them, and perform them more and more effectively. In short: "Lean thinking is lean because it provides a way to do more with less and less – less human effort, less equipment, less time, and less

space – while coming closer and closer to providing customers with exactly what they want."

For Womack (2005) lean always begins with the customer who wants value, that is the right good or service at the right time, place, and price, with perfect quality. To maximise this customer value, the steps in the process must be performed with zero waste. To achieve this zero waste, every step in a value-creating process must be adding value, capable, available, adequate, and flexible, and the steps must flow smoothly and quickly from one to the next at the pull of the downstream customer: "A truly lean process can thus be regarded as a perfect process: perfectly satisfying the customer's desire for value with zero waste." However, no such perfect process exists. Despite the former stated lean thinkers still believe in perfection, a never-ending journey toward the truly lean process.

Jones (2004b) describes lean as a business system focused on managing processes and improving them by compressing time rather than keeping each of the assets busy, whilst the Kaufman Global Group (2003c) is of the opinion that lean has become a generic term for pull (as opposed to push) system of manufacturing/operations and the great many tools and methods that support it.

For Wickens (1998:46) lean is much more than simply eliminating waste. The whole value stream has to be integrated and organised on lean principles, bringing products and services from initial concept to delivery to the customer, across all the different organisations, activities and functions that may be involved. Lean requires developing the concept of partnership sourcing leading to much greater supplier capability, particularly in the field of product development and engineering. Lean requires a sharing of the profit and the pain; being prepared for open book costing and working together for mutual benefit. Exactly the same principles extend forward to the distribution chain and eventually to the end customer orders, so that the whole system is driven by end customer orders which are quickly incorporated into the production schedules.

It would thus appear that lean is more a way of life than a programme.

From the above stated definitions a number of key words and concepts can be identified; not a batch production system, create value as defined by the customer, perfection, integrated systems approach, it is a culture, flexibility, waste elimination, flow and pull. These concepts will be dealt with in more detail in the rest of this study.

2.3 LEAN AS A COMPETETIVE BUSINESS MANAGEMENT STRATEGY

Vaughan-Jones (2003) considers lean as having a direct strategic link. Donovan (2005e) concurs and is adamant that the consequences of not adopting lean as a business strategy are so costly that lean should become a high priority strategic objective.

Art Byrne, in Womack and Jones (2003:148), is of the opinion that introducing lean techniques in every business activity should be the core of any organisation's strategy as lean provides both the opportunity and the resolve to generate and sustain profitable growth.

It would appear that management is taking note of this call as Mikiewitz (2002) reports that: "It's pleasing to note the degree to which manufacturing excellence has taken root as a key strategic initiative."

Liker (2004:6) is in no doubt that lean has a definite strategic impact when he states that: "Toyota has turned operational excellence into a strategic weapon."

Lean is operationalised in a strategic context by means of the concept of policy deployment, or *Hosni Kanri* in Japanese. Koenigsaecker (2006) describes strategy deployment as a process that ties senior leadership into the organisation wide business improvement practices. Strategy deployment originated with *Hoshin Kanri* which was a core part of the leadership-control practices of Total Quality Management. At the core of policy deployment is an annual planning process that develops organisation-improvement plans, and then includes a monthly review process. Over the ensuing years, *Hoshin Kanri*, has become the most important

linkage between improvement philosophies/practices and the organisation's business strategy. For Zayko (2006) policy or strategy deployment is an effective management process for organisations which links improvement practices to the organisation's business strategy on an annual basis with a monthly cadence of reviews, helping to clarify the scope and pace of improvement, as well as expected targets, to help balance and connect activity across the spectrum of the organisation.

According to Womack and Jones (2003:95) the technique of policy deployment is what's critically needed for lean implementation success. The idea is for top management to agree on a few simple goals for transitioning from mass to lean, to select a few projects to achieve these goals, to designate the people and resources for getting the projects done, and, finally, to establish numerical improvement targets to be achieved by a given point in time.

Jones (2004d) is of the opinion that it is top management's job to lead a policy deployment process, to prioritise the resources to implement the value stream plans, and to align the plans with the overall needs of the organisation.

Wickens (1999: 63-74) submits that the goals of an organisation are the tangible expression of its values and strategy. However, values and strategy are fine but unless organisations develop shared, tangible goals which are widely known and frequently reaffirmed the values and strategy may well drift away. As such a critical task is to share goals and to get everyone working together to achieve them; in short to ensure that the goals are aligned throughout the organisation. Goal alignment occurs when people at all levels of the organisation and in all functions and divisions work together to define and achieve their shared goals. Alignment is very different from just cascading goals down the hierarchy; it is about shifting the perspective so that the goals of the organisation and the goals of the individual are working to the same end. Gaining the commitment of everyone, not only to the top-level goals but also to the goals of their section of the organisation, is the real objective of goal alignment.

In summary strategic alignment occurs when people at all levels of the organisation

and in all functions and divisions work together to define and achieve their shared goals. Goals that are shared and aligned become so powerful that their achievement becomes a self-fulfilling prophecy.

Bicheno (2004:47) contends that policy deployment go some way to explaining why in better Japanese organisations the decision making process is slower, but implementation is much faster and smoother, as in essence policy deployment is about *nemawasi* or consensus building and *ringi* or shared decision making.

It would thus appear that there must be a clear link, or cause and effect relationship, between the organisational goals, key objectives, and activities.

From the above stated the following theoretical success factor elements (SFE) are formulated:

SFE1: Lean implementation must be considered as an integral part of the organisation's strategy deployment process.

SFE2: The goals and objectives of the organisation must be aligned and shared by all in the organisation.

SFE3: There must be a clear link between organisational goals, key objectives and lean activities.

2.4 THE FIVE BASIC LEAN PRINCIPLES

The pioneers of lean, Womack and Jones (2003:9 - 98), identified five basic principles of lean in their seminal work *Lean Thinking.* A number of other authors (Aberdeen Group, 2006a; Bicheno, 2004:10; Pieterse, 2006:11-14; Drew *et al*., 2004:36) have reported on these five principles without criticising or adding anything meaningful to the principles.

The lean principles are summarised hereunder. Under each principle reference, where applicable, will be made of the lean tools and techniques available to assist with the implementation of the specific principle. The tools and techniques are discussed in more detail in Chapter 3.

2.4.1 Specify value

The critical starting point for lean is value, which can only be defined by the ultimate customer. This value is only meaningful when it is expressed in terms of a specific product (a good or service, and often both at once) which meets the customer's needs at a specific price at a specific point in time. Value is thus what the customer is willing to pay for.

Lean therefore must start with a conscious attempt to precisely define value in terms of specific capabilities offered at specific prices through a dialogue with specific customers. The way to do the former is to ignore existing assets and technologies and to rethink organisations on a product-line basis with strong, dedicated technical experts. It is thus necessary to rethink every step in the business process with a view to create value, and to define value in terms of the whole product. Value creation often flows through many organisations; each one tends to define value in a different way to suit its own needs.

The most important task in specifying value, once the product is defined, is to determine a target cost based on the amount of resources and effort required to make a product of given specification and capabilities, if all the current visible wastes were removed from the process. Doing the former is the key to squeezing out the waste. Once the target cost is set for a specific product, it becomes the lens for examining every step in the value stream for product development, order-taking, and production. This relentless scrutiny of every activity along the value stream becomes the key to meeting the aggressive cost target.

Once the initial rethink of value is done, the organisation must continually revisit the value question with their product teams to ask if they really got the best answer.

The following success factor elements are proposed:

SFE4: Value must be defined by the ultimate customer.
SFE5: The organisation must continually revisit the definition of value to ensure it is still the best definition.

2.4.2 The value stream

The value stream is the set of all the specific actions required to bring a specific product (whether a good, a service, or a combination of the two) through the three critical management tasks of any organisation: the *problem-solving task* running from concept through detailed design and engineering to product launch, the *information management task* running from order-taking through detailed scheduling to delivery, and the *physical transformation task* proceeding from raw materials to finished product in the hands of the customer. Identifying the entire value stream for each product (or in some cases for each product family) almost always exposes enormous, indeed staggering, amounts of waste.

Just as activities that can't be measured can't be properly managed, the activities necessary to create, order, and produce a specific product which can't be precisely defined, analysed, and linked together cannot be challenged, improved (or eliminated altogether), and, eventually, perfected. The great majority of management attention has historically gone to managing aggregates – process, departments, and organisations – overseeing many products at once. Yet what's really needed is to manage whole value streams for specific goods and services.

The tool to be used is the value stream map, as described in more detail in the next chapter. The initial objective in creating a value stream map identifying every action required to design, order, and make a specific product is to sort these actions into three categories: those which actually create value as perceived by the customer; those which do not create value but are currently required by the product development, order filling, or production systems (type one waste) and so can't be eliminated just yet; and those actions which don't create value as perceived by the

customer (type two waste) and as such can be eliminated immediately. Once the wastes have been removed, the way is clear to go to work on the remaining non-value-creating steps through use of the flow, pull, and perfection techniques.

The focus of lean is not on competing against competitors, but rather on competing against perfection by identifying all activities that are regarded as waste and by eliminating them. This is an absolute rather than a relative standard which could provide the essential North Star for any organisation. However, to put this admonition to work the organisation must master the key lean techniques for eliminating waste, as described in Chapter 3.

A success factor element could thus be:

> *SFE6: The identification and management of a whole value stream for a specific product.*
> *SFE7: Identification of all activities considered as waste and eliminating it.*

2.4.3 Flow

Once value has been precisely specified, the value stream for a specific product fully mapped by the organisation, and obviously wasteful steps eliminated, it's time for the next step in lean transformation: making the remaining value-creating steps flow.

The argument is that the organisation would function better when the focus is on the product and its needs, rather than on the organisation or equipment, so that the activities needed to design, order, and provide a product is in continuous flow.

The first step in creating flow is to focus on the actual object – the specific design, the specific order, and the product itself – and never to let the object out of sight from beginning to completion. The second step, which makes the first step possible, is to ignore traditional boundaries of jobs, careers, functions (often organised into departments), and organisations to form a lean organisation removing all impediments to the continuous flow of the specific product or product family. The third step is to

rethink specific work practices and tools to eliminate backflows and stoppages of all sorts so that the design, order and production of the specific product can proceed continuously. These three steps must be taken together.

It can thus be said that:

> *SFE8: For lean to be successfully implemented the product must be manufactured in one continuous flow in a value stream.*

In creating flow the following areas in the manufacturing process need to be considered:

2.4.3.1 Design

The lean approach is to create truly dedicated product teams with all the skills needed to conduct value specification, general design, detailed engineering, purchasing, tooling, and production planning in one room in a short period of time using a proven team decision-making methodology, permitting development teams to standardise work so that a team follows the same approach every time. Because every team in an organisation also follows this approach, it is possible to accurately measure throughput time and to continually improve the design methodology itself. The concept of standardised work is discussed in more detail in paragraph 3.12.

2.4.3.2. Order taking

The ultimate goal of lean is to have no stoppages in the production system and products built to order. With only a few hours elapsed between the first operation on raw materials and shipments of the finished item, orders can be sought and accepted with a clear and precise knowledge of the system's capabilities.

A key technique in implementing this approach is the concept of *takt* time, which precisely synchronises the rate of production to the rate of sales to customers. *Takt* time is discussed in more detail in paragraph 3.3.

2.4.3.3. Production

The end objective of flow thinking is to totally eliminate all stoppages in an entire production process and not to rest in the area of tool design until this has been achieved.

The techniques used to ensure flow of the production system includes Just-in-time, reduce set-up times, multi skilled employees, Total Productive Maintenance, *poka-yoke*, visual control, 5S, and *kaikaku*. These techniques are discussed in detail in Chapter 3.

2.4.3.4. Right location

Both design and physical production must be located in the appropriate place to serve the customer.

If an organisation uses lean techniques only to make unwanted goods flow faster, nothing but waste results. How can the organisation be sure that it is providing the services and goods customers really want when they really want it? And how can the organisation tie all the parts of a whole value stream together when they can't be conducted in one continuous flow cell in one room? The answer lies in pull.

2.4.4 Pull

When flow is introduced, products requiring years to design are done in months, orders taking days to process are completed in hours, and the weeks or months of throughput time for conventional physical production are reduced to minutes or days. This ability to design, schedule, and make exactly what the customer wants, just when the customer wants it, means the organisation can simply make what the customers actually tell the organisation they need. That is, the customer pull the product from the organisation as needed rather than the organisation pushing products, often unwanted, onto the customer. The demands of customers become much more stable

when they know they can get what they want right away and when organisations stop periodic price discounting campaigns designed to move goods already made which no one wants.

Pull in simplest terms means that no one upstream process should produce a good or service until the customer downstream asks for it. In other words, don't make anything until it is needed; then make it very quickly.

Accordingly, a success factor element is:

> *SFE9: A pull system must be introduced, meaning that no one upstream should produce a good or service until it is needed by someone downstream.*

The techniques mostly used are levelling (see paragraph 3.15) and set up reduction (see paragraph 3.10).

However, much of the potential of lean is lost unless the organisation implements the final principle of lean, namely *perfection*.

2.4.5 Perfection

As the organisation begins to accurately specify value, identify the entire value stream, make the value-creating steps for specific products flow continuously, and let customers pull value from the organisation, it become evident that there is no end to the process of reducing effort, time, space, cost, and mistakes while offering a product which is ever more nearly what the customer actually wants.

No matter how many times the organisation improves a given activity to make it leaner; the organisation could always find more ways to remove waste by eliminating effort, time, space, and errors. The activity also becomes progressively more flexible and responsive to customer pull because the four initial principles interact with each other in a virtuous circle. Getting value to flow faster always exposes hidden waste in

the value stream. And the harder one pull, the more the impediments to flow are revealed so they can be removed. Dedicated product teams in direct dialogue with customers always find ways to specify value more accurately and often learn of ways to enhance flow and pull as well.

Perfection thus means the complete elimination of waste through endless steps, which is the fundamental principle or objective of lean. The most important spur to perfection is transparency, the fact that in lean everyone – subcontractors, first tier suppliers, system integrators (assemblers), distributors, customers, and employees – can see everything, and so it's easy to discover better ways to create value. There is also nearly instant and highly positive feedback for employees making improvements - a key feature of lean and a powerful spur to continue efforts to improve.

Every organisation needs both continuous radical and incremental improvement. The tools and techniques mostly used are *kaizen* and *kaikaku*, as described in more detail in paragraphs 3.4 and 3.5.

To effectively pursue both this radical and incremental improvement the organisation's management must firstly form a view in their minds of what perfection would be. To do this the organisation needs to apply the four lean principles of value specification, value stream identification, flow, and pull (Remember the organisation wants to compete against perfection, not just the current competitors, so the organisation needs to be able to gauge the gap from current reality to perfection). Secondly, the management needs to decide which forms of waste (or *muda)* to attack first, linking back to the strategic focus of lean (or policy deployment).

The two steps are now described in more detail:

2.4.5.1 The picture of perfection

At every step described so far the need for managers to learn to see has been noted: to see the value stream, to see the flow of value and to see value being pulled by the customer. The final form of seeing is to bring perfection into clear view so the objective

of improvement is visible and real to the whole organisation. Paradoxically, no picture of perfection can be perfect. Perfection is like infinity. Trying to envision it (and to get there) is actually impossible, but the effort to do so provides inspiration and direction essential to making progress along the path.

A clear sense of direction – the knowledge that products must be manufactured more flexibly in smaller volumes in continues flow – provides critical guidance to technologists in the functions developing generic design tools. In addition to forming a picture of perfection with the appropriate technologies, managers need to set a stringent timetable for steps along the path. The greatest difference between those organisations that have done a lot and those that have accomplished little or nothing with lean is that the high achievers set specific timetables to accomplish seemingly impossible tasks and then routinely met or exceed them. The low achievers, by contrast, asked what would be reasonable for their current organisation and disconnected value streams to accomplish, and generally defeated themselves before they ever set out.

2.4.5.2 Focusing energy to banish waste

Many organisations set off full of vision, energy, and with high hopes, but make very little progress with lean because they went tearing off after perfection in a thousand directions and never had the resources to get very far along the lean path. What's needed instead is to form a vision, select the two or three most important steps to get the organisation there, and defer the other steps until later. The idea is for top management to agree on a few simple goals for transitioning from mass to lean, to select a few projects to achieve these goals, to designate the people and resources for getting the projects done, and, finally, to establish numerical improvement targets to be achieved by a given point in time.

The most successful lean organisations have learned how to deselect projects, despite the enthusiasm of parts of the organisation, in order to bring the number of projects in line with the available resources.

Against the above background a number of success factor elements can be formulated:

SFE10: Complete elimination of waste through endless steps.
SFE11: Transparency so that everyone can see everything.
SFE12: Continuous radical incremental improvement.
SFE13: A vision what the organisation wants to be (policy deployment).
SFE14: To select a few projects to work on instead of on everything at once.

2.5 THE 4P MODEL OF LEAN

Based on the five basic principles of lean discussed above, as well as years of practical experience at Toyota, Liker (2004) developed what he terms the 4P model of the Toyota Way. Figure 2.1 describes the 4 P's as well as the 14 principles of each of the P's.

As these 14 principles, that according to Liker (2004:37-41) constitute the Toyota Way could be of value in the identification of the theoretical critical success factors for successful lean implementation they are summarised hereunder, organised in the four broad P's.

2.5.1 P1: Philosophy

Principle 1 – Base management decisions on a long-term philosophy, even at the expense of short-term financial goals.

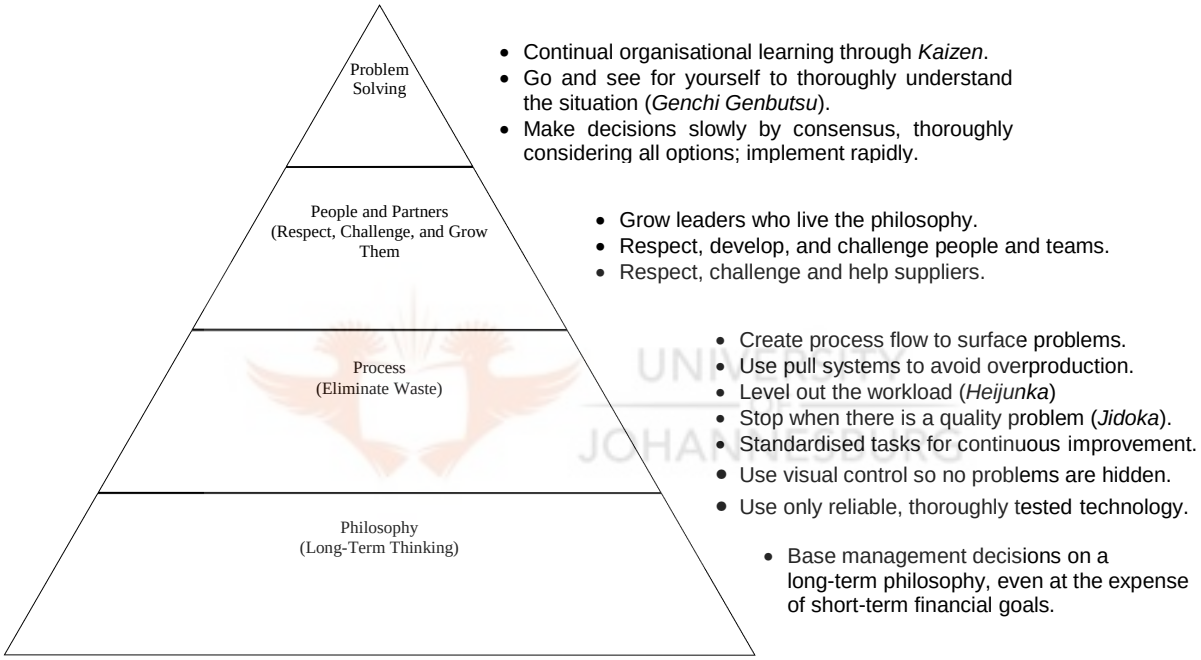
- Have a philosophical sense of purpose that supersedes any short-term decision making. Work, grow and align the whole organisation toward common purpose that is bigger than making money. Understand the history of the organisation and work to bring it to the next level. The philosophical mission is the foundation for all the other principles.
- Generate value for the customers, society and the economy – it is the starting point. Evaluate every function in the organisation in terms of its ability to

achieve this value.

- Be responsible. Strive to decide own fate. Act within self-reliance and trust in own abilities. Accept responsibility for own conduct and maintain and improve the skills that enable the organisation to produce added value.

FIGURE 2.1

THE 4P MODEL OF LEAN



Source: Adapted from Liker (2004:6).

2.5.2 P2: Process

Principle 2 – Create continued process flow to bring problems to the surface.

- Redesign work processes to achieve high value-added, continuous flow. Strive to cut back to zero the amount of time that any work project is sitting idle or waiting for someone to work on it.
- Create flow to move material and information fast as well as to link processes and people together so that problems surface right away.

- Make flow evident throughout the organisational culture which is the key to a true continuous improvement process and to develop people.

Principle 3 – Use pull systems to avoid overproduction.

- Provide down the line customers in the production process with what they want, when they want it, and in the amount they want it. Material replenishment initiated by consumption is the basic principle of just-in-time.
- Minimise work-in-process and warehousing of inventory by stocking small amounts of each product and frequently restocking based on what the customer actually takes away.
- Be responsive to the day-to-day shifts in customer demand rather than relying on computer schedules and systems to track wasteful inventory.

Principle 4 – Level out the workload (work like a tortoise, not the hare)

- Eliminating waste is just on-third of the equation for making lean successful. Eliminating overburden to people and equipment and eliminating unevenness in the production schedule are just as important – yet generally not understood at organisations attempting to implement lean.
- Work to level out the workload of all manufacturing and service processes as an alternative to the stop/start approach of working on projects in batches that is typical at most organisations.

Principle 5 – Build a culture of stopping to fix problems, to get quality right the first time.

- Quality for the customer drives the organisation's value proposition.
- Use all the modern quality assurance methods available.
- Build into equipment the capability of detecting problems and stopping itself. Develop a visual system to alert team or project leaders that a machine or process needs assistance.
- Build into the organisation's support systems the ability to quickly solve problems and put in place countermeasures.
- Build into the organisation's culture the philosophy of stopping or slowing down

to get quality right the first time and to enhance productivity in the long run.

Principle 6 – Standardised tasks are the foundation for continuous improvement and employee empowerment.

- Use stable, repeatable methods to maintain the predictability, regular timing and regular output of processes - The foundation for flow and pull.
- Capture the accumulated learning about a process up to a point in time by standardising today's best practice. Allow creative and individual expression to improve upon the standard; then incorporate the improvement into the new standard so that when a person moves on the learning can be transferred to the next person.

Principle 7 – Use visual control so no problems are hidden.

- Use simple visual indicators to help people determine immediately whether they are in a standard condition or deviating from it.
- Avoid using a computer screen when it moves the worker's focus away from the workplace.
- Design simple visual systems at the place where the work is done, to support flow and pull.
- Reduce reports to one piece of paper whenever possible, even for the most important financial decisions.

Principle 8 – Use only reliable, thoroughly tested technology that serves the people and the processes.

- Use technology to support people, not to replace people. Often it is best to work out a process manually before adding technology to support the process.
- New technology is often unreliable and difficult to standardise and therefore endangers flow. A proven process that works generally takes precedence over new and untested technology.
- Conduct actual tests before adopting new technology in business processes, manufacturing systems, or products.
- Reject or modify technologies that conflict with the organisation's culture or

that might disrupt stability, reliability, and predictability.

- Nevertheless, encourage the people to consider new technologies when looking into new approaches to work. Quickly implement a thoroughly considered technology if it has been proven in trials and it can improve flow of the processes.

2.5.3 P3: People and Partners.

Principle 9 – Grow leaders who thoroughly understand the work, live the lean philosophy, and teach the lean philosophy to others.

- Grow leaders from within, rather than buying them from outside the organisation.
- Do not view the leader's job as simply accomplishing tasks and having good people skills. Leaders must be role models of the organisation's philosophy and way of doing business.
- A good leader must understand the daily work in great detail so he can be the best teacher of the organisation's philosophy.

Principle 10 – Develop exceptional people and teams who follow the organisation's philosophy.

- Create a strong, stable culture in which organisational values and beliefs are widely shared and lived out over a period of many years.
- Train exceptional individuals and teams to work within the corporate philosophy to achieve exceptional results. Work very hard to reinforce the culture continually.
- Use cross-functional teams to improve quality and productivity and enhance flow by solving difficult technical problems. Empowerment occurs when people use the organisation's tools to improve the organisation.
- Make an ongoing effort to teach individuals how to work together as teams toward common goals. Teamwork is something that has to be learned.

Principle 11 – Respect the organisation's extended network of partners and suppliers by challenging them and helping them improve.

- Have respect for partners and suppliers, and treat them as an extension of the organisation.
- Challenge outside business partners to grow and develop. It shows that the organisation value them. Set challenging targets and assists the partners in achieving them.

2.5.4 P4: Problem Solving

Principle 12 – Go and see for yourself to thoroughly understand the situation.

- Solve problems and improve processes by going to the source and personally observing and verifying data rather than theorising on the basis of what other people or the computer screen tells.
- Think and speak based on personally verified data.
- Even high-level managers and executives should go and see things for themselves, so they will have more than a superficial understanding of the situation.

Principle 13 – Make decisions slowly by consensus, thoroughly considering all options; implement decisions rapidly.

- Do not pick a single direction and go down that one path until all alternatives have been thoroughly considered. Once a decision has been made, move quickly but cautiously down the path.
- *Nemawashi* is the process of discussing problems and potential solutions with all of those affected, to collect their ideas and get agreement on a path forward. This consensus seeking process, though time-consuming, helps broaden the search for solutions, and once a decision is made, the stage is set for rapid implementation.

Principle 14 – Become a learning organisation through relentless reflection (*hansei*) and continuous improvement (*Kaizen*).

- Once the organisation has established a stable process, use continuous improvement tools to determine the root cause of inefficiencies and apply effective countermeasures.
- Design processes that require almost no inventory. This will make wasted time and resources visible for all to see. Once waste is exposed, have employees use a continuous improvement process to eliminate it.
- Protect the organisational knowledge base by developing stable personnel, slow promotion, and very careful succession systems.
- Use *hansei* (reflection) at key milestones and after a project has been finished to identify all the shortcomings of the project. Develop countermeasures to avoid the same mistake again.
- Learn by standardising the best practices, rather than reinventing the wheel with each new project and each new manager.

2.6 BICHENO'S CHARACTERISTICS OF LEAN

Bicheno (2004:11-13) has identified what he termed the 20 characteristics of lean or common themes distilled from the writings of Womack and Jones, Schongerger, Hall, Goldratt, Juran, and Ohno.

- Customer: The external customer is the starting and ending point of lean. Seek to maximise value to the customer. Optimise around the customer. Understand the customer's true demand, in price, delivery and quality.
- Simplicity: Lean is not simple, but simplicity prevails. Simplicity in operation, in system, in technology and in control is the goal.
- Waste: Waste is endemic, learn to recognise it, and always seek to reduce it.
- Process: Organise and think by the process view. Concentrate on the way the product moves, not on the way the machines or people or services move. Map to understand the process.

- Visibility: Seek to make all operations as visible and transparent as possible. Control by sight. Adopt the visual factory.
- Regularity: Regularity makes for no surprises operation.
- Flow: Seek to keep it moving at the customer rate and one piece flow manufacturing. Synchronise operations so that the streams meet just in time.
- Pull: Seek for operations to work at the customer's rate of demand. Avoid overproduction. Have pull-based demand chains, not push-based supply chains.
- Postponement: Delay activities and commitment to product variety as late as possible so as to retain flexibility and to reduce waste and risk.
- Prevention: Seek to prevent problems and waste, rather than to inspect and fix. Shift the emphasis from failure and appraisal to prevention. Inspecting the process, not the product.
- Time: Seek to reduce overall time to make, to deliver, and to introduce new products. Use simultaneous, parallel, and overlapping operations in operations, design, and support services. Seek never to delay a value-adding step by a non-value adding step. Time is the best overall measurement. If time reduction is a priority the organisation tends to do all the right things – waste, flow, pull, and perfection.
- Improvement: Improvement and continuous improvement in particular is everyone's concern.
- Partnership: Seek co-operative working relationships both internally between functions, and externally with suppliers. Seek to use teams, not individuals, internally and externally. Seek to build trust.
- Value networks: The greatest opportunity for cost, quality, delivery and flexibility lie with co-operated networks. Supply chains compete, not organisations.
- *Gemba*: Go to where the action is happening and seek the facts. Manage by walking around.
- Variation reduction: Variation in time and quantity is found in every process from supply chain demand amplification to dimensional variation. Variation is the great enemy of lean.
- Participation: Give operators the first opportunity to solve problems. All

employees should share responsibility for success and for failure. True participation implies full information sharing.

- Thinking small: Specifically the smallest capable machine, and then build capacity in increments. Get best value out of existing machine before acquiring a new one. Break the economy of scale concept by flexible labour and machines.
- Trust: Trust allows great swathes of bureaucracy and time to be removed internally and externally. Building trust with suppliers gives them the confidence to make investments and share knowledge. Internally, trust allows a de-layered, streamlined and more creative organisation.
- Knowledge: Build knowledge into a system, cultivates both explicit knowledge but also tacit knowledge (involving softer and stickier skills). It is the tacit knowledge that is hard to copy and gives sustainable advantage.

2.7 SCHONBERGER'S PRINCIPLES OF LEAN

Richard Schonberger has developed 16 Principles of World Class Manufacturing (Bicheno 2004:87). World Class Manufacturing is considered to be the same as lean.

- Team up with customers; organise by customer/product family.
- Capture/use customer, competitive and best practice information in order to drive improvement efforts.
- Continual, rapid improvement in universal customer wants.
- Whole work force involvement in change and strategic planning.
- Cut to the few best components, operations and suppliers.
- Cut total flow time, flow distance and start-up/changeover times.
- Operate close to customer's rate of use or demand.
- Continually train everybody for their new roles.
- Expand variety of recognition, rewards and pay.
- Continually reduce variation and mishaps.
- Front-line teams must record and own process data at the work place.

- Control root causes and cut internal transactions and reporting.
- Align performance measures with universal customer wants.
- Improve present capacity before buying new equipment and automation.
- Seek simple, movable, scalable, low-cost and focused equipment.
- Promote market and sell every improvement.

From the above stated principles the following success factor elements are derived:

SFE15: Lean should be considered a long-term philosophy, even at the expense of short-term financial gains.

SFE16: Evaluate every function or activity in the organisation in terms of its ability to create value for the customer.

SFE17: Redesign processes to achieve high value-added continuous flow.

SFE18: Let customers pull what they want; when they want it in the amounts they want it.

SFE19: Be responsive in day to day shifts in customer demands.

SFE20: Level out workload of all processes.

SFE21: Build culture of stopping the line to fix problems.

SFE22: Problem detection and solving ability build into machines and culture.

SFE23: Standardised tasks and processes.

SFE24: Culture of continuous improvement.

SFE25: Simple visual control systems to bring problems to the fore.

SFE26: Use only reliable, thoroughly tested technology that serves the people and the processes.

SFE27: Develop leaders who understand and follow the lean philosophy.

SFE28: Train and develop people in lean philosophy and principles – build knowledge.

SFE29: Use cross-functional teams to solve problems and improve.

SFE30: Create a culture of shared values and goals.

SFE31: Respect suppliers and treat them as partners.

SFE32: Manage on the floor by walking the floor, see things for yourself.

SFE33: Consensus decision making.

SFE34: Relentless elimination of waste.

SFE35: Seek to prevent problems and waste, rather than to inspect and fix.

SFE36: Use time as the best overall measure.

SFE37: True participation by all, including operators.

SFE38. Trust amongst all stakeholders.

SFE39: Simple, movable, scalable, low-cost and focused equipment.

2.8 CHAPTER SUMMARY

This chapter defined lean, confirmed lean's importance as a business management strategy, and reviewed the basic lean principles and concepts - the powerful ideas in the lean tool kit needed to convert organisations and value streams from a meandering morass of waste to fast flowing value streams pulled by the customer.

The structure of the chapters to follow is based on the 4P model of lean as described in this chapter. The philosophy was dealt with in this chapter, the people issues will be dealt with in Chapter 4, whilst the process and problem solving issues are dealt with in Chapters 3, 5 and 6.

These chapters will not be an in-depth study of the principles, tools and techniques of lean but will be sufficient enough to identify the elements or factors for successful lean implementation.

A question that needs to be considered is how to actually achieve a lean organisation as described in this chapter, in other words what are the tools and techniques available to operationalise lean in the organisation. Some of these tools and techniques have already been alluded to in the above discussions of the lean principles and concepts. The next chapter will deal specifically with the available lean tools and techniques.

CHAPTER 3

LEAN TOOLS AND TECHNIQUES

3.1 INTRODUCTION

Vaughan-Jones (2003) maintains that the key to sustainable lean performance is having the right practices (tools and techniques) in place.

In a similar vain the Kufman Global Group (2003b) is of the opinion that an organisation that limits the amount of tools also limits the organisation's ability to solve problems and improve processes *as* quickly as those organisations with a larger tool inventory from which all employees can draw upon. It is however important to understand that the number of tools available to an organisation is not the only limiting factor, the ability of an organisation to provide structured, real-time coaching and decision support on the use of the tools will also limit the ability to quickly resolve problems and improve processes.

It can thus be argued that:

> *SFE40: The correct application of the applicable lean tools and techniques is essential for successful lean implementation.*

The primary objective of this study is to identify the critical success factors for the implementation of lean thinking in South African manufacturing organisations, and as such it is not considered necessary to describe each tool or technique in technical detail. The objective of this chapter will be to give an understanding of the tools and techniques rather than a scientific or detailed discussion of each tool or technique.

What follows is thus an overview of the available lean tools and techniques identified in the literature study.

3.2 VALUE STREAM MAPPING

In a survey conducted by the Aberdeen Group (2006a) reducing non value-added manufacturing and supply chain costs was recognised by 66% of the respondents as one of the most important strategic actions relative to pursuing lean. Value stream mapping is the proven and preferred technique to evaluate the organisation's operations, eliminate waste in its many forms, and substantially streamline business processes from the customer to the supplier.

Rother and Shook (2003) defines value stream mapping as a "…pencil and paper tool that helps you to see and understand the flow of material and information as a product makes its way through the value stream. It simply means following a product's production path from customer to supplier, and carefully drawing a visual representation of every process in the material and information flow, giving the current state map. Then ask a set of key questions and draw a future-state map of how value should flow". The value stream map thus permits the organisation to identify every process in the flow, pull them out from the background clutter of the organisation, and build an entire value stream according to lean principles. Value stream mapping is thus is the tool that should be use every time the organisation makes a change within a value stream.

Bicheno (2004:68) agrees and states that: adds that Value Stream Mapping is the meta tool in the lean toolbox, and as such it should be the guide to the use of all the other tools.

Annis (2006) also agrees and is of the opinion that value stream mapping of strategic products and services provides insights as to how organisations generate value and at what cost. Without a value stream of the current state, management thinks they know where waste exists and therefore, where improvement opportunities can be found. However, until management walk the process and collect input from employees, waste and opportunities are not fully understood. The value stream mapping process is thus a critical beginning to any lean implementation and helps that the right projects are

being embarked upon with the right tools.

Taking a value stream perspective thus means working on the big picture, not just individual processes, and improving the whole, not just optimising parts.

The benefits of value stream mapping are summarised by Rother and Shook (2003) as:

- It helps management to visualise more than just the single-process level in manufacturing, but to see the flow.
- It helps management to see more than waste, as mapping helps to see the sources of waste in the value stream.
- It provides a common language for talking about manufacturing processes.
- It makes decisions about the flow apparent. If not, many details and decisions on the shop floor just happen by default.
- It forms the basis of an implementation plan. By helping management design how the whole door-to-door flow should operate value stream maps become a blueprint for lean implementation.
- It shows the linkage between the information flow and the material flow. No other tool does this.
- It is much more useful than quantitative tools and layout diagrams that produce a tally of non-value-added steps, lead time, distance travelled, the amount of inventory, and so on. Value stream mapping is a qualitative tool that describes in detail how the facility should operate in order to create flow. Numbers are good for creating a sense of urgency or as before/after measures. Value stream mapping is good for describing what actually needs to be done to affect those numbers.
- It can be a communication tool, business planning tool, and a tool to manage the change process.
- It ties together lean concepts and techniques.

Womack and Jones (2005:183) cautions that the people who perform the value-creating steps in a process have done their tasks well only when three conditions are

met: when they can see the whole process, when they understand the logic of the whole process and the need for change, and when they believe in the virtue of the new process. The only way to achieve these conditions is to involve the people actually touching the process in the analysis of the current process and the design of a better future process. They thus argue for involvement of the people from all levels of the organisation in the value stream mapping exercise.

Considering the preceding arguments the following success factor elements are formulated:

> *SFE41: A complete value stream mapping exercise must be conducted.*
> *SFE42: People actually working in the process must be involved in analysing the current state and design of the future state.*

3.3 TAKT TIME

A key technique in implementing flow is the concept of *takt* time, which precisely synchronises the rate of production to the rate of sales to customers. *Takt* time is calculated by dividing the number of products required by the available hours of production, thus giving the production time per product. The *takt* time is adjusted continually so that production is always precisely synchronised with demand. The point thus is to always define *takt* time precisely at a given point in time in relation to demand and to run the whole production sequence precisely to *takt* time (Womack & Jones, 2003:55).

Bicheno (2004:50) considers *takt* time as the fundamental concept to do with regular, uniform rate of progression of products through all the stages from raw material to customer. *Takt* time should drive the production process and the supply chain, in other words it is the drumbeat of the plant.

When orders do not require the full utilisation of equipment and workers, *takt* time is accordingly increased, which goes against the age old practice in manufacturing to work ahead and build inventories if no orders were immediately on hand.

Drew *et al.* (2004:30) agrees and states that *takt* time is designed to optimise material flow in pursuit of Just-In-Time delivery to the customer by setting the pace of production at the rate of demand, thus eliminating the risk of overproduction, which Toyota deems to be the worst type of waste since it hides (and also causes) other types of waste. Once an operation is working to a steady pace it is much easier for management to monitor performance, allocate the labour force and plan capacity. *Takt* time is thus used to balance work in a continuous flow line, which often has the effect of reducing the amount of labour needed to build a product.

It can thus be argued that a success factor element is:

SFE43: To run the whole production process precisely to takt time.

3.4 CONTINUOUS IMPROVEMENT

The importance of continuous improvement (or *kaizen*) is captured in the words of Benjamin Franklin (Bleby, 2006):“The definition of insanity is doing the same thing over and over again and expecting a different result.”

For Wickens (1998:22-23) at the heart of much of the Japanese manufacturing success is the four stage continuous improvement cycle of standard operations, *kaizen,* eliminate waste and rewrite of the standard operation. For him of all the Japanese concepts, *kaizen* has the most to offer the Western World. *Kaizen* recognises that the person doing the job knows more about that job than anyone else and that it is management’s task to motivate everyone so that this knowledge can be utilised for the benefit of both the individual and the organisation. *Kaizen* is about seeking the hundreds of 0.01% improvements that, added together, can significantly improve quality, productivity and ease of working and, at the same time, greatly enhances employee motivation and commitment.

Drew *et al.* (2004:186) states that: reports that the ability to achieve continuous improvement is the ultimate goal of the lean journey, whilst Collins (2001:174) is of the opinion that tremendous power exists in the fact of continuous improvement and

delivery of results.

Imai (1986:3) describes the term *kaizen* as meaning "…ongoing improvement involving everyone, including both managers and workers. The *kaizen* philosophy assumes that our way of life – be it our working life, our social life, or our life – deserves to be constantly improved". *Kaizen* is thus "…a state of mind that encourages everyone to consider it unusual when conditions do not evolve continuously".

A number of key ingredients for successful *kaizen* have been identified in the literature, which is discussed hereunder.

For Wickens (1998:23) the key ingredient of *kaizen* is that it comes about as a normal part of the person's work, it is not something special. It is not a suggestion scheme, which is based on the premises that most people are not paid to think, and if they do they should receive some additional reward. For *kaizen* to be successful it is critical that employees feel secure, that is no person will lose his job because of *kaizen* improvements. Non-value adding work is waste and *kaizen* exists to eliminate waste. *Kaizen* thus links with the concept of standard operation (as described in paragraph 3.12) in that the standard operation provides the reference point for continuous improvement

Everett (Greif, 1991:140) considers observing phenomena, paying attention to details, recording problems, searching for causes, and validating hypotheses as essential requirements for an organisation seeking to constantly improve.

According to Wickens (1995:143) the improvements do not have to be big to be impressive. The essential points are that the search for improvement is continuous, no improvement is too small, once implemented improvements must be maintained to ensure a steady progress, any aspect of work performance and the working environment can be improved, and everyone can participate, not just experts

Robinson (1991:xxxi) identified three things that are required for a successful

continuous improvement programme. The first being operating practices must expose new improvement opportunities; secondly, every employee should want overall improvement; and thirdly, workers should be trained in practical problem solving techniques so they are able to make the improvement.

For Womack and Jones (2003:260 - 261) it's critical to get the organisation's employees to understand at the onset that no level of performance is ever good enough, and that there is always room for improvement. Also those mistakes in pursuit of the right goal are not a failure; it's not acceptable to do nothing to improve the operation on the grounds that risk of failure is too high.

Wickens (1999:141-142), however cautions that continuous improvement alone is not enough as it only works when an organisation is already highly effective. *Kaizen* worked in Japan in those organisations which were already at a high level of effectiveness – it is not the way out of trouble for those organisations which were at rock-bottom. *Kaizen* will improve the present; it will not create the future. In Japan they learned that *kaizen* alone was inefficient, they needed *kaikaku* or radical improvement, which is the next tool to be discussed.

Against this background a success factor element could be:

SFE44: Continuous improvement must become part of everyone's normal function.

3.5 KAIKAKU

Bicheno (2004:149) states that blitz or *kaikaku* events deliver results in a very short space of time. It is about going for it, about a preference for doing it now and reasonably rather than later, and about real empowerment to just do it without asking permission to make every little change.

For Jones (2005c) *kaikaku*, or radical improvement, come first, before *kaizen*, as *kaikaku* helped Toyota to make the fundamental shift that set the organisation off in the right direction.

Riek (2002) is of the opinion that a structured blitz (or *kaikaku*) exercise provides maximum impact in a short time to demonstrate the potential for improvement and build a we-can-do-this mindset.

Accordingly, a success factor element is:

SFE45: Radical improvement (blitz or kaikaku) must be considered as important as kaizen.

3.6 JUST-IN-TIME

Womack (2006a) describes Just-In-Time (JIT) as a simple idea first formulated by Kiichiro Toyoda at Toyota in the late 1930's. Each step in a value stream should pull precisely what it currently needs from the previous step in a value stream. This pull should be a signal for the previous step to immediately make new items to exactly replace those just withdrawn. The idea is to replace complex scheduling systems – depending on centralised accumulation of information and complicated formulae – with simple, intuitive systems that work much better while dramatically reducing the amount of inventories along a value stream. Toyota implemented its pull system by means of simple rules:

- Between every step in a value stream it is critical to calculate standard inventory, which is the amount of material that must be in place so that the downstream customer is never disappointed. This inventory consists of buffer stock, which is goods already finished that are kept on hand to deal with sudden spikes in demand from the downstream customer; safety stock, which is finished items of raw materials that are maintained to protect the output of the process if upstream suppliers fail to respond to problems (for example bad quality, broken equipment), and shipping stock, which are goods being built for the next shipment.
- Select one point along a value stream as the pacemaker step and add additional buffer stock there to deal with normal fluctuations in consumer demand. This buffer is sized to deal with all reasonable variations in commercial demand, so the customer is never disappointed. By doing this, every step backward upstream from this pacemaker can operate smoothly with

levelled demand for extended periods. When done properly, levelling demand largely eliminates the need for the buffer stocks between each step and reduces total inventories along the value stream dramatically (see levelling in paragraph 3.15).

For Wickens (1995:166) Just-In-Time is very much a philosophy, not just a manufacturing practice. In Japan the emphasis is on the 'J' – just. Delivering just what is necessary, build just what is needed, use just the required amount of effort, have just the right amount of stock in the system. It is about the elimination of waste. The Western World, however, have tended to concentrate on the 'IT' - in time and build stocks to give the protection considered needed to enhance on time delivery, 'just in case' suppliers run into difficulty or machines break down or workers go on strike. Concentrating on the 'in time' element actually achieves little and in fact can be positively harmful, as giving the impression of efficiency when all that has happened is that the inventory holding is passed from the customer to the supplier, or that a huge warehouse is built, space is rented by the supplier and inventory holding is relocated.

Drew *et al.* (2004:27) considers true Just-In-Time capability to be achieved when the products delivered have actually been manufactured in response to customer demand, not just delivered from stock. The process holds the smallest amount of stock needed to meet the delivery lead times customers require, thereby minimising the waste associated with inventory, reducing the risk of obsolescence, and providing a much more responsive system. In practice, inventory needs to be seen as the lubricant needed to ensure that the system keeps flowing.

It thus stands to reason that, as per Womack and Jones (2003:58) Just-In-Time can only work effectively if machine changeovers (as discussed in paragraph 3.10) are dramatically slashed so that upstream manufacturing operations produce small amounts of each part and then produce another small amount as soon as the amount already produced is summonsed by the next process downstream.

Thus, in order to implement Just-In-Time production, an organisation must create continuous flow processing, match the rate of production to the rate of customer

demand by means of *takt* (as described in paragraph 3.3) and control production through a pull system (as described in paragraph 2.4.4). These building blocks depend on the foundation of levelled production (as described in paragraph 3.15), which smoothes the workload over time.

The following success factor element can thus be suggested:

> *SFE46: For lean to be successful an effective Just-In-Time system must be in place.*
> *SFE47: The demand from the customer, and thus the workload, must be levelled at some point.*

3.7 ROOT CAUSE ANALYSIS OR PROBLEM SOLVING

Root cause analysis or problem solving appears to be fundamental to the lean philosophy.

Toyota, for one, attributes its success to brilliant processes and to a production system designed on lean principles. However, these processes and systems in turn is underpinned by a deep knowledge base of problem solving and process design. This knowledge is built up as every employee goes through successive rounds of problem solving and root cause analysis, which are captured in a common format (Jones, 2004c). For Jones (2005a): “Problem solving capability in every employee is the bedrock of lean process management...” and “…problem solving, process focus drives the efforts of the whole organisation”.

Liker (2004:253) reports that the Toyota Way (lean) of problem solving “…requires a level of detailed thinking and analysis that is all too absent from most companies in day-to-day activities. It is a matter of discipline, attitude and culture”. Bicheno (2004:152) seems to be in agreement in stating that problem solving requires a questioning attitude. Problem solving is based on the philosophy that a defect or problem is something precious; not to be wasted by merely solving it, but taking full benefit by exposing the underlying cause that have led to the problem in the first place. Many, according to Bicheno (2004:152), believe that it is this unrelenting

seeking out of root causes that have given the Japanese motor industry the edge on quality, reliability and productivity.

Womack and Jones (2005:61) sites Fujitsu as an example of the power of root cause analysis. By addressing root causes Fujitsu was able to reduce total calls to the BMI help desk by 40% within 18 months. Employees were converted from routine responders to recurring problems into active problem solvers. Every root cause analysis is now considered as an opportunity for improvement, as opposed to historical failures, thereby supporting *kaizen*.

The above justifies the following success factor elements:

> *SFE48: For lean to be successful a problem solving and root cause analysis mindset is imperative.*
> *SFE49: A questioning attitude is essential for lean success.*

3.8 MEASUREMENT

Womack and Jones (2003:264) considers it vital to create a scoreboard which shows everyone involved in a value stream exactly what's happening in real time.

According to the Aberdeen Group (2006a) much of the success attributed to lean is based on lean's unrelenting focus on process standardisation and continually looking for ways to improve. Process standardisation requires performing the same task time and time again, and measuring standard performance on that task. The ability to measure is thus critical.

For the Kaufman Global Group (2003b) a customer-focused, consistent, and understandable set of metrics, both at the micro-process level and at the organisation level are necessary to drive improvement efforts. Metrics, however, take time and effort to develop, and as such, are often developed after the fact.

In an Aberdeen Group (2006a) survey in addition to finding a correlation between

relative performance and what metrics were used, it was also found that a correlation exists with how frequently results are measured. Close to 30% of the best-in-class organisations measure results daily, but only 3% of laggard organisations measure results frequently. It is also interesting to note that 45% of laggards are measuring results on an ad hoc basis. The data also shows that some (11%) best-in-class organisations are beginning to incorporate the use of real-time technologies into their measurement programs.

According to the Kaufman Global Group (2003b) customer-focused metrics must be developed at each level of the organisation, and must be aligned in such a manner to support the overall business improvement goals. Moreover, metrics must be understandable by everyone involved in the effort. How, why, when and how often measurements are taken and interpreted must be understood by every employee. Process management and standard work are critical elements in establishing and sustaining useful and relevant metrics. Linkages between micro-process metrics and the long-term business improvement goals (lead-time reductions, yield improvements, inventory turns, increase in sales, flow days, and so on) should be readily apparent. If the linkages are not supported by the financial reporting structures, it will be extremely difficult for an organisation to see visible results at the bottom line without expending extraordinary effort to prove that improvements did in fact occur. These kinds of non-value-adding effort are an example of the type of people energy waste that often derails improvement efforts.

It can thus be said that:

> *SFE50: Measurement of performance against targets/goals is essential for lean success.*
> *SFE51: Customer-focussed measurements at each level of the organisation must be aligned to support overall business goals.*

It stands to reason that the measurement or metrics should be visible for all to see, which leads to the next lean tool or technique, namely the visual workplace.

3.9 VISUAL WORKPLACE

Greif (1991:71) describes a visual workplace as: “A place where there are spotlessly clean areas, bright colours, and living green plants. Several communication and rest areas are arranged in a homely manner at various locations. Wherever one looks, forms of communication command attention: identification of activities, production charts near the assembly lines, boards where employees can record problems occurring on a given day, and so on. Approaching the workplace, one encounters rotary panels with visual material for the work stations, including instruction sheets and colour diagrams.”

The distinctive aspect of visual communication appears to be that it is intended for the group, and not just for an individual. As such a golden rule of a visual organisation is to ensure participation by the people who use a given location.

Bicheno (2004:67) is of the opinion that visual management is the litmus test for lean – if one goes into any organisation and find that schedules, standard work, the problem solving process, quality and maintenance are not immediately apparent, and up to date, there is an excellent chance that the organisation is far from being a lean organisation.

Based on this argument it can be said that:

SFE52: Visual management is critical for successful lean implementation.

3.10 SET UP TIME REDUCTION

Wickens (1995:165) reports that Ohno and Shingo developed the concept of single minute exchange of dies (SMED) in which they aimed to achieve die and tool changes in less than 10 minutes. Under this system the aim is to maximise the amount of setting which is done outside the machine while the machine is still working, first by distinguishing internal from external work and then seeking to convert as much

internal setting work to external. Having done this, the next step is to eliminate work that needs to be done while the tool is actually being fitted into the machine. Finally, the amount of external work is reduced. Once single minute exchange of dies is achieved, machines need not be run for hours, producing sufficient inventory for several weeks (which is a form of waste). Machines can now be run for minutes. As a result inventory is reduced, less storage capacity is needed, quality problems are minimised and the operators are fully engaged virtually all the time.

Shingo (1981:70) states that a SMED system is one of the fundamental methods that had an important meaning for the development of the Toyota Production System (lean). Bicheno (2004:62) agrees that changeover reduction is a pillar of manufacturing in a lean organisation.

Padlasek (2006) concurs and states that elimination of setup must become a main requirement of management as setup time is a main source of waste in manufacturing systems trying to become lean. Unfortunately it would appear that machines are not designed for setup reduction. As such any setup reduction activity in-house must incorporate a redesign of the setup around the design of the machine.

Drew *et al.* (2004:32) is of the opinion that working in a pull or *kanban* (as described in paragraph 3.14) system has the general effect of increasing the frequency of changeovers, making changeover reduction (or SMED) techniques an intrinsic part of lean. The need to change over processes more frequently creates an incentive to reduce changeover times so that the proportion of time spend on changeovers doesn't rise. Indeed, in many cases, it is reduced. A good rule of thumb is that roughly 10 % of total processing time should be spent on changeovers.

The following success factor element is thus proposed:

> *SFE53: For lean to be successful the organisation must implement single minute exchange of dies on it's machines and equipment.*

3.11 TOTAL PRODUCTIVE MAINTENANCE

Smalley (2005b) believes that while lean strives to eliminate waste in terms of man, machine, material and method, Total Productive Maintenance (TPM) drives deeper into the specific realm of losses that relate to the machine component of manufacturing. Total Productive Maintenance is critical as a precondition for many elements of lean to flourish in manufacturing.

Each letter in the acronym, as per Smalley (2005b), of Total Productive Maintenance is subtle yet critical. Total implies a comprehensive look at all activities that relate to maintenance of equipment and the impact each has upon availability. Productive relates to the end goal of the effort – efficient production, not merely efficient maintenance, as is often mistakenly assumed. Maintenance signifies the directional thrust of the program in ensuring reliable processes and maintaining production.

Padlasek (2006) agrees that controlling machine variability is an important step in the lean transformation as unscheduled maintenance or machine downtime is a major obstacle in maintaining flow in the value stream. It is for this reason that techniques used to maximise the reliability and utilisation of equipment in a systematic way, such as Total Productive Maintenance, is an intrinsic part of lean operating systems.

Hughes (2004) contends that maintenance in a lean environment cannot be conceptualised in the same manner as in traditional manufacturing. As more and more organisations fight for survival and compete on a global scale, the move towards lean is pulling maintenance into a profit centred role. The need for different and improved maintenance is being driven by a need to continually narrow the gap between actual costs and ideal costs. This shift in emphasis towards failure prevention, elimination of waste and profit centred will not just happen of its own volition. The constant need to run and maintain equipment at the lowest cost is necessitating radical changes in the way organisations practice maintenance. Thus, it’s crucial to view maintenance as a profit rather than a cost centre, adopting a proactive profit-focused approach to narrow the gap between manufacturing actual and ideal costs.

Tom Harada (Smalley, 2006) lists five basic categories or types of productive maintenance practices:

- Breakdown Maintenance is the most obvious. The goal is to minimise the percentage of time spend on Breakdown Maintenance related work since it is costly and reactive. None the less it still occurs and has to be executed as efficiently as possible. The concept of single minute exchange of dies (as described in paragraph 3.10) can be applied to maintenance work too. Every simple breakdown should be done in ten minutes or less. For this a key focus, although reactive, is to constantly work on improving the top five machines in terms of the frequency and intensity of the breakdown.

- Preventive Maintenance is the practice of implementing preventive actions before the machine breaks. In addition to the recommended lists from the supplier about basic Preventive Maintenance items organisations must also learn to add their own based upon the actual condition of the machine and the point in the life cycle of the machine. Organisations also have to work on adjusting the frequency of the Preventive Maintenance interval so the organisation doesn't over-maintain the machine, as doing unnecessary Preventive Maintenance work is a form of waste like over-production.

- Daily Maintenance is the type of daily maintenance work that the operator is tasked with performing, and not the skilled artisan, and involves a lot of simple inspection and cleaning work. For example key items always include checking coolant condition, tooling wear, hydraulic oil levels, lube levels, to name a few. By doing these checks the operator can discover many little things like leaks or damaged hoses that can then be fixed between the shifts and avoid a more costly breakdown later.

- Corrective Maintenance is based on the premises that every machine has a weak spot of some kind that is only found after years of operation. Where it makes economic sense it is better to modify equipment to improve the basic design while the machine is still in production, sometimes this is as basic as

improving the design of a fixture to hold the part better, or eliminating cutting chip build up. In other cases it is entirely redesigning a mechanism that for some reason just fails, for example every six months. Thus a form of machine *kaizen*.

- Maintenance Prevention which involves spending a lot of time up front when new equipment is ordered, studying how it will be maintained properly.

A success factor element could thus be:

> *SFE54: Total Productive Maintenance must be implemented as a critical pre-condition for many elements of lean manufacturing.*

3.12 STANDARDISED WORK

Standardised work or the standard operation is defined by Womack and Jones (2003:113) as: "The best way to get the job done in the amount of time available and how to get the job done right the first time, every time." Wickens (1998:23) describes standardised work as: "The current best method for achieving quality, cost and delivery time in a safe manner. It is formalized in a written document which includes all information about a task, including its description, main steps in the correct order, the time allowed, required protective clothing, tools to be used, and so on."

Liker (2004:142) is adamant that it is impossible to improve any process until it is standardised, and that "…using standardization at Toyota is the foundation for continuous improvement, innovation and employee growth".

Piatkowski (2006) agrees and considers standardised work as "…the foundation of lean". Drew *et al.* (2004:34,42) also supports the former and states that: "Clearly defined work standards and a good understanding of the work content of each job are prerequisites if people are to be moved between cells to rebalance lines without creating confusion." The latter appears to be one of the reasons why Toyota and other Japanese manufacturers emphasise the need to standardise work and so create a

foundation for flexibility. One important manifestation of standardisation is the use of visual management (see paragraph 3.9) to make the status of an operating facility obvious to management and the workforce alike.

However, a common misconception is that lean is a highly standardised way of working that treats people like cogs in a machine and isn't suited to particular complex or variable operations. On the contrary: rightly understood, standardisation is a necessary step in laying a foundation for true flexibility, and opens up opportunities for employees to develop new skills and enjoy greater variety in their work. Standardisation creates flexibility so long as the people who work to them are properly trained and have responsibility for maintaining them. Without this freedom of interpretation, standardisation can indeed become constricting. Operating standards ensure that the safest and most efficient way of working is defined and repeated, which benefits the customers, who will see better and more consistent quality; shareholders, who will gain from higher productivity; and employees, who have clear and safe procedures to follow. Standardisation also greatly reduces the risks associated with introducing new products or changing a process. At the most basic level, standardisation ensures that tasks are done the same way no matter who is doing them. Standardisation also provides a foundation for training, and a baseline for improvement activity. Work standards should be seen as living documents, constantly being updated by work teams as they apply them. As processes are improved, the standard work needs to be updated to capture the changing conditions, which then become a new baseline for improvement (Drew *et al.*, 2004:42).

Against the above background the following success factor element is formulated:

SFE55: For lean to be successful all work processes must be standardised.

3.13 POKA-YOKE

Wickens (1995:189) believes that prevention is better than cure and states that the technique advocated by the Japanese is *poka-yoke (*mistake avoidance), or

autonomation with a human face. Mistakes will occur, particularly at people-machine interface, and although with effective training mistakes could be minimised, it is not enough. It stands to reason that statistical methods of measuring quality or sampling methods can never achieve 100% assurance, although they do give useful information on the ability of a process to operate within tolerance limits. By its nature such methods do, however, mean that some errors will go undetected, that the mistake can be repeated and rectification work will need to be done. *Poka-yoke* attempts to fill this gap and aims to design the process to prevent mistakes or to detect them immediately and avoid repetition.

Bicheno (2004:137) describes a mistake-proofing device as: “A simple, often inexpensive, device that literally prevents defects from being made.” The characteristics of a mistake-proofing device are that it undertakes 100% automatic inspection (a true *poka-yoke* would not rely on human memory or action), and either stops or gives warning when a defect is discovered. Note that a *poka-yoke* is not a control device like a thermostat or toilet control valve that takes action every time, but rather a device that sense abnormalities and takes action only when an abnormality is identified. Shingo (1986) distinguishes between mistakes (which are inevitable) and defects (which result when a mistake reaches a customer). The aim of *poka-yoke* is to design devices that prevent mistakes becoming defects.

Robinson (1991:345) considers p*oka–yoke* to be the quickest road leading to attainment of zero defects.

As such it is proposed that a success factor element is:

SFE56: For lean to be successful the implementation of poka-yoke devises is essential.

3.14 KANBAN

The principle on which *kanban* is based is that just like the replacement of goods on a supermarket’s shelves, the authority to produce or move a part or product is based on the actual usage of the part or product. In other words only make to replace what has

actually been used, when it has been used, rather than what was planned or forecasted would be used. It thus relates to the pull philosophy discussed in paragraph 2.4.4. These signals or *kanbans* can have various forms, for example a card, an empty space, an empty bin returned or an e-mail.

Drew *et al.* (2004:73) contends that a *kanban* system can be used to introduce quick changeover times, correct signal levels and batch quantities, clear visual standards and levelled production. However, a *kanban* won't work unless people are disciplined and respect the rules of the system. Operators must not produce parts too early; they need to trust their colleagues and wait for signals from downstream processes; and they need to discuss problems with team leaders as soon as they arise so that they can be resolved quickly and don't threaten the stability of the system. Cooperation is equally important, and applies both to the internal relationship with teams and departments and the way that functions work together.

Greif (1991:106) also cautions that although *kanban* is a highly decentralised and unusually simple control method, its applicability is limited to essentially continuous logistical processes (that is standard products with a smooth demand). Bicheno (2004:107) warns that the following must be in place before a *kanban* system is introduced: reduced demand amplification, reduced changeover, more stable work through standard work, reduced defect rate, and reduced disruptions through breakdowns.

A success factor element could thus be:

SFE57: The introduction of a kanban system will ensure lean success.

3.15 LEVELLING

Jones (2004b & 2006b) believes that where basic stability (as discussed in paragraph 5.6) is the foundation for creating flow, levelling (*heijunka*) is the foundation for creating pull (as discussed in Chapter 2). Without levelling the organisation is fighting an uphill battle against constantly changing schedules, resulting in fire-fighting.

Stability on the shop floor, and all of the subsequent positives associated with stability, are the objectives of levelling. Levelling is thus critical to creating a lean production system, as it's the key to achieving stability. *Heijunka* means two different, but related, things. One is the levelling of production by volume. The other is levelling production by product type or mix.

The premises of levelling is that it is much better to calculate long-term demand for the product in question, and to run the production process very smoothly at the level of long-term demand.

In order not to disappoint the customer, whose demand is variable around the average, the organisation must calculate a standard inventory of finished goods at the end of the production process for make-to-stock items. For make-to-order items, the organisation establishes a standard inventory of parts just before the point of customisation. The size of this inventory is proportional to the degree of variability (the amplitude) of customer demand, the stability of the production process, and the frequency of shipments.

Obviously, if the variability in demand is such that several weeks of more than average demand can occur in a row, the organisation would need to decide just how much larger standard inventory should be so that customer demand could always be met, yet production levels would not need to vary. Some sort of statistical analysis of standard deviations would be required. At some point, for example if there is significant seasonality in demand, it might be better to adjust production than to carry larger standard inventories, but the organisation must try very hard to avoid frequent changes in output.

By carrying what seems to be extra inventory at the end of the production process (or at the point-of-customisation in the case of make-to-order items), the organisation would find that it can smooth production all the way upstream, and reduce inventories at every juncture between flow and pull along the entire stream. Costs are reduced and total inventories in the value stream are smaller as well. This is because a seawall of inventory has been built in the finished-goods area or at the point-of-customisation

to protect the production process from giant demand waves and troughs unrelated to the average level of demand.

Bicheno (2004:119) however warns that *heijunka* should be regarded as the final lean tool because so much must be in place for it to be a real success, for example cell design, mixed model, low defect levels, *kanban* loops, discipline, changeover reduction, and operator flexibility and authority. Levelling is thus the ultimate tool for stability, productivity and quality.

Considering the above, the following success factor element is proposed:

SFE58: For lean to be successful levelling of demand is essential.

3.16 OVERALL EQUIPEMENT EFFECTIVENESS

According to Godfrey (2002) the effective operation of individual pieces of production equipment, assembly lines or whole factories are dependent on three dimensions: the speed of the equipment (its cycle time), the quality of product it produces and the time that it is available to run. Thus, for equipment to operate effectively, the equipment must achieve high levels of performance against all three of these dimensions. For example, a machine that cycles at its design speed but produces rejects and/or is constantly breaking down is not effective in overall terms.

A metric can be applied to each of these three elements of performance as follows: if a press operates at 80 strokes per minute but has a design cycle speed of 100 strokes per minute it can be said that its performance rate is 80%. Similarly if the machine produces 90 good parts out of 100, it has a quality rate of 90%. If the organisation plans to run (load) the equipment for 8 hours and it breaks down for 2, its availability is 75%.

Viewed in isolation, these metrics are important indicators of plant performance, but they do not give a complete picture of the equipment's overall effectiveness. This can

only be understood by looking at the compound effect of the three measurements. If a machine runs slowly, produces rejects and loses production time through breakdowns, the cumulative effect is calculated by multiplying the three individual metrics. In the example above, a 90% quality rate, combined with an 80% performance rate and a 75% availability rate produces an overall performance of just 54% (0·9 × 0·8 × 0·75).

When equipment performance is looked at in this way people are often surprised by the aggressive erosion of performance that occurs. This combined metric gives powerful visibility to the overall effectiveness of equipment, and unsurprisingly, is known as the overall equipment effectiveness measurement (OEE).

However, Smalley (2006) reports that Toyota does not consider OEE as a good management metric because OEE has several flaws from a practical point of view. If one measures a number of items and multiply them together to get a number there is a possibility that it might give a distorted picture. It is better to have the different components understood and tracked individually, failing which one can't tell the difference between 75% OEE and 85% OEE. The former could be better if it was due to the production mix and number of changeovers. The latter could have fifteen percentage points of scrap for example and be a total disaster. OEE is also based upon machine cycle time and not on production line *takt* time, so driving a higher OEE can lead to over production and inventory build up. In a large workplace with many machines data collection might become problematic. At Toyota OEE is occasionally used as a spot analysis tool but not as a management metric.

It could thus be concluded that:

SFE59: The measurement of the OEE would result in successful lean implementation.

3.17 5S SYSTEM

Wickens (1995:171) is of the opinion that the realisation of benefits of lean requires high levels of housekeeping, a task which is much maligned because of inadequate understanding of its value. Whilst Western World management pays lip service to

housekeeping, to the Japanese management housekeeping is much more than just sweeping up. Lean introduced the 5S system, consisting of the following steps or pillars:

- *Seiri* (sort or consolidate) – Separate the necessary from the unnecessary and dispose the latter, thus removing all items from the workplace that are not needed for current production operation.
- *Seiton* (set in order or orderliness) – Put the necessary objects in a safe place, convenient for use, or a place for everything and everything in its place. Arranging needed items so that they are easy to use and labelling them so that they are easy to find and put away.
- *Seiso* (shine or clean up) – Sweeping floors, wiping off machinery, and generally making sure that everything in the organisation stays clean.
- *Seiketsu* (standardise cleanliness) – Routinely maintain cleanliness and order to prevent deterioration.
- *Shitsuke* (sustain discipline) – Train everyone to systemise the discipline. Making a habit of properly maintaining correct procedures. Without this pillar the other pillars will not last long.

The responsibility for achieving the required level of 5S lies with the operators, as in a lean organisation there is no army of cleaners to do cleaning and organising.

For Hirano (1995) thorough implementation of the five pillars of 5S is the starting point in the development of improvement activities to ensure the organisation's survival. In the daily work of an organisation, just as in the daily life of a person, routines that maintain organisation and orderliness are essential to a smooth and efficient flow of activities. Sort and Set-in-Order are in fact considered to be the foundation for achieving zero defects, cost reduction, safety improvements, and zero accidents. Furthermore, a neat and clean organisation is claimed to have higher productivity, produces fewer defects, meets deadlines better and is a much safer place to work. Bicheno (2004:53) considers the prime reason for implementing 5S to be standardised work, a concept discussed earlier in this chapter.

The above discussion leads to the formulation of the following success factor element:

SFE60: The 5S system is a cornerstone for successful lean implementation.

3.18 PLAN-DO-CHECK-ACT CYCLE

The essence of lean is continuous improvement. In this regard the major tool appears to be the Plan, Do, Check, Act (PDCA) cycle, which is considered by Bicheno (2004:100) as a foundation of the Toyota Production System (lean).

The Plan step in the cycle is not just about planning what to do, but also about communication, scoping, discussion, consensus gaining and deployment. It is claimed that leading Japanese organisations take much longer to plan, but than implement far faster and smoothly. In this step the organisation must determine customer needs, identify the concern or problem, set objectives, set out working plan, collect data and study, seek root causes, and train as necessary. The Do step entails carrying out the plan or improvement, whilst the Check step is to see if the improvement is sustained, if it is working as predicted and if not why not. The last step Act is to hold the gains (or standardise). Without this vital step all previous steps are wasted. The last step also considers if the new way can be incorporated elsewhere, and prepares for the next round of the cycle by identifying any necessary further improvements.

From this discussion it could be said that a success factor element is:

SFE61: Adhering to the PDCA cycle.

3.19 CHAPTER SUMMARY

This chapter provided a broad understanding or overview of the most popular lean tools and techniques (so called hard issues) normally associated with lean implementation, the impact of the tools on successful lean implementation, as well as the inter relationship or dependence on each other, in other words the integrated nature of the lean tools and techniques.

In general it can be said that the some of the discussed tools lack applicability in certain environments or manufacturing processes, for example *takt* time is only easy to be used in an assembly operation but not so easy to apply in a continuous process.

It is furthermore clear that the application of these lean tools and techniques in itself will not ensure lean success as there are a number of people or soft issues that could impact on the successful implementation of lean in South African manufacturing organisations. Sinnicks (2005), for one, is of the view that the tools and techniques are only a small part of the whole lean intervention. The people or soft issues appear to be ultimately the determinants of lean's success. These people or soft issues, which ise one of the four P's in the 4P model discussed in the previous chapter, will be considered in more detail in the next chapter.

CHAPTER 4

PEOPLE AND LEADERSHIP – THE SOFT ISSUES OF LEAN THINKING

4.1 INTRODUCTION

Liker (2004:36) is in no doubt that it is the people who bring the lean system to life: working, communicating, resolving issues, and growing together.

Annis (2006) agrees and states that as often is the case, it is not just the technologies or methodologies that ultimately determine performance. The key to long-term, sustained lean performance lies in the ability to generate ownership, buy-in, and commitment to continuous improvement as a way of life. The power of lean "…comes from a different, sometimes overlooked source – the people".

For Howardell (2004) all the goals of the lean organisation, namely reduced waste, faster throughput, reduced costs, and higher profits, can only be achieved through the efforts of the people in the organisation.

Drucker (1993) contends that the means of production is no longer capital, nor natural resources nor labour: "It is and will be knowledge." Wickens (1999:192) is of the opinion that the fundamental changes which have taken place in the world economy mean that advanced industrial societies with their high wage and social costs can only succeed by having a highly trained, flexible and innovative workforce willing to accept devolved responsibility, in short, knowledge workers.

Wickens (1999:ix & 26) further states that the guiding premises is that the only elements that really count in any organisation are the quality of the leadership and the quality of the people, and that it is the task of leadership to create the environment in which all people are energised to work together for the benefit both of the organisation and themselves. The central trust of what he terms the Ascendant Organisation is

about people. An organisation as such, achieves nothing. Machinery, computers and tools left alone for long, deliver nothing. Managerial concepts, theories, systems and procedures are produced by people for people. Leadership cannot exist without followers. Culture is about relationships between people. Only when people are brought into the equation does anything come to life. Without people there are no organisation, no problems, no solutions and no need for managers: “It is people, not robots who continuously improve both products and processes.”

It would appear that all the above mentioned authors agree with Iacocca (1984) that: “In the end, all business operations can be reduced to three words – people, products and profits. People come first. Unless you’ve got a good team, you can’t do much with the other two.”

Lean is much more than a combination of tools, methods and principles. According to Drew *et al.* (2004:xv) the mindset and behaviour of people operating the lean system are fundamental for success. Toyota’s ability to align these intangible factors with its operating system is probably the aspect of Toyota’s success that is most often overlooked; yet it is a key source of advantage: “It is precisely this interdependence between structures and organisational features on the one hand and human aspects on the other that makes lean one of the most difficult management techniques to apply.”

From the above discussions the following success factor elements are derived:

SFE62: The ability to align people issues with operating systems.
SFE63: Ownership, buy-in and commitment of the people.
SFE64: Only the efforts of people will ensure success.
SFE65: Knowledge workers are essential for lean success.
SFE66: Quality of leadership is essential for lean success.
SFE67: Quality of people is essential for lean success.

People issues are normally very complex issues, spanning over a number of other or related issues. In a lean context it appears to be no different and as such this chapter will not only deal with the role and impact of people in lean, but also other issues like

discipline, training and development, mindset and attitude, leadership, the role played by trade unions, performance management, as well as the issue of extra people and people who cannot operate in a lean environment.

These topics will not be reported on in detail but with only enough depth in order to identify potential elements of successful lean implementation.

4.2 LEAN PEOPLE

According to Liker and Meier (2007:4) Toyota leaders truly believe that Toyota's only source of competitive difference is the exceptional people they develop.

Wickens (1995:202) introduced the concept of lean operators which are operators that need to be flexible, to be able to contribute to improvement activities, to be quality conscious, to plan and deal with contingencies, to operate either alone or in teams, to work to and interpret instructions, to monitor and control progress and to practice care in all they do. Lean operators use their brains as well as their hands.

The above stated view fits well with the realisation by Womack and Jones (2003:116) that all the workers in the (then) new Lantech plant "…would be skilled workers, but with very different type of skills".

Howardell (2004) is adamant that in order to have a lean organisation, one has to have what he terms lean people. Lean people make a lean organisation, and as such the people have to become lean before the organisation can get lean. Liker and Meier (2007:21) seem to agree, stating that: "… it is not possible to operate a lean system without highly capable people".

There is no clear definition or consensus in the literature on what makes people lean. According to Howardell (2004) it is the convergence of three spheres: experience, knowledge, and skill. Specifically, people need experience in the organisation or industry, knowledge of the tools and techniques of lean, and the soft skills that allow

the people to put that experience and knowledge to work.

According to Wickens (1998:192) organisations can only succeed by having a highly trained, flexible and innovative workforce, in other words what he terms knowledge workers.

Drew *et al.* (2004:18) is of the opinion that: "…the way people think about what they do, their attitude towards their work, their aspirations and goals, and the effect these factors have on their actions need to be consistent with lean principles".

Finally, Liker and Meier (2007:18) describes the people that Toyota selects for employment as people having the capacity and desire to learn the seven skills claimed by Howardell (2004) to make people lean are customer consciousness, enterprise thinking, adaptation, taking initiative, innovation, collaboration and influence

Based on the preceding review the following success factors elements are identified:

SFE68: People must become lean before the organisation can get lean.
SFE69: People need to be knowledgeable of lean tools and techniques.
SFE70: People need to be experienced in their own function.
SFE71: All employees must be skilled in their jobs.
SFE72: Everyone in the organisation should be focused on creating customer value.
SFE73: Process or enterprise thinking orientation is essential for all employees.
SFE74: People must be adaptive and flexible.
SFE75: People must be innovation and creative.
SFE76: Consensus decision making must be the norm in the organisation.

4.3 CULTURE OF DISCIPLINE

Liker (2004:134) reports that at Toyota there is a culture of discipline about following the standard tasks that workers tend to adhere to, as a matter of course. The Aberdeen Group (2006c) agrees, stating that discipline is a key factor in Toyota's success, and that Toyota believes that United States organisations do not have the

same level of discipline.

Bicheno (2004:161) believes that the required discipline for lean success has a cultural slant, which is depicted by the description of the Japanese worker who is being criticised thanking the critic for their correction, followed by a bow of acknowledgement. This discipline is engrained in the Japanese culture and education system, and is the reason why discipline is so much easier for Japanese organisations to cultivate.

Collins (2001:13 & 121) contends that all organisations have a culture, some organisations have discipline, but few have a culture of discipline. When an organisation has disciplined people, the organisation doesn't need hierarchy. When the organisation has disciplined action, it doesn't need excessive controls. The purpose of bureaucracy is to compensate for incompetence and lack of discipline – a problem that largely goes away if one has the right people in the first place. Most organisations build their bureaucratic rules to manage the small percentage of wrong people on the bus, which in turn drives away the right people on the bus, which increases the need for bureaucracy, and so forth. The organisation should thus aim to avoid bureaucracy and hierarchy and instead create a culture of discipline.

The good-to-great organisations in the research conducted by Collins (2001) built a consistent system with clear constraints, but these organisations also gave people freedom and responsibility within the framework of that system. The good-to-great organisations hired self-disciplined people who didn't need to be managed, and then managed the system, not the people.

A culture of discipline thus starts with disciplined people. Next is disciplined thought – one need to be disciplined to confront the brutal facts of reality, while retaining resolute faith that one can and will create a path to greatness. Finally, one has disciplined action. The point is to first get self-disciplined people who engage in very rigorous thinking, who then take disciplined action within the framework of a consistent system.

The good-to-great organisations had leaders who build and enduring culture of discipline, in comparison those organisations that never became great had leaders who personally disciplined the organisation through sheer force.

The above justifies the following success factor element:

SFE77: A culture of discipline is essential for lean success.

4.4 IMPACT OF LEAN ON PEOPLE

Drew *et al.* (2004:154) is of the opinion that although people claim that lean is about working smarter, not harder, the truth is that removing waste from the process does often make people feel they are working harder because they spend less time on waiting and other activities that add little or no value.

Wickens (1999:60) seems to share the above stated view in submitting that in most lean organisations, with all the talk of eliminating waste and increasing labour productivity, the one element that is left out of the equation is the impact of ever-reducing waste and ever-increasing labour productivity on the people who are subject to the elimination of waste. Most organisations dress waste elimination up by talking about work smarter not harder, but reality is that as waste is eliminated (any activity that does not add value is waste) and people move towards spending 100% of their time adding value, the pressure on them can, in fact, increase even although each individual activity may be less strenuous. The fact remains that the elimination of waste does stretch the system and, if undertaken in isolation and taken to extremes, can create unacceptable pressures on people. The former is true whether the waste is excessive people, activities, space, time or stock (whether inventory, work-in-progress, buffer stocks or finished goods). Just - In - Time systems are sensitive and fragile, and susceptible to delays and interruptions when small problems can have a disproportionate effect on the whole operation and the people. The elimination of waste, in removing easy jobs, can furthermore create problems for the future as operators become less capable of handling those jobs which remain.

According to Liker (2004:192) Toyota, counters the impact of lean on people by means of the work group structure which gives the team leader a very small span of control. The team leader acts like "…an on-the-spot physician ready to jump in any time there is a problem". The team leader is also the safety valve, always walking the line and watching to see if there are any problems emerging, such as parts getting low or someone getting behind who needs assistance or relief.

The impact on the required skills, knowledge, training, attitude, culture, mindset, leadership and job security is discussed elsewhere in this chapter.

From the above the following success factor element is identified:

SFE78: For lean to be successful the impact of lean on people need to be properly managed.

4.5 LEAN TRAINING

Drew *et al.* (2004:5 & 140) recommends that people development processes should be linked with the overall improvement effort as by having a higher skilled workforce enabled Toyota to involve its staff in continually improving the process. By shifting the balance of investment away from capital equipment towards people, Toyota had found a way of increasing its flexibility.

According to Piatkowski (2006) what organisations tend to forget is that a total understanding is needed of all lean processes in order to successfully implement lean. Organisations need to have the right people involved in the lean implementation and need to follow a learning model developed by Toyota. Many organisations initiate training activities and attempt to implement different aspects of lean looking for a quick fix. It took Toyota over 50 years to develop what is now called the Toyota Production System (lean). Organisations cannot expect long-term results by rushing the implementation or not investing in training.

Liker and Meier (2004:xxiii) is adamant that the lean organisation cannot separate

people development from production system development if the organisation wants to succeed with lean in the long-run. For Toyota developing exceptional people is the number one priority.

Based on his experience in North America with Japanese training practices Piatkowski (2006) recorded the following key aspects of the Toyota training style:

- Training is done by managers and leaders
- On-the-Job training (OJT)
- Understanding the principles of lean
- Five necessary skills of a leader: Knowledge of roles and responsibilities, Knowledge of job elements, Training skills, Leadership skills, *Kaizen* skills
- Development of managers and leaders

Against the above background a number of success factors elements can be formulated:

SFE79: An investment in training of people is essential for lean success.
SFE80: Each manager or supervisor must be skilled in on-the-job coaching.
SFE81: Training must be according to the Toyota training methodology.
SFE82: Leadership and team leader development is of utmost importance.
SFE83: People to be trained in the conducting of kaizen workshops.

4.6 LEAN MINDSET AND ATTITUDE

Balle (2005) defines attitude broadly as ways of thinking or behaving. A more specific definition would be: “Tendencies to evaluate an entity with some degree of favour or disfavour ordinarily expressed in cognitive, affective and behavioural responses.”

Drew *et al.* (2004:7, 20, 166 & 174) is of the opinion that the mindsets and attitude of people help determine whether lean changes can be sustained over time. As such, any organisation implementing lean must go into more detail and decide precisely what kinds of mindset and attitude the organisation needs to promote so as to support

its new lean operating system. The organisation also needs to ensure that the desired ways of thinking and acting are consistently displayed by senior managers for others to observe and emulate. For Rubrich and Watson (1998:22) the most difficult part of the lean journey is accomplished through people by getting people to change how they think – when people start to change how they think they will start to do things differently.

Lean thus changes people's basic beliefs about work. For example, a pull system entrusts the front-line with much more responsibility. Because seemingly small actions or omissions can have enormous consequences, the new lean operating system has to be underpinned by new mindsets and attitudes. The sustainability of a pull system depends as much on people understanding why pull is needed and what role they have to play as on the calculation of batch sizes, stock levels or signal points.

Certain ideas, as per Drew *et al.* (2004:67-69) are common to all lean organisations and contribute to what might be called the lean mindset. Some of the lean principles run counter to the prevailing mindset in many conventional organisations, for example: Don't think big; think small and flexible; The front line is where the value gets added; Everyone in the organisation needs to understand how his or her actions contribute to the organisation's goals; The root cause of problems need to be addressed, not just the symptoms; and a problem is an opportunity to improve, not to blame.

This new lean mindsets drive new behaviours, which as per Drew *et al.* (2004:69-71) include: Decisions are driven by long-term systems considerations; Management is connected to the day-to-day reality of the front line; Front-line staff is engaged in real improvement activities; Managers work to resolve system problems; and there is an open dialogue between staff at different levels.

To understand the puzzle of lean implementation, Balle (2005) argues that it is not enough to focus on the cognitive dimension of lean without also considering its affective and behavioural dimensions. Successful lean implementation requires a slightly different understanding of lean, not only as a perspective, but a way to look at operational systems through the special lenses of value, flow, pull and perfection, thus

an attitude.

What follows is a synopsis of an article entitled *Lean Attitude* by Balle (2005).

The effective dimension to lean attitude that underpins the progress through a lean learning cycle appears to be lean obsession. Managers who manage to progress from one step to the next simply seem to get obsessed with lean - continually talking about lean; explaining every day occurrences in lean terms of *muda*, flow, and *takt*; and spend far more time on the shop floor driving lean than they do dealing with corporate demands of reporting and the ensuing politics.

This obsessive link to lean is closely tied to an emotional interest in the continuous learning process, and is a key aspect of the character of most innovators. In this respect, the affective response to work situations is a constant irritation at wasteful operations, and a relentless drive to eliminate them.

Lean behaviour turns out to be equally distinctive. The first striking aspect of lean behaviour is *genchi genbutsu* (go see for yourself) to thoroughly understand the situation. Unlike most managerial practices, discussions in lean happen on the shop floor, at the real place, in front of the real situation, with the people really involved. This anti-meeting room bias is emotional as well as practical, as it usually takes ongoing drive and leadership to pull executives or support functions away from their desk and down to the shop floor where value is actually added.

Another feature of lean behaviour would be challenge, or criticism, as well as never being satisfied with the results of an improvement activity.

Lean leaders are also far more focused on problem solving, trying to fix the problem, not fix the blame. Their first reaction to problems tends to be an on the spot problem analysis, followed by an assertion that more detailed problem solving is necessary. This verbal behaviour is actually strikingly different from the one why approach of most traditional managers that inevitably results in repeating the fundamental error of attributing the cause of the problem to an individual’s behaviour or character, rather

than to more systemic causes.

Last but not least, lean people have a rapid bias to action, preferring to test imperfect solutions, and learn, rather than wait to be in a perfect situation and postpone action indefinitely. Lean leaders never suggest directly how to resolve problems but would rather ask what people intended to do, encouraging them to try it and then discuss in great detail the outcomes of their experiments. The behavioural response to wasteful situations is to constantly challenge the status quo and experiment with alternative solutions.

A strong argument can be made for lean to be considered as an attitude more than a perspective, as it is believed that many failures in the attempts to implement lean start with a fundamental misunderstanding of how to acquire lean. Clearly, the cognitive dimension is key. Whereas perspective change is largely a matter of education and training, attitude change is a far more complex endeavour, and indeed there is no great consensus in the psychological literature on how this can be achieved, if it can be achieved at all. Nevertheless some aspects of attitude change have been well documented and have lean implications. The first one would be the reward feedback that the environment gives to the individual, the second model behaviour, and thirdly, the power of social comparison.

Overall, individuals are very sensitive to conditioning from their environment. Constant reinforcement of verbal expression or behaviour does generally lead to attitude change, particularly when the person is aware of which behaviour is targeted. In the context of lean implementation, one has to consider whether the local organisational culture reinforces lean attitudes, or undermines them. The affective aspect of obsessiveness and constant, outspoken criticism is usually strongly frowned upon in the traditional workplace. In the same vein, the lean behaviour of go and see, challenging and expecting rapid action, runs contrary to how most organisations behave. If such general behaviours are not addressed, lean is likely to remain a lot of talk and little walk.

Modelling can thus be a strong lever for change towards a lean attitude as much

learning occurs through following a model, particularly if he or she is considered to be competent, is part of a group of like-minded people, and has the power to reward the observer. Furthermore, repeated contact with the role model, until the observer perceives some shared characteristic with the model, will reinforce the effect. In the lean context, the above explains the indispensable influence of a lean *sensei* (see paragraph 7.5) on the success of a lean implementation.

Social comparison can be a strong factor of attitude forming and change: the sheer number of people around a person who hold and share similar attitudes will have a strong influence on the latter's own. In this sense Balle (2005) argues that an isolated lean pilot is very unlikely to change the attitudes of those around it, which would suggest that, to have a chance of succeeding, a lean implementation should start all the way from the top, and involve all sites and departments outright, rather than conduct pilot after pilot. This viewpoint is contrary to the view expressed in the section on pilot implementation discussed in paragraph 7.8.

In conclusion it is submitted that to understand and succeed with lean implementation it is necessary for the organisation to face and embrace the various attitudinal aspects of lean. Takenaka, the general secretary of the Asian Productivity Organisation Africa, as reported by Mokopanale (2006), seems to agree when he states that South Africa, like most Asian countries, needed to change workers mindsets to increase productivity as creativity and innovation are key qualities required for the workforce in the new knowledge economy - mere quality improvement and problem solving are no longer enough. What is needed is knowledge workers that always seek new ways of doing the job to create extra value. It is with this new focus in mind to innovate and create value that Africa must embrace the productivity improvement movement. Ultimately it is people, knowledge, skills and attitude that will make the difference.

Based on the above arguments it can thus be concluded that lean is not about changing things, for example how organisations look and run, but changing how people think, especially as one considers that Womack and Jones (2003) coined the term lean thinking and not only lean for the Toyota Production System.

It is thus important to take cognisance of Drew *et al.* (2004:182) when they state that lasting behavioural change is dependent on capacity building (the employee has the skills to behave in the new way), aligned systems and structures (the system encourages the employee to do so), role modelling (leaders are seen to behaving differently), and understanding and commitment (employee knows what he needs to change and wants to change).

Considering the preceding arguments the following success factor elements are formulated:

SFE84: A lean mindset and attitude is critical for lean success.
SFE85: People must change their basic believes about work.
SFE86: People must be obsessed with lean.
SFE87: Go see for yourself attitude must prevail.
SFE88: Focus should be on real problem solving and root cause analysis.
SFE89: A sensei must be involved with lean implementation.
SFE90: The organisation should start from the top and involve all functions from the outright (no pilot) in lean implementation.
SFE91: Organisation must face and embrace the various attitudinal aspects of lean.

4.7 TRADE UNIONS

Pieterse (n. d. a) reports that South Africa organisations have to deal with the reality of the heritage of an adversarial relationship between employees and management. Although this relationship is a leftover from the political past, the political clout of union groupings under COSATU (Council of South African Trade Unions) and other organisations have served to maintain this attitude.

Achieving an atmosphere of cooperation to the benefit of the organisation is made very difficult when every initiative is viewed with distrust and as a way to erode the power base of unions or to exploit the worker. In practice the situation is made even worse in an existing organisation where the power base of the unions has become consolidated along political and sometimes even family or racial lines.

The partnership for lean implementation can only be built upon trust, which can inter alia be shaped by providing guarantees that no jobs will be lost due to the lean implementation The lean implementation plan should thus include a strategy for redeployment of staff that are made redundant (see paragraph 4.10), and involving the unions from the start. It is recommended that the top local union official should be at the podium when the plan is discussed with the workers for the first time, the organisation could even consider having a union representative as a part of all implementation meetings.

The unions very often have an issue with the concept of multi-tasking as it affects the worker who in a lean system doesn't have the luxury of standing idle and watching the machines work. When one machine is loaded, the worker can move on to the next and is therefore constantly busy prompting unions to refer to lean organisations as sweat shops.

Jablanski (1992:103) agrees that if the organisation does involve union leadership early in the lean implementation process it may cause problems. However, if the organisation does not include the union in the process it will definitely cause problems.

According to Wickens (1995:69, 140 & 285) there is no need for management to be frightened of trade unions. Management, broadly, get the unions they deserve and if managers abuse their authority, they deserve to be checked. In some respects trade union influence will be strong in the short term when they seek to criticise but, as employees come to recognise that their success and security are integrated with that of the organisation, the role of unions tend to change. Long-term influence can best be achieved if unions recognise that the prosperity and security of the organisation and the employees are bound together and that they should work within the system, seeking to minimise the potential influence and ensuring that the benefits are properly shared. Unions are more likely to participate constructively if they are brought into the change process than if they are left outside. A constructive trade union will be able to make a constructive contribution to the debate – but it must be able to represent its members who collectively may have a different view about the organisation’s plans. A trade union is not the mouthpiece of management and management must not use it as

such.

Wickens (1999:230-245) points to a paradox in that trade unions reinforce many of the central tenants of scientific management as, by insisting on narrow job description (thereby protecting skills and restricting flexibility); by insisting that an operator is an operator is an operator; and by rejecting management attempt to use the brain as well as the hands, unions actually give further support to scientific management. The result is that the contribution of all operators is far less than their inherent capability.

It can thus be said that:

> *SFE92: Involving the trade unions in lean planning and implementation is critical for lean success.*
> *SFE93: Trust between the organisation and the trade union is critical for lean success.*
> *SFE94: If unions are not prepared to work with the organisation they should be resisted*.

4.8 LEADERSHIP

Meyer, Wall, Waddell and Markovitz (2007) simply states that lean management begets lean manufacturing, and that traditional management begets traditional manufacturing. It is thus argued that lean is a direct function of management.

In a similar vain Faull (2004) is in no doubt that leadership is central to lean implementation success. Wickens (1999:15) considers it a common mistake to attempt reengineering without the requisite leadership. Strong, committed executive leadership would appear to be the absolute *sine qua non* for any lean implementation.

For Wickens (1999:31) leadership in a lean environment is about creating the strategy, the values, the sense of purpose and the goals of the organisation, then living them so that all employees are inspired by them and come to share them. Lean leadership is about creating the environment in which leadership can be displayed at all levels; and in which all people are valued, can perform to their full potential,

establish their own goals, successfully implement their goals, and innovate. Lean leadership is ensuring that the gains of lean are sustained and that the organisation is continuously improved.

Jones (2005c) concurs and states that if the logic in the heads of management has not changed along with the physical operations then things slide backwards and no amount of *kaizen* will get the organisation out of that hole. What is needed is lean leadership at the top.

Jones (2005f) is further of the opinion that for too long frustrated employees have wanted to do the right lean things, only to be frustrated by the lack of real interest and understanding of lean from top management.

For the Kaufman Global Group (2003a) the key element in transforming an organisation from traditional to lean is also leadership. Lean organisations are not just traditionally run organisations that operate more effectively than in the past. Lean organisations are radically different in structure, methods and day-to-day management. The dramatic transformation from traditional to lean, even if done in a deliberate, planned manner, requires transformational leadership at all levels, from office to shop floor to executive suite, if the metamorphosis is to be completed in time (to survive in the market). Many of today's leaders would appear to be well versed in the definitions of lean and its methods and approaches, the problem however comes between knowing what lean is and understanding how to implement lean.

Drew *et al.* (2004:21, 124 & 128) believes that the senior management team must shape the organisation’s culture by setting expectations about employee behaviour. In any organisation most people take their cue from those with power and influence, and are much more likely to modify their behaviour if they see change being modelled by those at the top (see paragraph 4.6). For this modelling to work employees need to see their leaders on a regular basis; part of the lean challenge is that senior management must be much closer to front-line operations than ever before. Managers who want their employees to engage in the lean change effort must first be willing to engage with the employees. If the journey to lean is to be successful, the leadership

needs to define the target end state, develop plans to achieve it, and engage the wider organisation in turning these plans into reality. The process of developing a shared understanding of the target state is at least as important as the solution itself, and plays a crucial part in aligning the leadership team. As well as acting as architects of the lean implementation plan, leaders are also responsible for ensuring that the right people are in the right roles to deliver the lean plan, and that all of the leaders take personal responsibility for their particular piece of the overall lean implementation plan.

Senior managers should thus be involved in regular progress reviews, improvement activities and workshops. Senior Managers need to work alongside front-line employees to understand the issues as well as engage in problem solving. By taking part, senior managers demonstrate their commitment to lean and can see for themselves whether lean improvements are taking hold.

For Jablanski (1992:57) top management commitment is a commitment of corporate resources, including the executive's time, to the lean implementation process. Although accomplished along with other executives, the active, hands-on participation of the senior executive is essential.

The above forms the basis for the formulation of the following success factor elements:

SFE95: Strong committed executive leadership is an absolute requirement for successful lean implementation.
SFE96: Leadership on all levels must live and demonstrate lean behaviour.
SFE97: Transformational leadership must be present at all levels in the organisation.
SFE98: Leadership must actively take part in implementation activities on the shop floor.

4.9 TEAM LEADER

The Team Leader or Frontline Supervisor plays such an important role in a lean organisation that this grouping of leaders deserves to be discussed on its own.

Wickens (1995:104 & 111) is in agreement in concluding that whatever the attitudes of the top leadership, it is the people in the middle of the organisation, in particular the Team Leaders, who make things happen. Top managers can pontificate and inspire all they want but unless they get the Team Leader on their side they will fail. Team Leaders, if carefully selected, well-trained, highly motivated and given the status and pay appropriate to being the professional at managing the processes can make more difference to the long-term success of the organisation than any other group other than top management. And even here it is the Team Leader who delivers top management's policies in the workplace. The Team Leader should be at exactly the same level in the hierarchy as other professionals, the engineers, financial analysts, buyers, personnel officers and so on.

Based on hundreds of day-in-the-life-of studies of Team Leader activities before and after lean implementations the Kaufman Consulting Group (1999) compiled a comparison chart (see Table 4.1) that shows the percentage time that the Team Leader spent in various activities before and after the lean implementations. The emphasis of the traditional Team Leader was on expediting materials/information and dealing with emergencies. Note that after lean implementation the emphasis changed from reactive behaviours to process improvement and other proactive activities. The most valuable insight to be gained from this chart is realising that behaviour, (not executive decisions, policy development, restructuring, outsourcing, changes in the working environment, or any single element alone), drives all lean results.

The following success factor elements can thus be suggested:

> *SFE99: Team Leaders should be professionals at managing people and processes.*
> *SFE100: The Team Leader must focus on proactive process improvement rather than on reactive behaviour*

TABLE 4.1

COMPARISON OF TEAM LEADER ACTIVITIES PRE AND POST LEAN

Activity	Pre	Post
Expediting	20	2
Emergency problem response	20	1
Touring area	15	1
Paperwork	10	5
Staffing	10	5
Discipline	5	1
Meeting out of area	5	5
Problem solving	5	20
Managing improvements	2	20
Conducting safety audits	2	2
Providing safety feedback	1	3
Coaching work standards	1	5
Coaching error proving	1	10
Coaching workplace organisation	1	5
Conducting shift start meeting	1	5
Coaching cross-training	1	5
Lean planning/coaching	0	5
Total	100	100

Source: Kaufman Consulting Group (1999).

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4.10 EXTRA PEOPLE AND ANCHOR- DRAGGERS

Womack and Jones (2005:179 & 184) is of the opinion that any process revisions are disruptive of existing jobs and organisational boundaries. To deal with these issues, management must make simple and profound decisions at the outset, especially as to how excess people will be dealt with.

Wickens (1998:240 & 266) constantly emphasized that if employees are to contribute continuously to improving productivity which might eliminate their particular job, they must have security of employment. It is however important to distinguish between

employment security and a specific job security (people might have to be transferred to different jobs), as to suggest that all organisations embarking on a lean journey commit to blanket employment security would be crazy. Such a commitment can only be done when staffing levels are about right, a high degree of leanness has been achieved, core processes clearly defined, and much of the peripheral work has been contracted out. Only once the excess employees have been dealt with can security of employment be offered to those that remain.

It is thus important to take note of Drickhamer (2004) who points out that lean still has the connotation that it is about getting rid of people, in other words people may associate lean with lay-offs.

Womack and Jones (2003:132), contends that lean is profoundly corrosive of hierarchy and some people just don't seem to be able to make adjustments. It's essential that these anchor-draggers find some other place to work, or the whole lean implementation will fail. Drew *et al.* (2004:142) agrees that it is normal for a few people not to be able to change their way of working and recommends that in the long run, it's better for them and the rest of the workforce that they move on. Henderson and Larco (2000) however prefer confrontations and a few heart-to-heart talks to convince the "…concrete heads". Paris (200) on the other hand suggests ignoring those who chose not to conform to lean.

The importance of dealing with the anchor-draggers is made clear by Womack and Jones (2003:259) in stating that in every organisation they found a small group of managers, generally less than 10%, who simply could not accept the new lean ideas. The great mass was undecided. The problem was with the few who would never go along, because they sent an opposite message from the early adapters and took special pleasure in highlighting all the mistakes made along the path to leanness, and in so doing having a negative influence on the great mass in the middle and jeopardised lean success.

It can thus be said that:

> *SFE101: For lean to be successful security of employment must be guaranteed to the employees.*
> *SFE102: The organisation must deal upfront with excess people.*
> *SFE103: The organisation must get rid of people that cannot adjust to the lean way of doing things (anchor draggers).*

4.11 PERFORMANCE MANAGEMENT SYSTEM

Drew *et al.* (2004:52), based on their experience, states that an organisation's performance management system is often the weakest link in the management infrastructure that underpins the lean operating system. A great performance management system in a lean operation is much more than just a colourful set of reports, or the tracking of the right metrics; it goes right to the heart of management. A performance management system in a lean context calls for not only a clear system definition – the right metrics, supported by effective tracking and reporting processes, information technology tools and linkages to financial and other systems – but also the right approach to managing the dynamics of performance hour by hour, shift by shift, day by day, month by month. The people who operate the lean processes must be able to see and understand the critical measures of performance so that they can take the right steps to make high performance an everyday reality (see Visual Workplace in paragraph 3.9).

Accordingly, a success factor element is:

> *SFE104: The organisation's performance management system must support the lean objectives.*

4.12 SAFETY AND MORALE

The Toyota Production System Basic Handbook (s.a.) describes it as impossible to achieve significant quality, cost and productivity improvements without consideration

for safety and morale, especially as issues that effect individuals are critically important and must be addressed continually.

Improving workplace safety is considered an ongoing topic for continuous improvement as accidents occur when an employee is not following standard work procedures, the work area is unorganised (5S as described in paragraph 3.17), or when tasks are difficult to perform. Reducing workplace hazards is considered as showing respect for people, and safety should never be sacrificed in the name of productivity.

All Toyota employees are expected to contribute to a creative positive workplace. Continuous improvement recognises the creativity and problem solving ability of all employees and is considered to show respect for the individual's dignity and worth. Creating an environment of mutual respect, trust and cooperation is considered to be critical for making improvements and maintaining morale.

Thus, as a success factor element the following is submitted:

> *SFE105: A safe and hazardous free workplace is essential for lean success.*
> *SFE106: An environment of mutual respect, trust and cooperation must exist in the organisation.*

4.13 CHAPTER SUMMARY

This chapter has explored the critical role played by people in a lean transformation, as well as the training needs and methodologies required to prepare people for these roles. The important role of leadership and more specifically the Team Leader in creating the mindset and attitude required for successful lean implementation has been analysed. The role of for trade unions has been identified, especially in the light of the consensus in the literature that a lean transformation will ultimately result in excess people and in some people not being able adapt to the new lean system. It would appear that the secret to real progress toward lean success is to harness the

creativity of all employees within the organisation to achieve continuous irreversible improvements for the better the operations of the organisation.

Apart form the people or soft issues dealt with in this chapter, and the lean tools and techniques dealt with in the Chapter 3, a number of other concepts that could impact on successful implementation of lean in South African manufacturing organisations have been identified in the literature. These concepts, of a diverse nature, are the subject of the next chapter.

CHAPTER 5

LEAN CONCEPTS THAT IMPACT ON LEAN SUCCESS

5.1 INTRODUCTION

In order to identify all the potential elements that could influence the successful implementation of lean in South African manufacturing organisations a broad as possible understanding of the concept of lean, as well as related concepts is considered to be essential. Apart from the scope and basic principles of lean (Chapter 2), the tools and techniques (Chapter 3) and the people or soft issues (Chapter 4), a number of other lean concepts that could potentially impact on the success of lean implementation have been identified in the literature study.

These concepts are of a varied nature and some were alluded to in the previous chapters (for example the value stream manager, a structure to support lean, the specific manufacturing process, process thinking, basic stability, the key concept of waste, the role of technology, lean accounting systems, suppliers, planning and the South African culture).

As was the case in all the previous chapters the discussions of the concepts will be in only enough detail to allow for the identification of elements of successful lean implementation.

5.2 VALUE STREAM MANAGER

Womack (2004c) argues that lean processes need to flow horizontally across the organisation because every process touches more than one area, department, function, or business unit. In order to address the former the organisation must create smoothly flowing product family value streams, running horizontal through production

operations from the receiving area to the shipping department.

In support of this value stream process focus Jones (2005c), submits that the most promising approach to lean implementation is to create a small team, led by a high potential executive, operating initially outside the normal departmental structure and reporting to the top, free to challenge the conventional wisdom, the organisation's current assets and relationships. This team's main function is to evaluate the core value creating processes of the organisation from the viewpoint of the customer, and to work out how to flow value to the customer smoothly and with minimum effort. A member of this value stream team then becomes the Value Stream Manager for each value stream, leading the operational design and its roll out across the organisation.

Over time the office of Value Stream Managers will become the way to articulate the needs of each process to the functions across the organisation. Most employees will continue to work in their functions but the core design, production and support value streams become the customers for their work. Resolving conflicts and demands for resources from the business functions will now be based on value stream plans and not just the result of a power struggle for budgets, of chimney costing within each function or measure of asset utilisation. The whole organisation can then unite around the core objective of creating value for customers.

Womack and Jones (2003:320) also propose that the organisation must be reorganised by product family and value stream, stating that: "Just as we failed to understand the importance of the value stream map, we also failed to grasp the significance of the value stream manager." The Value Stream Manager is the person who leads the value stream mapping process and takes responsibility for removing the waste from the value stream for a product, while introducing flow and pull. The organisation must be changed so that all the needed skills within functional areas would be directly under the authority of the value stream manager. Toyota gets brilliant results from giving the value stream manager responsibility for the value stream and the success of the product, but hardly any direct reports or traditional authority. Instead, the Value Stream Manager develops the vision for the product, determines the current state of the value stream, and then envisions the future state.

The business functions than get treated as the suppliers of the essential inputs (that is engineering, operations, and lean knowledge) needed to reach the future state. If a business fails to perform, the Value Stream Manager typically goes directly to the most senior person in the organisation.

Research conducted by the Aberdeen Group (2006c) shows that 54% of better performing companies have Value Stream Managers in place.

The following success factor elements can thus be suggested:

SFE107: Appointment of Value Stream Manager to manage the complete value stream.
SFE108: Reorganise the organisation by product family and value stream.

5.3 ORGANISATION STRUCTURE

Womack and Jones (2005:180) recommends that the organisation must first define value, then define a process that provides the desired value, and then create an organisational structure able to operate the process, whilst Wickens (1995:148) is of the opinion that the organisation's structure must be an outcome of good management, not a substitute for it.

According to Drew *et al.* (2004:48-49) every organisation embarking on the lean journey will need to consider whether its formal management processes, organisation structure and capability-building infrastructure reinforce the new lean operating system. If the management infrastructure is not aligned properly, the operation is unlikely to achieve its performance objectives. Three key aspects of organisational structure determine whether it is aligned with the operating system: the size of the front-line team, the role of the team leader, and the spans of control and levels of hierarchy in the organisation. Womack and Jones (2003:17) are adamant that it's impossible to introduce lean flow concepts in an organisation where the senior management does not understand the lean concepts and where the very structure of the organisation does not support the lean concepts.

In lean the shift is away from the traditional functional organisation to a cellular organisation. Boyer (2004c) describes a functional organisation as an organisation in which all like processes are grouped together. For example, in a sheet metal fabrication organisation, all the punches are grouped together, all the press brakes are together, all the hardware insertion is together, and all final assembly is together. Characteristics of a functional organisation include large lot sizes, long travel distances, functional supervision, high work-in-process, slow response to quality problems, and long throughput times. On the other hand, in a cellular or flow organisation, all the processes required to produce a product are co-located. For example, a cell to produce a computer chassis may include a turret punch, a surface finisher, two press brakes, a hardware insert machine, and final assembly. Characteristics of a cellular or flow factory include small lots (one being the ideal), very short travel distances, one supervisor or lead person (and team) accountable for the entire product build, very low work-in-process, immediate quality feedback, and short throughput times. The layout of cellular or flow organisations moves all the raw material, purchased components, and manufacturing component parts to the point-of-use, reducing the need for multiple handling, kitting, redundant transactions, and dedicated material handlers.

With the move to a cellular structure or layout comes the move to teams and team areas. Research by the Aberdeen Group (2006c), for example, has showed that better performing companies are all organising their employees into teams that support value streams.

Wickens (1995:120, 121, & 58) also reports that in lean the trend is to develop focused cells equipped with all machines, controls, people and support needed to make a finished product, sub-assembly or component. The actual work organisation within a cell can vary considerably, depending on how much authority the management wishes to devolve, but usually the operators take on broader responsibilities. At a minimum, responsibility for quality and material movement are added to the production tasks but responsibility can extend to routine preventive maintenance activities, problem-solving, improvement, material ordering, scheduling, and so on. Some cells may even become virtually self-contained business units

responsible for their own cost and performance monitoring, relationship with suppliers, and the selection and training of their team members. The support of other business functions is, however, essential for successful cell manufacturing, for example the need to train the supervisors and the operators who will be working in the new system.

For Womack, Jones and Ross (1991) the truly lean organisation has two key organisational features: It transfer the maximum number of tasks and responsibilities to those workers actually adding value to the product on the line, and it has in place a system for detecting defects that quickly traces every problem, once discovered, to its ultimate cause. This in turn, means teamwork, amongst line workers and simple but comprehensive information display system that makes it possible for everyone in the organisation to respond quickly to problems and to understand the organisation's overall situation. So, in the end it is dynamic teamwork that emerges as the heart of the lean organisation. Building these efficient teams is not simple. First, workers need to be taught a wide variety of skills – in fact, all the jobs in their work group so that tasks can be rotated and workers can fill in for each other. Workers then need to acquire many additional skills: simple machine repair, quality checking, housekeeping, and materials ordering. Then the employees need encouragement to think actively, indeed proactively, so they can devise solutions before problems become serious.

In support of teams Greif (1991) promotes that teams need to have a place they can identify as their own – a place to meet, to review indicators of the status of the work, to post information, to display personal touches and symbols of their team identity as well as examples of their product. Development of a visual mode of organisation (see Visual Workplace in paragraph 3.9) depends on the existence of a territory in which the employees feel a sense of ownership. This team location is not exclusively held property, but rather displays the features of public property. This mixture of personal involvement and public access is key to success. A visual mode of organisation cannot develop if employees are not free to adapt their surrounding space. Maintaining the commitments and results that are displayed in work teams (quality objectives, production schedules, inspection instructions, and performance indicators) requires a close, familiar relationship with the setting where these messages will appear. To want to express themselves in an environment, people must feel at home.

Liker (2004:185) raises an important point. In studying the not so successful implementation of team or group structures at General Motors in the United States of America he came to the conclusion that the failure is due to the fact that General Motors did not have the Toyota Production System or the supporting culture in place. General Motors merely copied and appended the work group structure onto traditional mass production plants. The lesson was clear: “Don’t implement work teams before you do the hard work of implementing the system and culture to support them.” At Toyota all the other business systems are there to support the team based value-added work.

It can thus be said that:

> *SFE109: A focused cellular structure must be introduced for lean to be successful.*
> *SFE110: The organisation must be organised into teams that support value streams.*
> *SFE111: The organisation must transfer the maximum number of tasks and responsibilities to the employees actually adding value to the product.*
> *SFE112: Dynamic team work is a pillar of lean success.*
> *SFE113: The organisation must not implement work teams before the systems and culture to support teams are in place.*

5.4 THE NATURE OF THE MANUFACTURING PROCESS

For Vaughan-Jones (2003) the challenge in lean implementation is that many manufacturing facilities are a mix of jobbing, assembly and continuous processes. Yet many organisations come up with one set of measures, one mode of team and one set of management tasks across all the different manufacturing process types. A beverage manufacturer can learn only a limited amount directly by visiting a car manufacturer in Japan. There’s much to learn, but the organisation needs to be able to adopt what it saw to its own industry or type of manufacturing process before applying it blindly. As a result, it’s not uncommon for managers in continuous processing industries, for example, to take ideas out of textbooks or from visits to assembly-based facilities and plug them straight into their organisations with limited or no success. Once management understands the nuances between different process

types, they can decide who they are and to understand the inherent characteristics of their process type.

Jones (2004b) cautions that management often think lean is about building everything to order – whereas this is not always the case. In many cases lean is about rapidly replenishing stock the customer has just purchased. If one start by analysing the product families by process route and by frequency of demand one normally discovers a few high volume products that account for the bulk of the organisation's output. These items should be made-to-stock with the customer pulling from a pacemaker at the end of the value stream. At the other end of the scale the organisation may well have a tail of low volume products, accounting for a small fraction of the organisation's output that have to be made-to-order from a pacemaker at the beginning of the value stream. These value streams should be mapped separately and treated as two quite separate projects.

The following success factor element is thus proposed:

> *SFE114: It is important to understand the organisation's processes and apply only what is applicable to that specific process type.*

5.5 PROCESS MANAGEMENT

Jablonski (1992:33) defines a process as: "A series of operations linked together to provide a result that has increased value."

According to Jones (2003b) the reason for Toyota's lean progress over the years can be ascribed to brilliant process management as Toyota gets brilliant results from average people managing brilliant processes, whilst their competitors often get average (or worse) results from brilliant people managing broken processes. The real challenge of lean according to Jones (2003b) thus is: "How to go beyond eliminating waste in broken processes to creating brilliant processes."

Management must thus learn to see the organisation from a process perspective as lean is a business system focused on managing and improving processes by

compressing time rather than keeping each of the assets busy. Every organisation is a collective of several primary value creating processes (design and production) and a host of supporting processes (such as finance and maintenance) which must be managed as a whole and not separately.

Womack and Jones (2005:175) concurs and considers process thinking as an essential complement to strategic and financial thinking; involving the definition of the key value creating processes, working backward from the customer's complete specification of value. Process thinking thus involves rethinking the value adding efforts of the organisation.

The tool to be used to learn to see and to re-evaluate a process is value stream mapping (as described in paragraph 3.2) as this tool reveals how the current process operates today, as well as all the wasted time and effort in the process. It is both a consciousness raising exercise for all those involved and a powerful diagnostic of how broken the current process is.

Thus, the organisation must rigorously develop process thinking as the essential complement to the financial and strategic thinking that practically all senior managers rely on.

Based on this argument:

> *SFE115: The organisation must build brilliant processes and manage it as a whole, not separately.*

5.6 BASIC STABILITY

According to Drew *et al.* (2004:2) fire fighting is the norm in many organisations, and fire fighting is considered a symptom of an operation that is fundamentally unstable. Such instability is an inevitable characteristic of mass production. Womack (2004b) defines basic stability as meaning that each process step is both capable (able to

produce a good part every time it operates) and available (able to operate every time it is needed), as well as flexible.

Smalley (2005) submits that what Toyota has learned the hard way is that in the beginning of lean transformation the organisation needs lots of basic stability before it can succeed with the more sophisticated elements of lean. Certain pre-conditions are needed for a lean implementation to proceed smoothly. These pre-conditions include relatively few problems in equipment uptime, available materials with few defects, and a strong Team Leader at the production line level. In its simplest sense basic stability implies general predictability and consistent availability in terms of manpower, machines, materials and methods.

Womack (2004b) also contends that trying to introduce continuous flow by linking steps and connecting areas of flow with pull systems, whilst experiencing low operational availability, is certain to be an exercise in frustration. The only way these systems can work at all is with large buffers of work-in-process between each step and these inventories hinder further improvement by hiding problems.

In a similar vain Drew *et al.* (2004: 6, 16 & 150) argues that stability is a prerequisite for lean as the new lean operating system will be impossible to sustain if variation in materials, equipment performance, and working methods prevent a reliable product flow from being established. Clear operating standards must be devised to ensure that tasks are carried out consistently and safely, which should include the standard time taken for each task. Stability in the operating system also requires discipline in mindsets and behaviour (see paragraph 4.3). It can thus be argued that it is the capability to design and operate a stable platform that separates the winners from the also-rans in the field of lean implementation.

Womack (2004b) is of the opinion that low operational availability (thus instability) traces back to six types of problems:

- Downtime when a process won't run at all.
- Changeover time to convert from one product to the next.
- Minor stoppages of just a few seconds.

- Cycle time fluctuations when a process takes longer than planned.
- Scrap, meaning some production is lost.
- Rework in which parts must be run through the process again, reducing the time available for new products.

The most important point is that these problems do not go away with a bit of random *kaizen* and they certainly do not go away if organisations are only practicing breakdown maintenance without identifying trends and determining root causes (problem solving as discussed in paragraph 3.7). The above listed problems also appear quickly in new equipment (sometimes bought because the old equipment won't run enough to meet demand) unless the equipment is very carefully designed from a maintainability standpoint and then systematically maintained.

The challenge would appear to be to create a rigorous maintenance process that involves everyone, gathers the appropriate data, discovers root causes, and installs preventive or corrective measures so known problems do not recur, and new problems are anticipated (thus productive maintenance as discussed in paragraph 3.11).

With the above measures in place, the lean goals of flow, pull, and levelled production are vastly easier to achieve. Even better, as basic stability is created, organisations will discover that they do not have capacity constraints, they may find that they have too much capacity rather than too little.

It can thus be argued that:

> *SFE116: Basic stability in machine, manpower, materials and methods is essential for successful lean implementation*.

5.7 WASTE

According to Ohno (1988:4) the basis of the Toyota Production System (lean) is "…the

absolute elimination of waste". Thus central to lean is the complete elimination of waste as the ideal conditions for making things are created when machines, facilities, and people work together to add value without generating any waste.

Wickens (1995:65) also reports that the elimination of waste is central to the Japanese way, which is waste in every aspect of the organisation from inventory to walking time, from buffer stock to unnecessary inspections. In a lean environment waste is considered to be the great enemy and the greatest evil.

For Womack and Jones (2003:15) waste or *muda* means specifically any human activity which absorbs resources but creates no value. Wickens (1998:25) also defines waste or *muda* as anything which does not add value to the product or services.

Taiichi Ohno (Butcher, 2006) identified the following seven types of wastes:

- Overproduction – Producing more than what is actually needed by an upstream process or customer.
- Transportation – Unnecessary movement of product, materials and information.
- Inventory - Finished product, parts and supplies kept in inventory are a pure cost, not value, as they add additional cost by requiring space, additional facilities and equipment, and they may become obsolete before they are sold.
- Waiting - Waste of people and machine time whilst waiting for parts, materials or information.
- Motion – Unnecessary movement of people such as walking, lifting, reaching and stretching.
- Over processing – When a step in the process does not add value, as perceived by the customer, or a particular product feature is of no concern for the customer.
- Defects – Scrap and rework.

Wickens (1999:36) added an eight waste, the waste of underutilised employees, "…the waste of human potential which arises when managers fail to realize they are

not using people's abilities to the full, or worse, when they do realize but do nothing about it".

Annis (2006) warns that waste elimination requires knowledge and insight as to why the condition exists. Once that underlying causes (thus root cause analysis as discussed in paragraph 3.7) are clearly understood, developing a superior future state concept is usually straightforward.

In line with the above the following success factor element is proposed:

SFE117: The complete elimination of waste.
SFE118: A constant focus on waste identification and elimination by all.

5.8 TECHNOLOGY

The Aberdeen Group (2006a) reports that in many cases, technology solutions are enabling lean organisations to outperform their competitors by continuously measuring, monitoring, and responding to key production metrics in real-time, providing the foundation from which organisations are enshrining value streams, improving productivity, preparing for new product launches, and driving culture change throughout the organisation and supplier base. An Aberdeen Group (2006b) survey shows that best in class organisations are twice as likely to deploy Information Technology solutions as an integral part of their manufacturing performance management strategies. Findings indicate the use of enterprise applications was not as pervasive as is commonly believed. Where systems are deployed, integration remains a challenge.

Lean technology solutions should provide a solid foundation from which organisations can manage lean across core value streams that extend from the customer, through production, and back to the supplier. Technology should support lean by dynamically managing key control points, scheduling and tracking critical resources, and promoting continuous improvement programs. In addition to managing transactions,

technologies should facilitate the capture of standardised processes and value stream operating models.

Collins (2001:148-152) however, warns that it is never technology *per se*, but the pioneering application of carefully selected technologies that counts. Every good-to-great organisation they researched became a pioneer in the application of technology, but the technologies themselves varied greatly. The pioneering application of technology usually came late in the transition to greatness and never at the start.

Jones (2005d) concurs and states that: “Lean processes do not necessarily require high tech equipment or expensive IT systems. Technology alone is not enough.”

For Toyota, as per Liker (2004:161) technology is a tool that, like any other tool, exists to support the people and the process.

The Aberdeen Group (2006a) is of the opinion that the importance of maintaining a digital model of lean processes will become increasingly critical as more frequent product launches are driving the need to quickly modify line design, simulate process flow, and re-optimise key control points (for example *kanban* sizes, supermarkets and *takt* time) to ensure rapid and accurate changeovers and restarts. Ensuring quality products and processes requires a closer alignment between engineering and manufacturing than what currently exists in many organisations.

Donovan (2005d) reports that over the past two decades, manufacturing organisations have lagged behind other industries in adopting new technologies and tools, which is especially odd as many of these new tools and technologies (especially in information technology) have tremendous power for storing, processing, and communicating massive amounts of the right information seamlessly and in real time.

Two main technology systems have been identified in the literature.

5.8.1 Enterprise Resources Planning

Boyer (2004b) defines Enterprise Resources Planning (ERP) as an organisation wide information system that describes the fully integrated and functionally complete manufacturing software products, involving demand management, order entry, production management, distribution management, warehouse management, transportation planning, human resources, and others. ERP is a wonderful tool for planning as it can provide management visibility on material and capacity issues, subject to being setup and used correctly. The latter meaning data elements are provided for proper information aggregation for management, the system contains only valid dates for computing requirements, and information is available in a timely and fit-for-use condition for all users.

An Aberdeen Group (2006a) survey shows that most organisations are using their ERP systems to manage enterprise processes such as customer orders, financials, purchasing, supply chain, and manufacturing planning. According to this survey, 62% of manufacturers are able to leverage at least a portion of their ERP capabilities to perform these (as well as other) major enterprise processes. In addition, lean leaders are beginning to look to their ERP vendors to help manage supplier collaboration electronically to avoid issues associated with language, culture, and 12-plus hour time zone differences.

Boyer (2004d) has a basic problem with ERP in lean manufacturing as in general, while manufacturing has become much simpler, ERP systems have become more complex. Many ERP systems have retained traditional functionality and have not kept pace with the internal workings of high performing manufacturing operations. To combat this problem, many organisations who have state-of-the-art ERP systems have embraced other tools to provide the information needed for day-to-day operations. Spreadsheets are used to post-process information (or worse, as the primary disconnected source of information). Off-line databases are used for backlogs and shipping requirements. People are employed to put information in a fit-for-use condition simply because the ERP system can not do it. Critical day-to-day

functionality in many ERP systems is missing or has not kept pace with operations simplification.

Despite the concerns expressed above Boyer (2004b) is still of the opinion that connecting ERP planning with lean manufacturing execution is a missing link for most manufacturing organisations. The challenge would appear to be how to use ERP and how to execute manufacturing using visual *kanban*, and thus eliminate the need for work orders.

Jones (2004d) on the other hand is of the opinion that in lean manufacturing ERP systems should not be used as a production instruction tool, but be kept only for capacity and materials planning as demand trends change.

5.8.2 Manufacturing Execution System

The class of tools called Manufacturing Execution Systems (MES) allows for highly effective links between operations on the shop floor and the business systems that are tracking customer orders, production costs and material inventories. By appropriately constructing those links, manufacturing events can be more carefully synchronised with supply chain drivers, which can tremendously improve overall business performance.

The Aberdeen Group (2006a) reports that MES solutions play an important role in the daily operations of many lean organisations, particularly in high-volume or highly complex production environments. These solutions are designed to publish weekly schedules and daily sequences; to manage the flow of product; and consistently collect shop floor data relative to material flow, process and component traceability, resource performance, and quality conditions. The MES systems are often supported by barcode and wireless technologies, and combined with electronic *kanbans*, sending triggers upstream and to suppliers as materials are consumed.

MES operator control panels can deliver *poka-yoke* (see paragraph 3.13) as such a

system validate orders before they go into production by enforcing the setup, ensuring inventory availability, verifying that selected operators have received the correct training, and ensuring that all needed tooling is accessible.

Against the above background it can be argued that:

> *SFE119: Technology is essential for successful lean implementation.*
> *SFE120: Technology should be considered as a tool to support people and processes, not as an enabler of lean.*

5.9 LEAN ACCOUNTING

Because the conventional standard cost accounting systems make machine utilisation and employee utilisation their key performance measure while treating in-process inventories as an asset, even if no one will ever want them, it's not surprising that managers also fail to grasp that machines rapidly making unwanted parts during 100% of their available hours and employees earnestly performing unneeded tasks during every available minute are producing waste or *muda* (Womack & Jones, 2003:60). As such Maskell and Baggaley (2003) argue that traditional standard costing systems actively motivate non-lean behaviours.

Bicheno (2004:193 – 194) reports that after centuries of little change the basic assumptions of accounting are at last being questioned in the light of lean and the Theory of Constraints (discussed in paragraph 6.4). The lean focus is on the Management Accounting side which is used for decision making purposes. A new field of lean accounting is being developed that should provide the organisation with:

- More reliable information for decision making – ability to identify factors that are becoming uncompetitive, and opportunities for improvement.
- Positive support and evidence for doing the right things – fast flexible flow, reducing inventories and lead times, improving quality and improving delivery performance.
- Financial numbers that is able to be understood by non-accountants.

- A simplified system that eliminates waste and unnecessary transactions – tracking only the absolute minimum transactions with the lowest frequency possible.
- A system that highlights when to take action, but more importantly when not to.
- Guidance on medium term product costing and target costing.
- Excess information must be suppressed.

A lean accounting system should, furthermore:

- Work towards direct costs. Rather than trying to solve the overhead allocation problem by some elegant procedure such as Activity Based Costing, it should set an objective to decentralise overhead functions such that they can be directly associated with cells or product lines.
- Allocate the remaining overhead in a way that supports lean.
- Eliminate variance reporting.
- Eliminate detailed product cost reporting. Instead does a periodic estimation exercise together with line managers.
- Look ahead rather than back. Report product contributions rather than product cost.
- Reduce the number of transactions.
- Reduce reporting time.
- Get accountants to think about variation of costs rather than cost variances.
- Report by exception.
- Get accountants to think common cause and special cause.
- Reduce the frequency of reporting intervals.
- Clarify the presentation of accounts so all can read them.
- Concentrate on cash flow. It is money going into and out of the organisation that is of prime importance, not the transfer price or factory recoveries.
- If the organisation has constraint resources, focus cost around these constraints.

Considering the preceding arguments the following success factor element is

formulated:

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SFE121: The organisation should convert from standard costing and accounting model to throughput accounting model.

5.10 SUPPLIERS

According to Greif (1991:162) organisations that have selected just-in-time methods (see paragraph 3.6) have found it necessary to modify extensively their relationships with suppliers.

Jones (2005g) agrees as for him it is apparent that the practice of simply squeezing supplier margins is reaching the end of the road. There is a limit to how much margin there is left to squeeze as raids on margins are having a serious damaging and even perverse effect on supplier performance.

The term partnership sourcing which is where the customer and the supplier develop such a close and long-term relationship that the two work together as partners, is coined by Wickens (1995:208-209). It isn't philanthropy, the aim is to secure the best possible commercial advantage based on the principle that teamwork is better than combat. Partnership sourcing works because both parties have an interest in each other's success, requiring the rejection of the master-servant syndrome where the supplier is merely told what to supply and the customer told the price. Instead the partners agree on common goals and build the commitment, trust and mutual support necessary to achieve them. Central to partnership sourcing is the establishment of a long-term relationship so that the environment is created in which the supplier has the confidence to invests in its design and development capability, its facilities, and in particular its people.

Jones (2005e) further contends that increased supplier relations may also mean choosing suppliers located closer to the point of assembly. It will certainly mean building a very different relationship with key suppliers to conduct joint value stream

analysis around target cost rather than cost plus objectives.

Womack and Jones (2003:207 & 266) is of the opinion that an organisation will not get very far along the path of leanness unless the organisation get its suppliers and customers to also implement lean. An organisation that squeezes the suppliers margins generally do nothing for the supplier's costs and lead times because the supplier simply does not know what to do. The only alternative for the lean organisation is to actually fix the production, product development, and order-taking systems of the supplier by sending the organisation's lean implementation team to help. An example is Porsche where it was immediately apparent that teaching the suppliers to see the benefits of lean was as critical as teaching Porsche's employees.

Liker (2004:202) provides a good description of how Toyota regards and deals with suppliers. Toyota views new suppliers cautiously and gives only very small orders. The suppliers must prove their sincerity and commitment to Toyota's high performance standards for quality, cost and delivery. If the suppliers demonstrate this for early orders, they will get increasingly larger orders. Toyota will teach the suppliers the Toyota Way (lean) and adopt them into the family. Once inside, the suppliers are not kicked out except for the most egregious behaviour. Toyota's view is that just as it challenges its own people to improve; it needs to challenge its suppliers. Supplier development includes a series of aggressive targets and challenges to meet those stretched targets. The result is that suppliers want to work for Toyota because they know they will get better and develop respect among their peers and other customers.

The above justifies the following success factor elements:

SFE122: Close relationship with suppliers.
SFE123: Long-term relationship with suppliers.
SFE124: Supplier development programmes.
SFE125: Suppliers to implement lean thinking.
SFE126: Constantly challenge suppliers to improve.

5.11 PLANNING

Boyer (2004b) defines planning as an activity to look into the future for making resource decisions. The questions dealt with by planning include:

- How much material is needed, especially for long lead-time high value items?
- How much labour is needed?
- How much critical machine or line capacity is needed?
- How much supplier capacity is needed for outsourced operations?
- How much cash is needed to support operations?

Many lean implementations appear to have ignored or inappropriately discounted the importance and the proper design of lean planning, instead focusing on executing activities (which includes pull systems, 5S and visual control) whilst almost none focus on planning activities. Planning and execution should work together as they are not mutually exclusive. By doing planning activities correctly, resources are positioned and managed in a way that the benefits of lean can be fully realised.

As discussed earlier, most lean manufacturing organisation designs result in some form of structured line flows or cells dedicated to specific product groups. These lines or cells produce an item from start to finish without any significant amount of work-in-progress. Materials are stored at the point-of-use and come directly from suppliers or from feeder departments via *kanban* execution replenishment.

To achieve the desired line balance, equipment configuration, and staffing, a run rate by line or cell is needed (see *takt* time in paragraph 3.3). This rate must be projected for several weeks or months into the future to accommodated needed changes in terms of equipment, people, and materials. Forward visibility is necessary because of the time generally associated with making these changes. Sometimes the rate is level, sometimes it is increasing over time, and sometimes it is decreasing.

The business process for determining the production run rate by line or cell is called Sales and Operations Planning (Boyer 2004a). The objective of Sales and Operations

Planning is for the top management team to reach agreement on booking, shipment, and production rates; backlog and inventory levels; and capacity requirements. All detailed planning must derive and flow seamlessly from this plan.

Some lean manufacturing organisations are tempted to dismiss Sales and Operations Planning as not needed since *kanban* signals prescribe what to build daily for customer requirements. *Kanban* signals, however, are part of the execution process, whilst Sales and Operations Planning is part of the planning process that is critical to properly balancing demand and supply on a regular and formal basis to properly resource the organisation. Having the proper Enterprise Resources Planning systems tools (see paragraph 5.8.1) to accommodate the Sales and Operations Planning process in terms of data retrieval and presentation of fit-for-use information is critical for Sales and Operations Planning to work properly.

Accordingly the following success factor element is identified:

SFE127: Sales and operations planning systems must be in place.

5.12 DATES AND DATA

The lean organisation is essentially prioritised on due dates. Even the most carefully worked out lean manufacturing *kanban* replenishment systems are date sensitive. For example, when a *kanban* signal arrives, replenishment must occur within five days, the due date is five days from today (Boyer, 2004a).

The lean organisation must thus operate from valid dates. Valid means a couple of things. First, no current date is ever past due. If today is the 1st of March and the current ship date in the system says 20 February, the date is not valid as it is not possible to ship in the past. The date has changed and the only outstanding question is whether to formally deal with the changed date or not. The lean organisation will keep the date valid by changing the date to the date that represents the current best estimate of the truth. Second, future dates that are suspected to be invalid due to

material or capacity problems must be updated when a change is suspected.

Most organisations, however, still want to know performance based on customer needs and original promises. This is easily accomplished by having three dates associated with each order line: request, original promise, and current. The current date is the system positioner and must be kept valid. The others are used to assess performance.

This concept of date management applies not only to customer orders, but also to work orders or schedules, and to purchase orders to the extent that they are used. In all cases, dates must be valid. It is the only way to make crisp and fast priority decisions for answering the when question.

In a lean environment it is also essential that the data must be flawless. Information for answering simple questions must have one answer. If the data is not flawless, waste appears in terms of duplicate systems, data chasing, refiguring, unnecessary communication, and debates about who has the right number.

Against this background the following success factor elements are formulated:

SFE128: The whole organisation should be date driven.
SFE129: In all cases dates must be valid.
SFE130: Data must be flawless.

5.13 SOUTH AFRICAN SITUATION

Schifferes (2007) reports that Toyota does have a worldwide organisational culture that transcends Japan. This global culture is a hybrid system where Toyota takes the best of every culture and distils that into a system that really works effectively in every country where Toyota does business. The Toyota philosophy is to think globally, but act locally.

Pieterse (s.a.b) is of the opinion the lean practices were devised in Japan, with its own set of geographical, business and demographical factors and that South Africa has to adapt lean practices to make them fit to local South African conditions.

This adaptation seems to be possible, as Shingo (1981:18) submits that if lean is reviewed from the standpoint of fundamental production control system, lean must be applicable to factories in any country as a universal production control system, being adapted to the characteristics of each organisation.

Piatkowski (2006) agrees and states that: “Thousands of executives from hundreds of businesses have toured Toyota plants in Japan and in North America. Frustrated with their inability to replicate Toyota’s performance, many visitors assume that the secret of Toyota’s success must lie in its cultural root. But that’s not the case.” Toyota has very successfully launched several manufacturing plants in North America employing American and Canadian workers. Many of these plants have outperformed their sister plants in Japan, and as such “…failure to implement lean in North American cannot be blamed on our culture”.

Based on this argument a success factor element is:

SFE131: Lean practices must be adapted to fit the local culture and conditions.

A number of country (or macro) specific issues that could have an influence on the success of lean implementation in South African manufacturing organisations have been identified in the literature.

5.13.1 Culture

Wickens (1995:310-312) states that there are numerous influences on the culture and behaviour of people. The Japanese ethical system built on the teachings of Confucius clearly has an influence, but so too does the fact that historically the Japanese formed a nation of mutually dependent farmers with the person who disrupted the village

harmony being ostracised. Japan's long period of isolation, during which there developed the practice of interdependent allegiance between servant and master, no doubt played a part. The code of the warrior (*bushido*) emphasised winning, but also honour in personal relationships. The first true constitution of Japan, promulgated by Prince Shotuko Taishi in AD 604, stipulated that the principle of all societies and communities was *wa (*harmony). The desire to emulate Western World standards without losing Japanese values was the guiding spirit of the *Meiji* Restoration in 1867, which began the emergence of the Japanese nation from isolation. No doubt the fact that Japan is one of the most homogeneous industrial nations in the world helps achieve an intuitive understanding of lean within a unified culture (Wickens, 1995:311).

The Japanese tend to value group harmony more than individuality and it is not surprising, therefore, that group-oriented ideas have been adopted in corporate management practices. There is a belief in Japan that a person who works diligently will gain social recognition and work is regarded as something of a virtue, an integral part of a person's life and consequently that it should be enjoyable; which leads to independent efforts on the part of workers to improve their jobs and to upgrade the quality of their work. In addition, since changing jobs is relatively rare in Japan the work that an individual does within the framework of a single organisation takes on a great deal of importance in his personal life. Therefore, there is a strong feeling that if one contributes to his organisation by working hard, his efforts will be rewarded and his private life will be enriched accordingly (Wickens, 1995:311).

These deep-rooted social and cultural values clearly impact on Japanese behaviour in the workplace and in particular on the following areas: the primacy of the group, the commitment to security of employment for the core workers, the prime importance of the quality of the product or service, always achieve the required schedule, absolute control of the process, continuous improvement, the elimination of waste in all its forms, rapid product development from concept to market, simultaneous engineering, and a long-term view of investment.

The literature also describes a number of customs and approaches in the South

African culture that could, if compared with the Japanese culture, impact positively or negatively on the success of lean implementation in South Africa:

- Ill-discipline: Fuelled by the past political situation and revolt against the system and the government, resulting in not much regard for the law which seems to continue even in the new dispensation (Pieterse, 2006). The high crime rate and disregard for traffic laws are examples.
- The assumption that management knows best and that only the industrial engineers can change how things are manufactured (Pieterse, 2006:121).
- Ethnic differences, which reflects the cultures of the individuals in the organisation. Pieterse (2006:123) is of the opinion that lean depends for much of its success on the contribution of people working in groups. People from certain South African cultures tend to prefer working on their own and to perform individually, whilst people from other cultures are used to work in groups - individuality by whites and *ubuntu* by blacks. *Ubuntu* provides some similarity with Japan's culture. Bicheno (2004:159) describes *Ubuntu* as a word used in South African management circles to mean the fusion of modern management with tribal thinking. In an African tribe there is a hierarchy, but anyone may speak and will be listened to sympathetically in the knowledge that anyone can have good ideas. The literal translation from the Zulu is to do with dignity and humanity, or a person becomes a person through other persons, or I am because we are. In tribal societies there is the concept of the extended family with mutual help being given between age groups and between immediate family groupings. In South Africa, *Ubuntu* has come to mean a more people orientated approach. It is a team-based approach to management - we are all in this together. So, that's not *Ubuntu* means it does not suit the aspirations of all; it does not fit in with the common good, it may suit the management and may even be the optimal economic thing to do, but some will be harmed. *Ubuntu* is thus very much in line with, or should be in line with, lean and South African management should capitalise on it.
- The political baggage of the past results in misgivings about personal objectives and motivating factors (Pieterse, 2006:124).

- Slow and persistent culture of work, which fits with the Liker and Meyer's (2006:145) view that Toyota would always prefer a slow and consistent pace of work.

A success factor element specific to South Africa could thus be:

> *SFE132: South Africa should capitalise on the Ubuntu concept in the implementation of lean.*

5.13.2 Skills shortage

Yudelowitz (2006), joint MD of consulting firm YSA and author of *Smart Leadership* expresses concern about the lack of skills across all sectors of the South African economy. The situation is worsened as there also are tensions about the sourcing of the skills on the one hand and the requirements of the Employment Equity legislation on the other hand. The latter involves filling positions with previously disadvantaged South Africans, while the former challenges organisations to employ whoever has the competence necessary to do the job. It would appear that the dilemma of finding and nurturing skills will change South Africa much more than did the advent of democracy.

Njobeni (2006) reports Tony Twine, Economix director, as saying that most industries can get by with the available skills. The crunch, however, comes when they have to do things better and smarter, as is required for lean implementation.

It can thus be said that:

> *SFE133: To implement lean successfully South African organisations have to find a solution for the skills shortage.*

5.13.3 Unemployment

According to Stats South Africa (2008) the official rate of unemployment for March 2007 was 25,5%. Hazelhurts (2006b) is of the opinion that if people who have given

up looking for a job are included, the official unemployment rates figure is nearer to 40%. As stated previously the implementation of lean will eventually result in less people employed in the organisation. There is thus a direct conflict between lean implementation and the need to alleviate the unemployment dilemma in South Africa. This obviously brings into the picture the support of the trade unions, as discussed hereunder.

It can thus be suggested that:

> *SFE134: For lean to be successful South Africa will have to find answers to the unemployment issue.*

5.13.4 Resistance by trade unions

According to Pieterse (2006) a reality South African organisations have to deal with, is the heritage of an adversarial relationship between employees and management. Although this is a leftover from the political past, the political attitudes of union groupings under the Council of South African Trade Unions (COSATU) and other organisations have served to maintain this adversarial attitude. Achieving an atmosphere of cooperation to the benefit of the organisation is made very difficult when every initiative is viewed by labour with distrust and as a way to erode the power base of unions or to exploit the worker. In practice it is made even worse in an organisation where the power base of the unions has become consolidated along political, ethical and sometimes even family or racial lines.

Refer to the previous chapter for a more detailed discussion on the role and impact of trade unions in general.

5.13.5 Distance

Pieterse (2006:126) reports that Japanese organisations have the advantage that their suppliers are close at hand and delivery of small quantities on a regular basis is a

relatively simple matter. In South Africa organisations usually do not have that luxury and materials have to travel long distances, sometimes spending several weeks on a ship. Just-in-time, for one, becomes very difficult to implement.

5.14 MONUMENTS

Bicheno (2004:64) considers the small machine concept as one of the least recognised lean facilitators. The general principle is to use the smallest machine possible, consistent with quality requirements. Several smaller machines instead of one bigger, faster monument allows flexibility in layouts, easier scheduling, reduction in material handling, less vulnerability to breakdown, less vulnerability to bottleneck problems, possibly reduce cost, improve cash flow and more frequent technology updates.

The problem is that, according to Jones (2004c), most engineers designing new equipment still dream of the even bigger, better, faster and more capable machines. As a result one often see ridiculous situation of a huge line of big machines stretching across the shop floor making a piece that can fit into one's hand. Bigger machines are not the future; simpler, cheaper and more manual systems are, as they require less operator knowledge and can be moved around the world very easily, greatly facilitating the compression of each value stream so that as many value creating steps as possible can be placed close to each other. Not only are these clever but simple machines less expensive, but capacity can be added (and removed) in smaller increments to mirror changes in demand over the lifetime of the product in each region.

Womack and Jones (2003:176) define a monument as any machine which is too big to be moved and whose scale requires operating in a batch mode. The term also applies to anything that requires batches to operate and can't be moved as the value stream changes. Because continuous improvement and changing processing requirements require the continuous movement of machines, monuments can be considered as another form of waste or *muda*.

This observation leads to the following success factor element:

> *SFE135: Elimination of large, inflexible machines that requires operating in a batch mode is critical for successful lean implementation.*

5.15 DESIGN FOR MANUFACTURE

Bicheno (2004:171) considers design for manufacture as a key enabling concept for lean. Easy and fast assembly has an impact right through the manufacturing life of the product, so time spent up front during the design phase is time well spent. The design should consider cost of components, cost and ease of assembly, support costs, design for no change over or minimal change over, design for minimum fixturing, minimum number of parts, and complexity of assembly and complexity of design.

It can thus be said that:

> *SFE136: For lean to be successful machines and products must be designed for manufacture, considering ease of assembly, minimal change over, and so forth.*

5.16 CHAPTER SUMMARY

This chapter highlighted numerous concepts (other than the principles, tools and techniques, and people and leadership discussed in previous chapters) that could impact on the success of lean implementation in a South African manufacturing context. By now it should be clear that the scope of lean is very broad, not only impacting on all aspects of the organisation, but also being impacted upon by numerous and wide ranging concepts and issues.

The next chapter will review other related organisational improvement programmes that could impact on lean or that could shed further light on the critical success factors for successful lean implementation. These improvement programmes should also assists with the last chapter in the literature research, being the lean implementation

methodology, as well as with the defining of the sample population for the empirical research.

CHAPTER 6

LEAN THINKING: OTHER IMPROVEMENT PROGRAMMES

6.1 INTRODUCTION

There are a number of other improvement programmes available in South Africa that claims to be related to, or based on the philosophy and principles of lean. Goldratt (1990:109) is of the opinion that most of the approaches to organisational improvement usually provide a significant contribution. These programmes may emerge from different angles and may be based on different facets of the established base of knowledge, but this does not mean that only one programme is valid and all the others are wrong.

The argument is that an organisation does not have to choose one programme over the other or one programme at the exclusion of the others. As such a study of some of these other approaches might contribute to the primary objective of this study, being the identification of the critical success factors for lean implementation in South African manufacturing organisations.

A study of these improvement programmes will also confirm, or otherwise, that the programmes are close enough to lean in order for people with practical experience in these programmes to qualify as respondents to the empirical research, in other words they are considered as having sufficient practical experience with or knowledge of lean.

As such this chapter will only provide an overview of the identified programmes, in other words only enough information will be provided in order to determine if the programme is closely related to lean, as well as to identify success factor elements.

From the preceding chapters it is furthermore clear that lean brings about drastic

changes in the organisation, and a such it is considered important to review the principles of change management as it might contribute towards the successful implementation of lean, and as such the stated primary objective of this study

6.2 CHANGE MANAGEMENT

It is submitted by Parks (2002) that as creating a lean organisation requires changing the corporate culture a robust change management strategy is needed.

Donovan (2005d & 2005e) contends that: “The difficulty in changing mind-set, at all levels of the organisation, is a task that should not be underestimated; but the bias must be changed or one will not succeed at achieving the levels of performance of truly lean manufacturers.” Accordingly one more thing is needed for success, namely: “Management must also master what has proven to be a significant hurdle in many organisations: the resistance to change by managers and employees who have grown comfortable with outmoded, dysfunctional systems, policies, and procedures.” It is submitted that about 25% of the organisation’s employees will willingly accept the planned process changes and another 25% will aggressively resist the planned changes. The remaining 50% are somewhere in between those two extremes. It is thus essential that management must be able to get all employees to give up the old way of doing business and adapt the new values and culture required for a lean organisation.

Pieterse (s.a.a) is in agreement, stating that to change to a lean culture some of the lessons of change management can be used, according to which, the organisation has to be prepared well before the change is even attempted. A big effort must be made to change the hearts and minds of everyone, since an element of fear of change is present in even the staunchest supporter of the change initiative.

It is purely natural to be afraid of change. Some of the reasons for this resistance include a tendency to want to cling to a comfort zone, fear of the unknown, threat to position power, disruption of social networks and threat to security. This resistance to

change must be understood and be planned for. Some of the actions that can be taken to reduce resistance to change include: provide as much as possible information about the change to employees; create a vision of where the organisation is heading and promote this vision through proper marketing; provide effective leadership; inform employees of the reasons for change; conduct meetings to address employees' questions about the change; prepare employees for how change will affect them; and involve employees in the change process.

According to the management-consulting organisation Change Wright Consultants (2001) there are four levers of change in any organisation.

- The first lever is the people in the organisation; more specifically their competencies, attitudes, roles, team dynamics, emotional reactions and other people-specific attributes and events.

- The second lever relates to the organisation itself; how the organisation is structured, the rules and procedures relating to the structure (and the relationships between elements in the structure) and the organisational culture.

- The third lever, that of business processes, deals with how the various tasks and activities are strung together to provide value to customers or to support processes that do.

- The final lever is technology, which are all elements of technology employed in pursuit of the organisation’s objectives.

In other words, the people in the organisation, the organisation itself, business processes and technology, bring about change. Lean relates to each of the four levers, in other words a lean implementation can be the result of any of the four levers of change mentioned above.

The Change Wright Consulting (2001) suggests that change methodology should consist of four major phases, namely preparation and planning, alignment, enablement, and adoption and embedding. Within these phases a number of actions or steps are proposed.

The first step is to draft a case for change, detailing the why are we doing this and defining the way forward. A good case for change should be simple, brief and compelling, and needs to be widely communicated to all stakeholders through the different media channels.

The next step is to map the changed landscape in order to ensure that the major change dynamics are identified at the beginning of the project. This process will give an idea of the level of the impact that will take place, which aspects require urgent attention, and ultimately what level of change intervention may be required.

In order to identify all the stakeholders involved in or affected by the change process a stakeholder's analysis is conducted. It is important to know who should be targeted by the communication process, what expectations should be managed and who should be involved in the change process in an effort to obtain their commitment and support.

A communication plan is then compiled, covering what should be communicated, when, by whom and through which media. It should provide a structured approach to managing stakeholder expectations, establishing awareness and understanding and generating buy-in and ownership.

The final step is the conducting of an adoption or embedding assessment, which is done pre- and- post implementation of the change and allows for stakeholder communication and feedback success to be constantly measured, ongoing identification of issues that hamper the implementation of the change, as well as to elicit information that may be used as a starting point for further analysis.

Jones, Aquirre and Calderome (2004) believes that no single methodology fits every organisation or intervention and proposes a top 10 list of guiding principles for change

management, which is summarised below.

Principle number one states that the human side should be addressed systematically as any significant change creates people issues, for example new leaders will be asked to come forward, jobs will change, new skills and capabilities must be developed, and employees will be uncertain and resistant. As such a formal approach for managing change, beginning with the management team and then engaging key stakeholders and leaders, should be developed from the outset.

Because change is inherently unsettling for people at all levels of an organisation all eyes will be on the Chief Executive Officer and top management for support and direction. It is thus important that the top management team embrace the new approaches first, both to challenge and to motivate the rest of the organisation.

Every layer of the organisation should be involved. Change efforts must include plans for identifying leaders throughout the organisation and pushing responsibility for design and implementation down, so that change cascades through the organisation.

A formal case for change must be drafted. People are inherently rational and will always question to what extent the change is needed, whether the organisation is heading in the right direction, and whether they want to commit personally to making the change happen.

Ownership of the change should be created. The required ownership demands more than mere buy-in or passive agreement that the direction of change is acceptable, and is best created by involving people in identifying problems and drafting of solutions.

The change message should be constantly communicated. The best change programmes reinforce core messages through regular, timely advice that is both inspirational and practicable.

Thorough cultural diagnostics can assess organisational readiness to change, bring major problems to the surface, identify conflicts, and define factors that recognise and

influence sources of leadership and resistance. These diagnostics also identify the core values, beliefs, behaviours, and perceptions that must be taken into account for successful change to occur.

Once the culture is understood, it should be addressed as thoroughly as any other area in a change programme. Leaders should be explicit about the culture and underlying behaviours that will best support the new way of doing business, and find opportunities to model and reward those behaviours.

No change programme goes completely according to plan, and as such effective managing of change requires continual reassessment of its impact on the organisation and its people.

Individuals need to know how their work will change, what is expected of them during and after the change, how they will be measured, and what success or failure will mean for them and those around them. As such the impact of the change on each individual needs to be assessed and discussed.

Any lean transformation will bring about some drastic changes, and as such the following success factor element is formulated:

> *SFE137: For lean to be successful the lean implementation methodology should incorporate change management principles.*

6.3 SIX SIGMA

According to Bicheno (2004:131) the term six sigma derives from the spread of the normal distribution (plus minus 3 standard deviations or 3 sigma indicating the control limits). The premises is that if specification limits can be set and the process spread limited such that the distance from the process centre line to the nearest specification limit is six standard deviations, than a highly capable process will have been achieved. So, six sigma performance means close to perfection (3.4 defects per million).

6.3.1 Basic principles and concepts

Six Sigma follows a specific methodology of DMAIC, which is very similar to the Plan-Do-Check-Act analysis of lean (Bicheno 2004:132):

- D - Define the problem (scope of problem).
- M - Measure the performance or problem (link to the 7 tools of Total Quality Management discussed further on in this chapter).
- A - Analyse the cause of variation and defects (provide statistical evidence that causes are real).
- I - Improve (fix what is wrong).
- C - Control (hold the gains and sustain).

Six Sigma is strongly biased or based on data and statistics and driven by people (experts) qualified in the methodology (black and green belts).

6.3.2 Lean and six sigma

Loubser (2003) states that using Six Sigma techniques to apply a new way of thinking in solving problems will no doubt deliver significant results. However, to truly deliver and sustain the results that most organisations seek when embarking on Six Sigma intervention requires a level of organisational focus and maturity that includes practices from Lean, Theory of Constraint, Toyota Production Management and Total Quality Management.

The Kaufman Global Group (2003b) contends there is a great deal of common ground in terms of the goals and tools employed between lean and Six Sigma initiatives. Several world-class companies such as Maytag and Lockheed-Martin Aerospace have abandoned the either/or position, and elegantly combined these two initiatives into an integrated approach at achieving excellence in all areas of business performance improvement and productivity: cost, quality, responsiveness, and design innovation.

The best approach seems to depend on what the specific problem is. It is argued that both lean and Six Sigma is needed because they do different things. The organisation can't afford to let big, dangerous process problems and quality issues go unattended until after the implementation of lean. Conversely, the organisation cannot afford to wait to implement lean if the rest of the market segment is already moving in that direction. Six Sigma cannot produce the required results in inventory reduction and cycle time on a sufficiently broad basis fast enough.

The best approach, as per the Kaufman Global Group (2003b) is to launch a lean initiative that will begin to improve all micro processes. At the same time, develop resources like Six Sigma black belts or similarly trained reengineering specialists to attack acute, complex issues. Bicheno (2004:133) provides a useful comparison between lean and Six Sigma, as depicted in Table 6.1.

Considering the above discussion Six Sigma is considered not to be close enough to lean, specifically the lean philosophy and people or soft side of lean, for someone with knowledge and experience of only Six Sigma to be considered sufficiently knowledgeable and experienced in lean for inclusion in the sample population of this study.

There are however merit in including Six Sigma methodology in the lean implementation plan, and as such the following success factor element is proposed:

SFE138: Six Sigma methodology should be incorporated in the lean implementation plan.

TABLE 6.1
COMPARING LEAN AND SIX SIGMA

Area	Lean	Six Sigma
Objectives	Reduce waste. Improve value.	Reduce variation. Shift distribution inside customer requirements.
Framework	5 Principles (not always followed).	DMAIC (always followed).
Focus	Value stream.	Project/process.
Improvement	Many small improvements, a few low *kaizens*. Everywhere, simultaneous.	A small number of large projects. One at a time.
Typical goals	Cost, quality, delivery, and lead time. Financials often not quantified.	Improved sigma level (attempt six sigma 3.4 DPMO). Money saving.
People involved in improvement	Team led by (perhaps) lean expert. Often wide involvement on different levels.	Black belts supported by Green belts.
Time horizon	Long term. Continuous, but also short term kaizen.	Short term. Project by project.
Tools	Often simple but complex to integrate.	Sometimes complex statistical.
Typical early steps	Map the value stream.	Collect data on process variation.
Impact	Can be large, system-wide.	Individual projects may have large savings.
Problem root causes	Via 5 why's (weak)	Via e.g. Design-Of-Experiments (strong).

Source: Bicheno (2004:133).

6.4 THEORY OF CONSTRAINTS

The Theory of Constraints (TOC) improvement cycle has similarities with the Plan-Do-Check-Act cycle of lean discussed in paragraph 3.18. Goldratt (1990) describes the 5 step TOC cycle as: identify the constraint or constraints; decide how to exploit the

constraint; subordinate all other resources to the constraint; elevate the constraint; and repeat the cycle.

Womack (2003) asks the question: “Can the Theory of Constraints be used as a catalyst for lean implementation?”, and answers “…yes, as TOC methods fit nicely into the lean thinking five-step change framework between steps two and three”. Using TOC can help lean change agents to improve performance in processes where it is infeasible to eliminate bottlenecks. Specifically, after creating the ideal future value stream map incorporating TOC methods can give lean the following benefits:

- Determining Where to Begin - TOC advocates beginning with the constraint that most limits throughput. This should create substantial improvements to the value stream in a short time, which is beneficial for igniting the required employee momentum and support.
- Sustaining Momentum - Achieving the future state may require designing new equipment that has not currently been developed. Until these processes can be eliminated, and if they are constraints, TOC can be used to continue the implementation momentum. Then, the organisation can develop continuous flow that operates based on *takt* time, a pull system to control production, and implement production levelling.
- Performance measures that support lean implementation - Replacing traditional financial metrics of asset utilisation and burden absorption with Goldratt’s Throughput, Inventory, and Operating Expense measures will help management see the benefits of lean.

Bicheno (2004:121) concurs and believes there is a lot of synergy between lean and TOC. TOC identifies the constraint or bottleneck which is than targeted by lean for improvement. Both are logical and pragmatic, and both share the goal of flow and throughput. Whilst TOC is better at identifying that handful of potential improvements that will make a real difference, lean has a battery of useful tools and an attractive philosophy. Lean’s mapping techniques enable the organisation to understand the system and its dependencies more clearly. TOC on the other hand helps to identify and quantify the opportunities without taking the leap of faith sometimes associated

with some lean implementations. Both encourage pull rather than push, but in some circumstances, for example where demand is erratic, the ‘drum-buffer-rope’ of TOC may be more effective than *kanban*.

Although there are a lot of synergy, as described above, between lean and TOC, TOC is not considered to be close enough to lean for someone having experience and knowledge of TOC only to be included in the sample population for empirical research as someone having sufficient experience and knowledge of lean.

TOC, however, has a lot to offer to ensure a successful lean implementation, and as such the following success factor element is proposed:

SFE139: TOC principles must be incorporated in the lean implementation methodology.

6.5 20 KEYS

According to Bicheno (2004:88) Kobayashi’s concept of 20 Keys has gained increasing acceptance as both a manufacturing audit and an implementation guide to lean at shop floor level. This is mainly due to the fact that the 20 keys relate to concepts fundamental to lean.

Kobayashi (1995) believes that organisations that lead the world in their markets do so by improving more than one thing at a time, and by doing it in the long run. Such organisations recognise the importance of synergy between different improvement efforts and the need for commitment at all levels of the organisation to achieve total, systematic upliftment. Team building exercises, management practices and programmes like Total Quality Management, technology improvements, customer care programmes, supplier relationships, production techniques such as Linear Programming (LP), Flexible Manufacturing Systems (FMS), Computer Aided Design and Manufacturing (CAD and CAM), Statistical Process Control (SPC), process control and quality programmes are mostly handled in separate programmes and therefore easily seen as separate programmes.

One system that tries to combine all these programmes is the 20 Keys programme. The economic environment is undergoing rapid change and managers need to determine to what degree their organisations can rapidly respond to change and to regard such responsiveness as a standard for evaluating corporate strength. To have such strength organisations must have specific items that can be improved. Managers cannot make their organisations stronger unless they know how to improve items that assessment shows require improvement (Kobayashi, 1995).

It is only when all employees are aware of the organisation's position in relation to other organisations that a true feeling of competition is developed, and only than that employees will do whatever they can to win, and only than that management and employees will co-operate in their efforts to raise quality and productivity. There is thus a need for a powerful multi-organisational benchmarking and development tool for the boardroom and the shop floor methodology, which will ensure that everyone will work together towards common goals in the interest of the organisation. As such Kobayashi (1995) suggested 20 key aspects that an organisation must continuously focus on, and improve in, to achieve organisational excellence in terms of market share and customer satisfaction through improvement in cost, quality and speed. Speed refers to the speed of distribution or delivering the product and service. The 20 keys identified are: Key1 - Cleaning and organising; Key 2 - Rationalising the system/Goal Alignment; Key 3 - Small Group Activities; Key 4 - Reducing Work-in-Process; Key 5 - Quick Changeover Technology; Key 6 - Kaizen of operations; Key 7 - Zero Monitor Manufacturing; Key 8 - Coupled Manufacturing/Production; Key 9 - Maintaining Machines and Equipment; Key 10 - Time Control and Commitment; Key 11 - Quality Assurance; Key 12 - Developing Your Suppliers; Key 13 - Eliminating Waste; Key 14 - Empowering Employees to Make Improvements; Key 15 - Skills Versatility and Cross Training; Key 16 - Production Scheduling; Key 17 - Efficiency Control; Key 18 - Using Micro Processors; Key 19 - Conserving Material and Energy; and Key 20 - Leading Technology/Site Technology.

Bicheno (2004: 89) contends that it is interesting to note the similarity of Kobayashi's views with the views of Dan Jones, one of the authors of *Lean Thinking*. Jones states that the foundation of lean thinking is 5S, shop floor teams, 7 quality tools and Plan-

Do-Check-Act (which are covered by keys 1, 3 11 and 6) which support production smoothing, demand smoothing, Just-In-Time, and *Jidoka* (covered by keys 10, 16 and 5), which in turn are held in place by waste elimination and Total Productive Maintenance (dealt with in keys 13 and 9) and capped by policy deployment (the subject of key 2).

The main aim of the 20 keys, which relates well with the objectives of lean, is to energise the entire organisation to work together for continuous improvement to: Achieve strategic objectives of top management; Improve customer satisfaction and market share by making products and services better, faster, and cheaper; and to improve the productivity and flexibility of the organisation to adapt rapidly to changing market requirements.

Based on the above stated it is submitted that the 20 Keys programme shares enough principles, techniques and philosophies with lean for a person having experience and knowledge of the 20 Keys programme to be considered as having sufficient experience and knowledge of lean, and as such can be included in the sample population for the empirical research of this study.

6.6 TOTAL QUALITY MANAGEMENT

Jablonski (1992:21) defines Total Quality Management (TQM) as a cooperative form of doing business that relies on the talents and capabilities of both labour and management to continually improve quality and productivity. Embodied in this definition are the three ingredients necessary for TQM to be successful: participative management, continuous improvement and the use of teams.

According to Moody (1997) TQM is a program that instils a climate of continuous improvement on a permanent basis toward products and services that customers will find more satisfying. TQM has a few elements that are emphasised, namely continual improvement, competitive benchmarking, employee empowerment, team approach, knowledge of quality control and improvement tools, focus on customer needs, and

relationship with suppliers. TQM moves the focus of control from outside the individual to within; the objective is to make everyone accountable for their own performance and to get them committed to attaining quality in a highly motivated fashion.

6.6.1 TQM principles

Jablonski (1992:24 – 29) compiled six principles of TQM, namely having a customer focus; focussing on the process as well as on the result of the process; prevention versus inspection; mobilising expertise of the workforce; fact based decision making; and feedback or communication. These TQM principles should assist with deciding whether TQM is close enough to the lean philosophy and principles for a person with experience in TQM to qualify as a respondent to this study.

6.6.2 Total Quality Management tools

The following seven tools of Total Quality Management (ODI, 2004) are included in most of the improvement programmes:

- Fishbone diagram which purpose is to identify, explore and graphically display (in increasing detail) all of the possible causes related to a problem to discover its root cause(s). The focus on the content of the problem, not on the history of the problem or personal interests.

- Pareto analysis focus efforts on causes of problems that offer the greatest potential for improvement and help to focus on biggest impact causes. Based on proven principle: 20% of sources cause 80% of the problem.

- Histogram is used to summarise data, collected over a period of time, from a process and graphically present its frequency distribution in bar form. Visually display of large amounts of data and shows the relative frequency of occurrence. Also reveals the centring, variation and shape of data (illustrates underlying distribution of the data).

- Checklists allow a team to systematically record and compile data so that patterns and trends can be clearly detected and shown. Creates easy-to-understand data and builds a clearer picture of the facts as opposed to opinions.

- Scatter diagram is used to identify and study the possible relationship between the changes observed in two different sets of variables (it does not predict cause and effect; it only shows the strength of the relationship). Supplies the data to test a hypothesis that two variables are related.

- Run charts allow a team to study observed data for trends or patterns over a specified period of time. It monitors the performance of one or more processes over time to detect trends, shifts or cycles.

- Control charts are used to monitor, control and improve process performance over time by studying variation and its source (there are many types of control charts). It analyse process variation over time and distinguishes special from common causes of variation. A good tool for ongoing control of a process.

Considering the above, it is clear that TQM fits within the lean philosophy, and especially in the lean toolbox (the seven TQM tools are widely considered as key tools in the lean toolbox). TQM however lacks in a number of ways, for example pull, flow and small lots versus batch production, and as such TQM is not considered as generic to lean, but rather a very good support system or tool for lean. As such a TQM expert is not considered to be a lean expert for inclusion in the sample population of this study for the empirical research.

The following success factor element is however proposed:

SFE140: TQM principles and tools must be incorporated in the lean toolbox.

6.7 MISSION DIRECTED WORK TEAMS

Competitive Dynamics International (s.a.) describes their Mission Directed Work Teams (MDWT) programme as a programme comprising of a toolkit designed to assist organisations in implementing recognised lean or world best practices in their workplace, mobilising every employee in the drive to continuously improve quality, speed, cost effectiveness, safety and morale. The MDWT program is claimed to be a vehicle to drive responsibility to the frontline, creating multi-skilled, empowered mini-business teams that take ownership and have skills to improve their business performance.

The programme is aimed at providing leaders and their teams with the essential skills to: Achieve high and continuously improving levels of quality, speed and cost effectiveness; Establish goal alignment and business focus based on competitive and market requirements; Benchmark themselves against best leadership and workplace practices to identify high leverage areas for improvement, in a systematic manner; Create a visual workplace thereby simplifying the management of objectives; Involve all employees in continuous improvement activity and innovation; and establish a culture of empowerment, participation, flexibility and continuous learning.

The MDWT programme consists of the following 10 modules:

Module 1 – Mini-business goal alignment which covers establishing organisational focus through the mini-business concept; aligning goals and implementing visual management of quality, speed, cost effectiveness, safety and morale; and implementing continuous improvement by applying the Plan-Do-Check-Act cycle.

Module 2 – Visual workplace (5S) as discussed in paragraph 3.17.

Module 3 – Asset care which focuses on achieving world-class Overall Equipment Effectiveness (OEE); establishing team ownership for asset care; quick Changeover Technology (SMED); and implementing autonomous maintenance.

Module 4 – Team leadership which includes developing the team through empowering leadership and participation; gaining insight into personal leadership, decision making and conflict handling behaviours and the effectiveness of these; creating a culture of participation and involvement; and analysing and improving the motivation climate in the team.

Module 5 – Workflow management, covering improving organisational responsiveness and speed by managing capacity constraints and reducing work-in-process; establishing visual, continuous flow by using coupling techniques; and introducing lean at the front line.

Module 6 – Team coaching with the objective to create a learning environment for skill enhancement; build a competent, multi-skilled and versatile team; and to optimising the potential of every team member.

Module 7 – Quality assurance, which is basically Total Quality Management as discussed in paragraph 6.6.

Module 8 – Service quality, dealing with identifying and satisfying total customer service requirements; focusing the team on delivering defined value; developing service level agreements with customers and suppliers; and strengthening and developing suppliers to improve their quality, speed and cost performance.

Module 9 – Process improvement and waste elimination, touching on identifying and eliminating the seven wastes; applying process-mapping techniques to improve processes for world-class quality, speed and cost effectiveness; and enhancing value flow.

Module 10 – Self development with a focus on gaining self-insight for personal development; developing an internal locus of control and emotional intelligence; and forging the attitudes necessary for personal and organisational success.

The similarity between the 20 Keys programme discussed earlier and the MDWT

programme is very clear. It is also clear that the MDWT programme is based on the philosophy, principles, tools and techniques of lean and as such a person with knowledge and experience of the MDWT programme should qualify for inclusion in the sample population for the empirical research.

6.8 TRACC

Competitive Capabilities International (s.a.) developed a programme called TRACC, which consists of a number of modules or building blocks.

Whilst the Operations Strategy Module considers the organisation's operations strategy, the Leading and Managing Change module provides both senior management and the steering committee with a step-by-step guide on how to plan, implement and co-ordinate the overall change initiative. It also aims to ensure that change best practices are effectively implemented so that the changes are sustainable, and provides tools and processes to encourage all stakeholders involved in the change effort to participate on an ongoing basis.

The Teamwork Module helps with the design of workplace teams, prepares the workforce for teamwork and develops the teams into productive and increasingly autonomous units. Through the team structure employees are able to contribute meaningfully to improved organisational performance and productivity levels. The team becomes the basic unit of organisational learning. Included in this module are goal setting, problem solving, decision making and facilitating change.

The 5S Module incorporates a structured way of implementing and maintaining workplace organisation through the proven principles of 5S, as discussed in paragraph 3.17.

The Visual Performance Measurement Module is aimed at setting up visual scoreboards throughout the organisation with specific focus on the workplace level. Current performance levels in key measures are measured by the teams and are

displayed visually against targets. This in turn drives awareness, problem solving and continuous improvement. The measures for each area are derived from the organisation's key success factors to ensure competitiveness in the market place.

The Focused Improvement Module is a results-driven improvement process that identifies and eliminates the root causes of problems in a structured way and encourages ongoing innovation. Once the low hanging fruit has been addressed and a sustainable problem solving infrastructure is in place, more advanced statistical techniques are introduced to eliminate all forms of waste and variability. This is in essence a transition to classic Six Sigma improvement methodology.

The Autonomous Maintenance Module assists the organisation to ensure that operators take ownership of their equipment and share the responsibility for its maintenance with the maintenance department.

The Business Centred Maintenance Module addresses all aspects of the maintenance process as performed by the maintenance department such as maintenance strategy, preventive maintenance, spare parts, work planning and control, technical training, facilities and maintenance prevention. The objective of this module is to establish an effective maintenance organisation consisting of people with the right skills, the right facilities and the right spare parts, leading to reduction of equipment failure.

The Set-up Time Reduction Module is aimed at reducing the change-over and set-up times on machines, thus making them more productive and efficient.

The Quality Module provides the organisation with the capability to control quality at source and to ensure consistency in those product characteristics that the customer values. Customer requirements are clarified and translated along the value-adding chain to create a set of quality standards at each step in the process. The ultimate aim of this module is self-control and zero defects.

The Process Flow Module aims at getting material, products and information to flow through the system.

The Administrative Excellence Programme supplements the other modules by applying the generic best practices to the non-operational, administrative functions such as human resources, accounts and purchasing.

The objective of the suite of Supply Chain Modules is to support manufacturing and distribution organisations to enhance their supply chain performance.

The implementation of the programme starts with an assessment conducted by a team of consultants at the organisation to assess the following: The organisation's readiness for change as well as potential risks which will have to be addressed; An initial loss and waste analysis that will identify the performance improvement opportunities and potential savings; and a best practice maturity assessment based on the TRACC toolkits.

The results of the assessment are than discussed with management and a broad improvement programme compiled, which consists of a change management process with clearly defined roles and responsibilities, a selection of the appropriate lean tools which will close the maturity gaps and leverage performance improvements. Specific improvement targets are set.

From the above it is clear that the TRACC programme is very much based on lean principles, methodology and tools, and the 20Keys and MDWT programmes, and as such a person with knowledge and experience of the TRACC programme could be considered as being sufficiently experienced in lean for inclusion in the sample population.

6.9 CHAPTER SUMMARY

It should be clear that lean can benefit greatly by incorporating aspects of the other available improvement programmes discussed, and vice versa. There is thus not a need to select one or the other but rather to consider how they could be integrated and combined to suite the organisation's specific needs and circumstances. It was

established that a person with experience and knowledge of the 20 Keys, MDWT and TRACC programmes could be considered as sufficiently experienced and knowledgeable of lean to qualify for completion of the questionnaire developed for the empirical research of this study. Six Sigma, TOC and TQM are considered good support programmes but not as generic for lean. Change management is considered as essential intervention for lean and all the other programmes.

The philosophy of lean; the lean principles, tools, concepts and techniques; the lean people issues; as well as other related improvement programmes have now been considered. What still needs to be considered in the pursuit of the theoretical success factors for lean implementation is the actual lean implementation process or methodology, which is the subject matter of the next chapter.

CHAPTER 7

IMPLEMENTATION METHODOLOGY OF LEAN THINKING

7.1 INTRODCUTION

Donovan (2005a) is of the opinion that the lean business case is definitely there to be made, and substantial benefits can rapidly accumulate. Done right, a lean transformation can reinvigorate and strengthen an organisation to its core. But the key to significant success with a lean transformation is to do it right, quickly and complete and to do it that way the first time. Once implemented the organisation must ensure that as the lean culture becomes permanent, limited to no slip back is allowed (basically referring to embedding as discussed under Change Management in paragraph 6.2).

Faull (2004) reports that there is a growing awareness that implementation is a core competency of organisations capable of sustained lean success, and that effective implementation is essentially about knowing what gap the organisation wants to close and then making significant movements towards the target outcomes.

A warning is however sounded by Faull and Whelan (2003) that frequently organisations are intent on the process they were implementing rather than the effect they wish to change, in other words they showed a process focus rather than an outcomes focus. It could thus be argued that the actual implementation process is not the overriding success factor in lean implementation.

Zayko (2006) seems to support the above notion in stating that often there is a lot of interest in finding the one roadmap or blueprint for implementation lean in an organisation. Unfortunately, no magic pill exists and it is not something that can be treated as a project that can be completed quickly and easily. Lean implementation is an evolving process that continues without end, it is not something that one put in

place and walks away from; otherwise the organisation will revert back to its initial condition or worse.

The Kaufman Global Group (2003b) concurs with the above stated but however still believes that the use of an overall implementation framework or methodology throughout the organisation is critical to successfully deploying an organisation wide lean initiative. There is thus no specific methodology or step-by-step process to be followed; however, a number of critical issues need to be addressed. The key is to decide where to start and what lean tools to use. If a mistake is made in the implementation process it is not a train smash as continuous improvement will sort it out. Change management and leadership are the overriding issues.

In support of the above stated Kobayashi (1995:1) contends that reengineering is not a particular method but rather the trial-and-error application of various methodologies at numerous organisations. This trial-and-error approach means that every sparkling tale of success reflects the many failures that have been stepping stones on the way.

It is interesting to note that the fathers of lean, Ohno (1988) and Shingo (1989) also do not deliver an overall approach an organisation could follow to become lean.

It is not an objective of this study to research or compile a detailed lean implementation plan or methodology. However, in order to identify all the potential factors that could impact on the success of lean implementation a study and understanding of lean implementation methodology are considered necessary. The purpose of this chapter is thus to present the key aspects, grouped together under different headings, relating to lean implementation methodology identified in the literature study.

Based on the above introduction, the following success factor elements are identified:

SFE141: Lean implementation must be considered as an evolving continuous process
SFE142: An overall lean implementation framework or plan/methodology must be followed.
SFE143: The selection and application of appropriate lean tools is critical for lean implementation
SFE144: Change management methodology must be followed with lean implementation

7.2 NO ONE RIGHT APPROACH OR METHODOLOGY

For Drew *et al.* (2004:10) it is very clear that there's no one right way to approach a lean transformation and that the implementation sequence of events isn't as neat as has always been suggested. Lean practices are not things that can be copied from one place and pasted into another.

Womack & Jones (2003:16) also do not believe in a one methodology fits all approach, and states that lean transformation techniques and processes will vary widely from organisation to organisation, depending on the organisation's overall business strategy, position in the market place, current operations process, and nature of the supply chain.

Jones (2004e) agrees that lean has to be modified to suit the peculiarities of each kind of manufacturing, from autos and aerospace to food and pharmaceuticals to custom designed machinery (see the discussion on the nature of the manufacturing process in paragraph 5.4). However, the lean principles remain the same.

In a similar vain the Kaufman Global Group (2003a) believes that each lean implementation must be developed on-site, adapted by the people to mesh with all the nooks and crannies of the organisation. While the basic principles of lean are the same in any organisation, each implementation is unique. Lean implementations are analogous in concept: much the same in outward appearance across organisations but form-fitting to each organisation's unique profile and nuance.

Womack and Jones (2003:101), however, cautions that it's often hard to imagine how to install lean in an organisation without a clear example of successful practice to follow, in other words a template for action. This template needs to be specific enough to show the real nuts and bolts, but broad enough to keep the big picture in view. The example needs to share enough of the characteristics of the organisation's own situation that extrapolation is possible with confidence about results.

Such a broad lean implementation framework is presented by Smalley (2005) when stating that at Toyota production consultants usually follow (but not dogmatically) an implementation framework of helping to establish basic stability, improve process flow, pace work to *takt* time, develop pull systems, and level production, in other words basically following the five principles of lean as discussed in paragraph 2.4.

Rink (2005a), however, cautions that while the above described implementation framework may be the optimal sequence for one specific organisation, the unique circumstances in another organisation could indicate a completely different plan.

The above leads to the following success factor element:

> *SFE145: Lean implementing methodology must be adapted to suite the peculiar circumstances of the organisation*

7.3 INTEGRATED APPROACH

Drew *et al.* (2004:22 & 25) believes that a lean system is more like a living body than an inanimate object, linking all the various parts of an operating system into a coherent whole. Isolated lean initiatives often fail as the effectiveness of the lean operating system comes from the integrated nature of lean's practices and methods. Yet many organisations assume they can accomplish a successful lean transformation merely by applying a few lean tools. The problem with such a system is two fold. First, lean tools are being applied without reference to business needs. Secondly, the lean tools are being used outside the context of a coherent operating system that can

enable the organisation to meet organisational needs.

Womack and Jones (2003:16) is of the opinion that the thought process needed to tie all the lean tools, techniques and methods together into a complete system was left largely implicit by them and other authors. As a result, they have met many managers who had drowned in techniques as they tried to implement isolated bits of a lean system without understanding the whole.

In a similar vain Womack (2005) contends that identifying the steps in the manufacturing process, getting the process to flow, letting the customer pull, and so forth are not the objectives of lean practitioners. The former are simply necessary steps to reach the goal of perfect value with zero waste, and the lean tools and techniques are simply the means to the end; the critical tools for making the general lean methods work. Lean must include all of the aforementioned as the one can't work without the other, and the organisation needs to utilise all of the goals, methods, techniques, and foundation elements of lean in combination. For example, no process can be capable, available, or smoothly flowing without standard work and there will be no improvement in any process without rigorous *kaizen*.

The problem with United States organisations, according to Liker (2004:12) is that they have "…embraced lean tools but do not understand what makes them work together in a system".

The above arguments identified the following success factor elements:

> *SFE146: Lean must be integrated with other business systems and programmes*
> *SFE147: Lean must not be seen as just the application of lean tools and techniques*
> *SFE148: All lean tools, techniques, methods and principles must be integrated into one whole system*

7.4 IMPLEMENTATION STRUCTURE

Boyer (2004a) promotes the establishing of an active top management lean

implementation steering team which generally contains the organisation's Chief Executive Officer and most direct reports as: "If you want your lean implementation to go fast … engage this group. They must make the key resource allocations and approve significant process and practice changes. If you want to be frustrated and be a lean underachiever, ignore this group."

In a similar vain Jones (2003c) argues for the creation of a lean promotion function and is adamant that: "We are now even more certain that every organisation needs such a function, where its senior experts on every aspect of a perfect value stream, from quality to equipment availability to continuous flow and pull, can be located." It is however of utmost importance to understand that "…the lean promotion group can never substitute for widely instilling lean skills in value stream managers and function leaders".

Donovan (2005d) argues that establishing a structure for lean implementation is the first of many key actions that signal the commitment of top management. The structure should include:

- Executive Champion - a highly visible senior executive to oversee lean planning and implementation. This executive must have a strong leadership style and command the respect of top management.
- Process Owners - Each process (and sub-process) should have its own change and lean implementation champion.
- Steering Committee - The executive champion should have a high-level steering committee to formulate the lean strategy for the internal organisation as a whole and also for external supply chain partners whose activities must be integrated during the lean implementation. This committee also reviews and approves all redesign plans and resolves any implementation issues.
- Experienced Consultant - The executive champion and the steering committee should consider bringing in a very experienced outside lean consultant, which should be able to help to identify opportunities, assist with implementation priorities, and estimate the potential business impact, among other things. A consultant can also help bridge the gap between strategy and tactical actions,

providing a way for management to assess, at each stage of the lean implementation, whether the expected lean benefits are forthcoming.

- Cross-Functional Implementation Teams - Cross-functional implementation teams should be appointed that include the organisation's most highly committed and competent employees from all key functional areas and business units that will be affected. The cross-functional team must have the authority to define and implement the necessary changes to achieve the lean objectives that were established during the planning stage. Together the organisation needs to remould key supply chain processes, linking customers and suppliers in a seamless exchange of information and products.

Faull (2004) promotes what he calls dual organisation capacity. A dual organisation has two parts, one designed to meet daily targets, the other to manage the lean implementation process. The Chief Executive Officer leads both structures and people move for shorter or longer periods between the two structures. In so doing, the ability to initiate and co-operate in lean implementation processes is not only clearly managed, but also becomes widely understood and disseminated. Furthermore, the lean implementation is done without focus being lost on day-to-day management and control of the organisation.

Bicheno (2004:142), in also promoting a lean promotion office, reports that many organisations, including Toyota, have found that implementing and sustaining lean requires full-time expert facilitators who are the repository of lean expertise and who should have general responsibility for lean implementation. The ideal head of the lean promotion office is a respected lean believer, and an influential individual who works through line managers, helping them to achieve their goals. The very existence of such a lean promotion office is an indication of the organisation's commitment to lean. Bicheno (2004:142) supports the caution issued by Jones (2003c) that the lean promotion office does not have authority for lean implementation as such authority must always remain with line managers.

The specific responsibilities of such a lean promotion offices include: facilitate the general roadmap or master schedule for lean implementation; assistance with

mapping and development of future state maps; advice on specific aspects such as *kanban;* tailoring 5S and lean audit assessment tools for specific value streams; preparing waste questionnaires; running short courses on specific topics; coaching; and preparing newsletters and videos.

The lean promotion office must, furthermore, be assisted by appointing various line managers as expert internal lean consultants (champions or subject matter experts) on relevant aspects such as lean accounting, changeover, *poke-yoke*, pull systems and demand management. These people have the responsibility of keeping up with developments of their topic.

Based on the above the following success factor elements are proposed:

> *SFE149: An active lean implementation steering team should be responsible for lean implementation.*
> *SFE150: Active top management involvement in lean implementation.*
> *SFE151: A lean promotion office to facilitate the lean implementation process must be established.*
> *SFE152: An outside experienced lean consultant must assist the organisation with lean implementation.*
> *SFE153: Line management must always retain the authority and responsibility for lean implementation.*

7.5 LEAN FACILITATOR

For Drew *et al.* (2004:9 & 105) lean principles "…aren't intuitive; indeed, they run counter to the experience of most operational professionals". As such an organisation embarking on a lean journey will need the support and guidance of people with substantial experience of lean implementation, people who have previously helped to design and introduce a successful lean operating system. Care should be taken as many people claim to have designed a lean system, but few have successfully implemented a sustainable one. The role of such a facilitator is to gain the trust of each person in the team, to understood where points of divergence may lie and then

to put those differences on the table without unduly exposing any individual.

Womack and Jones (2003:313) fully support the need for a facilitator, stating that: “No organisation has ever undergone dramatic and comprehensive change without someone, softly or in a loud voice, taking the lead.”

In considering the profile of a facilitator Womack and Jones (2003:250) contends that the facilitator and all the senior managers in the organisation must master lean themselves to the point where lean thinking becomes second nature. If the facilitator doesn’t fully understand lean, the implementation will be bogged down at the first setback. So the facilitator must truly understand the techniques of flow, pull, and perfection, and the only way to gain this understanding is by participating in improvement activities hands-on, to the point where lean techniques can be taught confidently to others.

It would thus appear that a success factor element is:

> *SFE154: An expert full-time lean facilitator is critical for successful lean implementation.*
> *SFE155: All the senior managers in the organisation must master the lean philosophy, principles and tools.*

7.6 SYSTEMS BUILDER

For Womack and Jones (2003:97 & 313) a key to successful lean implementation is that the organisation should carefully team an internal system builder with each of its external or internal lean facilitators in order to sustain lean results. This person is the “…catalytic force moving organisations and value streams out of the world of inward – looking batch-and-queue”, an outsider “…who breaks all the traditional rules, often in a moment of profound crisis”.

Jones (2003c) agrees and states that he has discovered that there are really two roles involved in creating permanent change: pushing the old ways aside and firmly installing the new way as a business system. In the most successful lean

implementations, the visible change agent was assisted by a system builder, sometimes behind the scenes, who methodically put all the elements of organisation and method in place so the new lean system continued to improve even after the change agent moved on. In the absence of the system builder, lean results often last only as long as the change agent is in charge.

The above argument leads to the formulation of the following success factor element:

> *SFE156: An internal systems builder must be developed to sustain lean implementation after the external agent has left.*

7.7 CONTINUOUS PROCESS

Lean is described as a journey and not a destination (Drew *et al.*, 2004 & Rink, 2005a), as the best lean organisations have learned that their lean improvement efforts never ended. Each set of lean improvements result in improved bottom-line results but also exposes more opportunity for improvement.

Balle and Balle (s.a.) agree and state that as the organisation implements lean, the organisation gets transformed in practice and new opportunities for further progress appear. As the new lean model is implemented, the reality of the vision of excellence is uncovered in the organisation, and guides managers in their improvement efforts, resulting in "…a journey, not a destination, as improvement efforts never end. Each set of improvement results in improved bottom line, but also exposes more opportunity".

Jones (2003c) puts the continuous process view in practical terms by stating that: "When you've fixed something, fix it again: This is an obvious point. Every Future State for your value streams, as it is achieved, must become the new Current State as you start the improvement cycle over again."

In discussing what made good organisations to become great organisations Collins

(2001:14) reports that: “Those who launch revolutions, dramatic change programmes, and wrenching restructurings will almost certainly fail to make the leap from good to great. No matter how dramatic the end result, the good-to-great transformations never happened in one fell swoop. There was no single defining action, no grand programme no one killer innovation, no solitary lucky break, no miracle moment. Rather the process resembled relentlessly pushing a great flywheel in one direction, turn upon turn, building momentum until a point of breakthrough, and beyond.“

Accordingly the following success factor element is formulated:

> *SFE157: Lean implementation must be considered a continuous process or journey, not as a destination.*

7.8 PILOT IMPLEMENTATION

Jones (2003a) promotes a lean pilot area and believes that all the lessons learned and successes achieved in the lean pilot area need to be captured as it could be duplicated elsewhere in the organisation, either by moving to the next pilot, or by rolling out to the wider organisation.

Zayko (2006) also recommends that the organisation should select a small handful of pilot area candidates. These areas should have strong leadership and the lean approach must be made mandatory to follow - where the area is heading to is not negotiable, but how to get there is. This pilot group of areas should be used to tailor a lean implementation plan for the organisation through reflection and feedback. The pilot should show that lean works in the organisation, showcase a living go and see example, and eliminate the ‘lean does not work in our business’ syndrome.

The argument thus is for a pilot lean implementation in one area, followed by a rollout in the next department and so on. In other words not a full and comprehensive rollout across all departments.

The above premises lead to the following success factor element:

SFE158: A pilot rollout implementation methodology must be followed.

7.9 BUSINESS CASE

Donovan (2005a) submits that it is important to develop a concise written lean transformation strategy that explains to future executives who may join the organisation why the lean journey was embarked on in the first place - in other words the business case or case for change. Management tend to change, and so does the budgetary climate within the organisation. The written business case also serves to refresh the memories of those in the organisation that at a later date may forget exactly why the lean transformation was initiated and who needs to be re-focused.

The business case, as per Donovan (2005a), for a lean implementation must support the following ten overarching critical leadership issues: define the overall business objective; document the assumptions for and the expected benefits; stimulate cross-organisational buy-in; overcome resistance to change; establish for the future the benefits and importance of the lean implementation; maintain a focused high priority on the lean implementation; create a vision of how the lean implementation will improve the performance of the organisation; remind executive team members and others why the organisation is implementing lean; maintain focus and participation of all team members; and achieve and maintain executive leadership engagement.

Everyone in the organisation needs to understand the business case for the lean implementation if the organisation is going to realise breakthrough results. Once the business case is understood, and objectives and performance metrics are understood, resistance to change is less of a difficult factor to deal with.

Faull and Whelan (2003) support the importance of the lean business case and state that: “Among the leaders in effective implementation there was a high awareness at least about why action was necessary.”

Rink (2005a) believes that without a business case poorly conceived lean improvement efforts will result in projects that fail to address the critical needs of the organisation. For example, an organisation that finds its greatest competitive need to be the reduction of production lead times should organise its lean efforts in a way to deliver results in that area. This doesn't mean that other potential lean benefits are ignored. A typical lean implementation would deliver a wide range of improvements in productivity, inventory, and quality, fill rates and more. However, a well-designed lean implementation will focus improvement efforts on deliverables that address the greatest need. In essence, a well designed lean implementation accomplishes the same result as the emergency room doctor (that is, first focus on life threatening injuries, followed by the less serious or urgent injuries) by providing overall improvement but deals with the greatest needs first.

Jones (2003c) links the business case as described above to the lean tool of policy deployment (as discussed in paragraph 2.3), stating that: "A failure to rigorously define and deploy policy at the outset has been the root cause of every failed initiative."

A success factor element thus is:

> *SEF159: A clearly defined business case or case for change must be formulated for the lean initiative.*

7.10 BURNING PLATFORM

Jones (2003a) reports that lean was born out of a crisis in 1950 when Toyota was on the brink of bankruptcy (sales collapsed, forcing Toyota to reduce its headcount by 25%), providing Taiichi Ohno with an opportunity to push the Toyota Production System through the entire Toyota Motor Company, having tried to do so for several years making slow progress. Toyota offered employment guarantees to those employees who remained, providing they learn to work together in new ways. The first oil shock in 1973 was the crisis Toyota needed to push the Toyota Production System through its total supply base. Ohno formed the Operations Management Consulting

Group at Toyota in 1969 to teach the Toyota Production System to suppliers, but made little progress until suppliers faced bankruptcy during the recession that followed the oil shock. It wasn't until the 1981 crisis, when the United States of America and the European Union placed limits on car imports from Japan, and the United States government rescued Chrysler from bankruptcy that the American car makers began to take lean seriously. The success of the new Japanese plants opened during the 1980's in the United States and United Kingdom reinforced the need for lean in auto industries of these countries. However, it was only during the recession of 1991 and the arrival of the first Lexus that European car makers began to realise that they also would have to embrace lean.

It seems that Rink (2005a) supports the above stated notion that a burning platform or crisis is needed by submitting that: "Too often it takes a competitive crisis to create the realization that old methods are no longer good enough for today's business needs. The better alternative is to follow the advice of Jack Welch and change before you have to. However, reality is that a lean initiative is often the response to a competitive crisis."

Womack and Jones (2003:250) report that they have not found an organisation free of crisis that was willing to take the necessary steps to adapt lean across the board in a short period of time. Given this apparent fact that a burning platform or crisis is required for lean they propose that one approach is to take some sub unit of the organisation which is in crisis and focus all the organisation's energies in applying lean to it. Once dramatic change has been introduced in the unit, the leaders of other units can be invited over for hands-on learning and can take ideas back to their own units (thus a form of pilot implementation as discussed in paragraph 7.8). If no sub-unit is in crisis, there may be an opportunity for dramatic change if the organisation can find a lean competitor. Another approach is to find a lean customer or supplier.

A South African example of lean being implemented as a result of a burning platform or crisis is sited by Pratten (2002). In 1999, the Ola factory in Queensborough, Kwazulu Natal was rated by Unilever as one of the worst performing ice cream factories in the group, the cost of manufacturing outweighed the market price the

product could justify, and closure was a strong possibility. Ola was than requested by the head office to embark on the group's Total Productive Manufacturing/Best Practices Implementation process, which is based on lean. This Ola factory is now setting benchmarks for the rest of the group.

The question arises how an organisation can drive the lean transformation if there is no crisis? Liker and Hoseus (2008:530) provides a solution by reporting that an interesting thing about Toyota is that no matter how successful the organisation is, the feeling inside the organisation is that disaster is right around the corner – there is always a burning platform, top management is constantly talking about competition and setting increasingly aggressive targets.

From this argument a success factor element is submitted:

SFE160: A burning platform or crisis is needed for successful lean implementation.

7.11 FOCUSSED CURRENT STATE ASSESSMENT

Donovan (2005c) promotes an expert-guided focuses assessment of the as-is condition in the organisation versus what will be required to achieve a could-be state of lean as an essential starting point for lean implementation (obviously drawing from the value stream mapping tool discussed in paragraph 3.2). This focused assessment should have the objective of quickly evaluating what improvements are needed when and what is the potential impact of lean on the overall organisational performance, the end product being a game plan that specifies the improvement actions and measurable performance improvements as: "Nothing drives the adopting of a new and better way of doing business than very compelling performance improvement potential." The latter links in to the business case, or case for change, discussed earlier.

Boyer (2004a) also refers to an initial assessment and considers the objectives of such an assessment to be to determine where the organisation is in terms of lean

planning and execution, where the organisation wants to be in the next three to five years, and what are the missing pieces.

Although Rink (2005a) also believes that it is critical to know the initial business opportunities, he warns that it is equally important to understand the types of production and support systems that are in place (see discussion in paragraph 5.4), as without this information lean implementation could waste precious time with false starts and dead end projects. The assessment process should answer questions such as:

- What is the level of understanding in the organisation of lean principles and tools? This will determine how much training is necessary to develop internal resources.
- What type of material control systems are in place? This will determine whether the organisation can build on systems that already respond to actual demand or whether improved methods must be introduced.
- How do products currently move through manufacturing steps? This will provide insight into what changes must be made to move toward single piece flow.
- What is the relationship of processes and products? While lean principles apply universally, the outcome looks much different in a plant that makes commercial airplanes than in a facility that makes semiconductors (see discussion on the nature of the organisation's manufacturing processes in paragraph 5.4).

A critical role of the assessment process is thus to identify the expected outcome of the lean implementation efforts, creating a sequence of logical steps leading to total organisational improvement. The arrangement of the steps depends on the organisation's needs.

From the above the following success factor element is formulated:

> *SFE161: A detailed assessment of the current status of the organisation in order to identify the improvement areas and desired outcomes.*

7.12 SENSITISATION

Botha (2003) reports that at Aspen Pharmacare (after forming a cross functional lean implementation team) they embarked on a six week organisational sensitisation process to sensitise the whole workforce on lean and to build commitment.

A sensitisation process is also supported by Jones (2003a), describing its purpose as "…to establish face-to-face interaction between the leadership group and all employees that'll be affected by the process". During this sensitisation, it's critical to convey the imperatives of the lean process as powerfully as possible and it's essential that all employees get the opportunity to raise and discuss issues and concerns.

As a method for the sensitisation intervention Pratten (2003) proposes industrial theatre. These theatres can be customised to the culture of the organisation and to suite the audience, the objective being to capture the interest of people and to impart important knowledge of lean. The theatre must be entertaining and informative; successful in relaying the message meaningfully; conducted in a light hearted atmosphere; and people encouraged to partake in quizzes that test their understanding of lean.

A success factor element thus is:

SFE162: Before embarking on lean implementation a sensitisation process must be followed.

7.13 BUILD INTERNAL CAPACITY

Critical to any improvement programme is the aspect of long-term sustainability. A number of authors on lean have identified the building of internal capacity as key to long-term sustainability of lean implementation.

Faull and Whelan (2003) believes that in order to make implementation capacity available even in a moderately successful lean implementation, employees should be

partly or fully released from day-to-day responsibilities to work on the lean implementation initiative, thereby gaining lean knowledge and experience.

Boyer (2004a) is of the opinion that the first step in lean implementation should be to ensure that the leadership team has a working knowledge of both lean execution and lean planning, best accomplished by a variety of educational activities including in-house seminars that are tailored to an organisation's specific situation and needs, group discussions, reading, and talking to other organisations that are going through a similar business transformation.

Roper (2004) contends that a lean culture is characterised by: extensive knowledge of, and successes with, the tools of lean; ability to apply lean tools every day to improve operational performance without overt management direction; and knowledge of where to apply the lean tools, or a process for continually refocusing on problems and opportunities.

As such Jones (2005f) submits that lean starts with hands-on training of a core group in lean system design. This group's task is then to cascade the knowledge to every one in the organisation.

Accordingly the following success factor element is formulated:

> *SFE163: Internal lean capacity and knowledge on all levels of the organisation must be created.*

7.14 REVIEW AND MEASURE PROGRESS

Jones (2003b) believes that once lean improvement results emerge and a level of sustainability is being achieved, it's necessary to review the progress of the lean implementation. Ideally, this review should be a continuous effort as part of the lean implementation team's responsibility. During the review process, the implementation team will evaluate progress against plans and targets, cumulative benefits achieved,

lessons learned, manufacturing best practice maturity and outstanding actions.

Vaughan-Jones (2003) agrees that measurement is an essential step which should be measured by a balanced scorecard approach.

Rink (2005a) believes that periodic review of lean progress can avoid missing a major lean opportunity. As such Boyer (2004a) proposes that the organisation must establish performance measures that reflect the sought after improvements that the lean implementation is to provide, and then measure performance on a regular basis. The organisation must also make sure there is an overall Gantt chart showing each task team's time frame, each task team has an ongoing action plan and decision log for managing and teaching their piece of the implementation, and that each task team report to the steering team periodically (weekly or monthly as appropriate) for tracking progress and adherence to schedule.

Based on this argument the following success factor element is identified:

> *SFE164: Regular review and measurement of lean progress against pre-determined targets and expectations*.

7.15 CHAPTER SUMMARY

An important aspect of lean identified in this chapter is that lean is not a codified body of knowledge but rather the cumulative behavioural experience of the people who practice lean.

Some insight was provided into the important aspects of the lean implementation methodology relevant to the main objective of this study, that is, the identification of the critical success factors for lean implementation in South African manufacturing organisations.

This chapter also brings to an end the reporting on the literature study. The rest of this

thesis will focus on the empirical research in pursuit of the stated primary and secondary objectives of the study. As such the next chapter will describe the design and execution of the empirical research.

CHAPTER 8

RESEARCH DESIGN

8.1 INTRODUCTION

The research design reflects the type of study undertaken to provide acceptable answers to the research problem (Mouton, 2001). According to Kerlinger (1973) research design is invented to enable the researcher to answer questions as validly, objectively, accurately, and economically as possible.

In designing the research for this study the aim was to select a design that would best answer the primary objective of this study, namely the identification and empirical assessment of the factors and variables that influence and eventually determine the successful implementation of lean as a business management strategy in South African manufacturing organisations. As such two broad categories of variables have been identified, namely the factors that will influence the successful implementation of lean (critical success factors), and successful lean implementation (success indicators). The success factors were modelled as the independent variables, and successful lean implementation as the dependent variable. The empirical study thus called for the identification of success factors, as well as indicators of successful lean implementation.

The insights developed during the literature study were used to identify those success factors and indicators of success. The identified factors and indicators were then operationalised and their theoretical inter-relationships determined. Based on the theoretical relationships a number of hypotheses were formulated to be empirically tested. The operationalisations were used to develop the items for the research questionnaire, or measurement instrument, to measure all the constructs in a theoretical model of successful lean implementation. Primary data of numerical nature will be used.

This study was thus done with quantitative methods based on the establishment of a measurable model through a comprehensive strategy. De Vos (1998) contends that in quantitative research the researcher collects data to assess preconceived hypotheses and theories, thus calling for the setting of hypotheses.

This chapter will detail the formulating of the hypothesis, the construction of the questionnaire or measurement instrument, and the defining of the sampling and sampling procedure.

8.2 SUCCESS FACTORS

As basis to eventually formulate the research hypotheses, 164 potential success factor elements were identified from the literature study, and reported in the previous chapters. These success factor elements are listed in Annexure A.

Each potential success factor element identified has been linked to a core success element (see Annexure A). The objective was to group the listed success factor element together into a final list of theoretical critical success factors to be empirically tested.

The core success elements identified in Annexure A were than grouped together on theoretical grounds to formulate the potential critical success factors for successful lean implementation. Each theoretical core success element identified in Annexure A was grouped into the theoretical critical success factors for lean. This formed the basis for the development of the research questionnaire items (see Annexure B). From each theoretical critical success factor a proposition was formulated. In this study the critical success factors for successful lean implementation served as the independent variables.

8.3 PROPOSITIONS FOR SUCCESS FACTORS

Based on the identified potential success elements (Annexure A and Annexure B) the theoretical critical success factors for successful lean implementation have been formulated and will be empirically tested. From each critical success factor a proposition was formulated.

The identified theoretical critical success factors are grouped together into the two broad focus areas of lean, as identified in the literature, namely people or soft issues and process or hard issues.

8.3.1 People or soft issues

The literature (Liker, 2004:36; Drew *et al.*, 2004: xv; Howardell, 2004; and Wickens, 1999:ix) is very clear that the goals and objectives of lean can only be achieved through the efforts of people as it is lean people that make a lean organisation – it is the people that bring the lean system to life. Lean is considered in the literature to be much more than just a combination of tools, methods and principles – the mindset and behaviour of people operating the system, leadership and the quality of people are also considered to be fundamental to lean success.

People issues are normally very complex issues, spanning over a number of other or related issues – discipline, training and development, impact of lean on people, leadership, trade unions, performance management, job security, safety and morale, to mention just a few. However, the following three major people related critical success factors for lean implementation have been identified in the literature.

8.3.1.1 Mindset and attitude

The mindset and behaviour (which is the ways of thinking and behaving) of people operating the lean system are fundamental. It is thus important to ensure that the mindset and behaviour of people are given the same attention as operating systems

right from the start. It is the mindset and attitude of people that will determine whether changes can be sustained over time. A lean mindset is thus required (a new mindset that drives lean behaviours) as well as a lean way of life that permeates all levels of the organisation.

The most important aspects of a lean mindset are a lean thinking mindset, a problem solving mindset and a continuous improvement mindset.

Lean is not only about changing things (how organisations look and run) but about changing how people think. The lean way of thinking runs counter the prevailing mindset, for example think small and flexible instead of big, and a problem is an opportunity to improve and not to blame.

According to Balle (2005) the dimension that underpins a lean thinking mindset is an obsession with lean, which implies a total long-term commitment to lean. Other dimensions of a lean thinking mindset and attitude are go and see for yourself (*gemba*), challenge or criticism, problem solving focus and a rapid bias to action. If people change how they think, than they are inspired to do things differently and only than can the organisation hope to obtain different results. The Japanese phrase 'Yoi shina, yoi kangai' which means 'Good thinking, good products' is thus very much applicable.

Root cause analysis or problem solving appears to be fundamental to the lean philosophy. Jones (2005a), for one, submits that problem solving capability in every employee is the bedrock of lean process management. A vigorous problem solving culture in which every manager and employee must take responsibility for solving problems to further continuous improvement is promoted by a number of authors. What is required is a root cause analysis attitude, as every root cause analysis is considered as an opportunity for improvement, thus supporting continuous improvement (*kaizen).*

Continuous improvement is a fundamental concept and objective of lean. For Imai (1986:3) continuous improvement is a state of mind, whilst Wickens (1998:23) is of the

opinion that continuous improvement should come about as a normal part of an employee's work – it is about thinking about what you do, how you do it and then finding a better way as a normal part of your daily duties.

Accordingly the following proposition is considered:

P1: A lean mindset and attitude amongst all levels of employees of the organisation is critical for successful lean implementation.

8.3.1.2 Leadership

The literature study revealed that strong committed leadership is an absolute *sine qua non* for lean success, and as such lean must be driven by the top. In a lean environment leadership is about creating the strategy and the values and goals of the organisation – lean management begets lean manufacturing. It would appear from the literature that the difference between lean success and failure starts with leadership.

For the purpose of this study leadership includes all levels of leadership, which is executive level, senior management, middle management and first line management (Team Leader). A Lean Enterprise Institute (2007) survey conducted in the United States of America has shown middle management resistance (36%) as the number one obstacle to implementing lean and supervisor resistance (23%) as number four.

Leadership, on all levels of the organisation, could impact lean success in three major areas, namely strategic, knowledge of lean, and involvement.

The strategic commitment from leadership is a commitment of resources and to continually invest in its people, as well as to promote a culture of lean and continuous improvement. Nothing will kill buy-in and commitment from the shop floor employees faster than leadership and management not following through on its commitments to the lean transformation.

Without a deep knowledge and understanding of the underlying lean philosophy and

principles, as well as lean implementation know how leadership cannot lead the lean transformation. The Lean Enterprise Institute (2007) survey identified lack of implementation know-how (31%) as the second biggest obstacle to lean implementation. Without in-depth lean knowledge leadership will not be able to align lean with strategy, people, process, and practices – in other words not be able to create a lean culture and way of living. Leaders also need to get the right people in the right roles, for which the leaders need to know what type of people lean success demands. It is important for leadership to understand that there is a lot more to lean than meets the eye.

The literature suggests that leaders who want their employees to engage in the lean transformation must first be willing to engage with them in turning the plans into reality. Leaders need to work alongside front-line employees (reconnect with the frontline) to understand the issues as well as to actively engage in problem solving. By taking part leaders demonstrate their commitment and see for themselves whether the improvements are taking hold. The difference between leadership success and failure in a lean context thus appears to be the difference between just head nodding and verbal support from leadership, and getting real action from the top.

Lean thus demands a personal investment from leadership. It is furthermore important that the right leadership and the right management structure must be in place before lean transformation commences.

From the preceding discussions the following proposition is suggested:

P2: Knowledgeable and committed lean leadership is key to successful lean implementation.

8.3.1.3 Non-management employees

Howardell (2004) is adamant that the goals of lean, thus lean success can only be achieved through the efforts of people. The Lean Enterprise Institute (2007) study identified employee resistance (28%) as the third biggest obstacle to successful lean

implementation.

The essence of lean would appear, as per the literature, to be exceptional individuals working within the lean philosophy and principles. The lean tools and techniques are not worth much if the people do not bring them to life.

The literature study identified a large number of aspects that would make people lean, the major ones being mindset and attitude (as discussed in paragraph 8.3.1.1), experience, knowledge, skills, customer consciousness, enterprise thinking, adaptation, taking initiative, collaboration, influence, discipline, and commitment. However, the major non-management employee issues that could influence the success of a lean intervention appear to be mindset and attitude; commitment; skills; and involvement.

- Commitment to lean: Lean requires a permanent commitment (lean is a long term philosophy) as lean is a lifelong or never ending quest for perfection. Lean is not just another programme (flavour of the month) or project with a definite start and end date. The required commitment includes a willingness to change the way of thinking and doing things (lean mindset and attitude) and to continuous learning. In a lean context commitment includes a commitment to a culture of discipline. If people refuse to change the way they work there is little chance of lean success.

- Skilled: Skilled and knowledgeable employees are prerequisites to effectively applying lean principles, tools and techniques. According to Womack and Jones (2003:116) very different type of skills are required. These skills include customer consciousness, enterprise thinking, adaptation, taking initiative, innovation, collaboration and influence. What is needed is a deep understanding of the concepts that support the philosophy of lean, not only the tools and techniques. Human capital development is thus at the very core of lean. The people development process must thus be linked to the overall lean transformation process.

- Involvement: If people are key to lean success it stands to reason that they should be deeply involved in all aspects of planning and execution of the lean journey. It is the people, through their involvement, that continuously improve products and processes. It is not a superfluous or forced involvement but a genuine involvement based on a deep appreciation that people have a lot to offer. Involvement should also focus on dispelling the ingrain distrust people have.

Based on the above premises the following proposition is suggested:

P3: For lean to be successfully implemented the people in the organisation must become lean before the organisation can become lean.

8.3.2 Process or hard issues

Jones (2003b) reports that Toyota gets brilliant results from average people managing brilliant processes. A process is defined by Jablanski (1992) as "…a series of operations linked together to provide a result that has increased value". These processes must be managed as a whole and not separately.

For the purposes of this study lean implementation methodology and the fourth principle of lean as identified by Liker (2006:6) and discussed in paragraph 2.5.4, namely Problem Solving, are included as process issues.

Five key process related critical success factors for lean implementation stood out in the literature study, namely lean as a strategic driver, basic stability, lean promotion office, the lean toolbox, and lean as an integrated approach.

8.3.2.1 Strategic driver

The literature suggests that lean has a definite strategic impact; in fact it is submitted by Donovan (2005c) that the consequences of not adopting lean as a business

strategy are so costly that it should become a high priority strategic objective. The importance of viewing lean as a strategic issue is underlined by the lean technique of policy deployment, which links improvement practices to the organisation's business strategy. Womack and Jones (2003:95) consider policy deployment as critical for lean implementation success. Jones (2003c) goes as far as to state that "…failure to rigorously define and deploy policy at the outset has been the root cause of every failed initiative".

Dealing with lean in a strategic context would ensure that lean is considered as a long-term philosophy, that resources are allocated accordingly, that goals and objectives are aligned and linked with business strategy, and that lean practices are institutionalised.

From the above stated the following proposition is formulated:

P4: For lean to be successfully implemented it must be considered as an important strategic driver of the organisation's business strategy.

8.3.2.2 Basic stability

For the purpose of this study basic stability is defined as manpower, machines, materials and methods being capable, available and flexible in order to ensure predictability and reduce variability in processes. The literature (Smalley, 2005; Womack, 2004b; Drew *et al*., 2004) suggests that at the beginning of lean transformation an organisation needs lots of basic stability before it can succeed with the more sophisticated elements of lean, in other words basic stability is considered a prerequisite or foundation for successful lean implementation. If the organisation's processes are not reasonably stable the support systems will be overloaded, resulting in the change process quickly unravelling. Furthermore, if the variability in processes is excessive it will be difficult to distinguish between real improvement and chance variation, in other words it will be difficult to assess the success of lean implementation steps. Important building blocks of basic stability are standardised work, standardised processes, levelling of demand and production, skilled employees and organisation

structure.

Based on the above contention the following proposition is suggested:

P5: For lean to be successfully implemented basic stability in manpower, machine, methods and materials must first be achieved.

8.3.2.3 Lean promotion office

The literature promotes the establishing of a lean promotion office where senior experts on every aspect of lean can be located. Bicheno (2004:142), for one, is convinced that implementing and sustaining lean requires full-time expert facilitators, which are people with substantial experience of successful lean implementation.

Lean is a specialised discipline. While the basics are relatively easy to pick up and use, the organisation will benefit by having access to lean experts. The lean promotion office will furthermore ensure that lean projects are aligned to corporate goals and that lean approaches are used in a standard manner. It is also a key element in helping the organisation to sustain a lean focus.

However, of utmost importance is that the lean promotion office must only facilitate the lean implementation, as the direct responsibility for lean implementation must always remain the responsibility of the line management. This office will inter alia lead the change management process, facilitate the master schedule for lean implementation, run short courses on specific topics, do coaching, measure performance against targets, and build internal lean capacity.

Establishing a lean promotion office is also a sure way of indicating that the executive leadership is serious about lean.

Against this background the following proposition is formulated:

P6: For lean to be successfully implemented a full-time lean promotion office

must be deployed.

8.3.2.4 Lean tools and techniques

Lean has available a large number of tools and techniques, the so-called tactical or operations aspect of lean implementation.

Having the right tools and techniques in place is considered to be key for sustainable lean performance. What is needed is an understanding of the organisation's processes and the skill to apply what is applicable to that specific process type and organisational needs – thus based on a need or gap analysis. Also needed is a deep understanding of how each tool is utilised to accomplish an end objective.

Based on this contention that the selection of the appropriate tools and techniques is a key factor in lean implementation the following proposition is proposed:

> P7: For lean to be successfully implemented the appropriate lean tools and techniques must be applied at the appropriate time.

8.3.2.5 Integrated approach

It would appear that the lean theories of the father of lean, Ohno (1988), were misunderstood because a lot of organisations tried to implement the individual elements of lean instead of the entire approach, mainly due to the fact that Ohno's theory lacks the clear direction that the key to successful lean implementation is the integrated nature of its practices and methods.

Drew *et al.* (2004:22 & 25) support the argument that the effectiveness of the lean operating system comes from the integrated nature of its practices and methods. In other words the tools, techniques and methods need to be tied together into a complete system as they cannot work without each other. In fact, lean is more a way of life than a programme or system.

For the purposes of this study an integrated approach refers to the alignment of systems and structures, seeing the whole picture, which includes the infrastructure and behaviours that support lean, the ability to align people issues with the operating system, integration of lean with other business systems and programmes, and integrating lean with technology.

Lean must thus be seen as a comprehensive fully integrated management and manufacturing philosophy and approach which must be consistently practiced throughout the organisation. It is the sum total of all the elements of lean and the synchronised relationship to one another that make lean most effective.

Accordingly the following proposition is formulated:

P8: For lean to be successfully implemented it must be considered as a fully integrated business system.

8.4 SUCCESS INDICATORS

From the literature study (Drew *et al.*, 2004:2,26,27 & 35; TRACC, 2002; Riek, 2005; Jones, 2005a; Stone & Watson, 1999; Faull & Whelan, 2003; Vaughan-Jones, 2003; Donovan, 2005a; and Womack & Jones, 2003:148-150) it is very clear that an important aim or objective of lean is the continuous and sustainable elimination of waste resulting inter alia in reduction in lead times, stable operations, improved safety, improved morale, faster new product development, freed up resources, increased competitiveness, better quality, supply matched with demand, reduced inventory, lower capital investment requirements, reduced change-over time, on-time deliveries, just-in-time, balanced workload, customer satisfaction, increased revenue, and a skilled workforce.

Theoretically the elimination of waste would thus result in the reduction of operating cost and the ability to provide the customer with what he wants, when he wants it and

where he wants it (in other words delivery on-time-in-full), and ultimately customer satisfaction.

The reduction in cost and improved customer satisfaction will result in reaching the ultimate objective of lean, namely increased profitability - an organisation cannot claim lean success unless it can show an increase in profitability.

Based on the above the under mentioned theoretical indicators of successful lean implementation were formulated, namely reduction in cost and increased customer satisfaction. As for the success factors a proposition was formulated from each theoretical indicator of successful lean implementation. In this study the indicators of successful lean implementation served as the dependent variables.

8.4.1 Reduction in costs

Lean, according to Womack and Jones (2003:6 & 15), is lean because it provides a way to do more with less – less human effort, less equipment, less time, less space, and so forth. In other words lean results in reduction of costs, especially manufacturing costs (inter alia due to elimination of waste, improved quality, lower capital investment requirements, less rework, shorter lead times and freeing up of resources). Toyota for example is absolutely driven to achieve continually declining costs.

Central to lean is the absolute or complete elimination of waste in all its forms. Womack and Jones (2003:6 & 15) describes lean as the most powerful tool available for creating value while eliminating waste in any organisation, thus resulting in cost reduction.

As a proposition it is thus proposed that:

P9: Successful lean implementation will result in the reduction of operating costs.

8.4.2 Customer satisfaction

For Womack and Jones (2005) lean always begin with the customer who wants value, that is the right goods or services at the right time, place, and price, with perfect quality.

An objective of lean is thus to edge closer and closer to providing the customer with exactly what he wants, when he wants it and where he wants it, in other words delivery on-time-in-full (OTIF).

Customer satisfaction is thus a critical measure of how effective value, as defined by the customer, is created for the customer, and as such an indicator of successful lean implementation. Profits are the rewards of satisfied customers.

Based on this contention the following proposition is formulated:

P10: Successful lean implementation will result in increased customer satisfaction.

8.5 HYPOTHESES

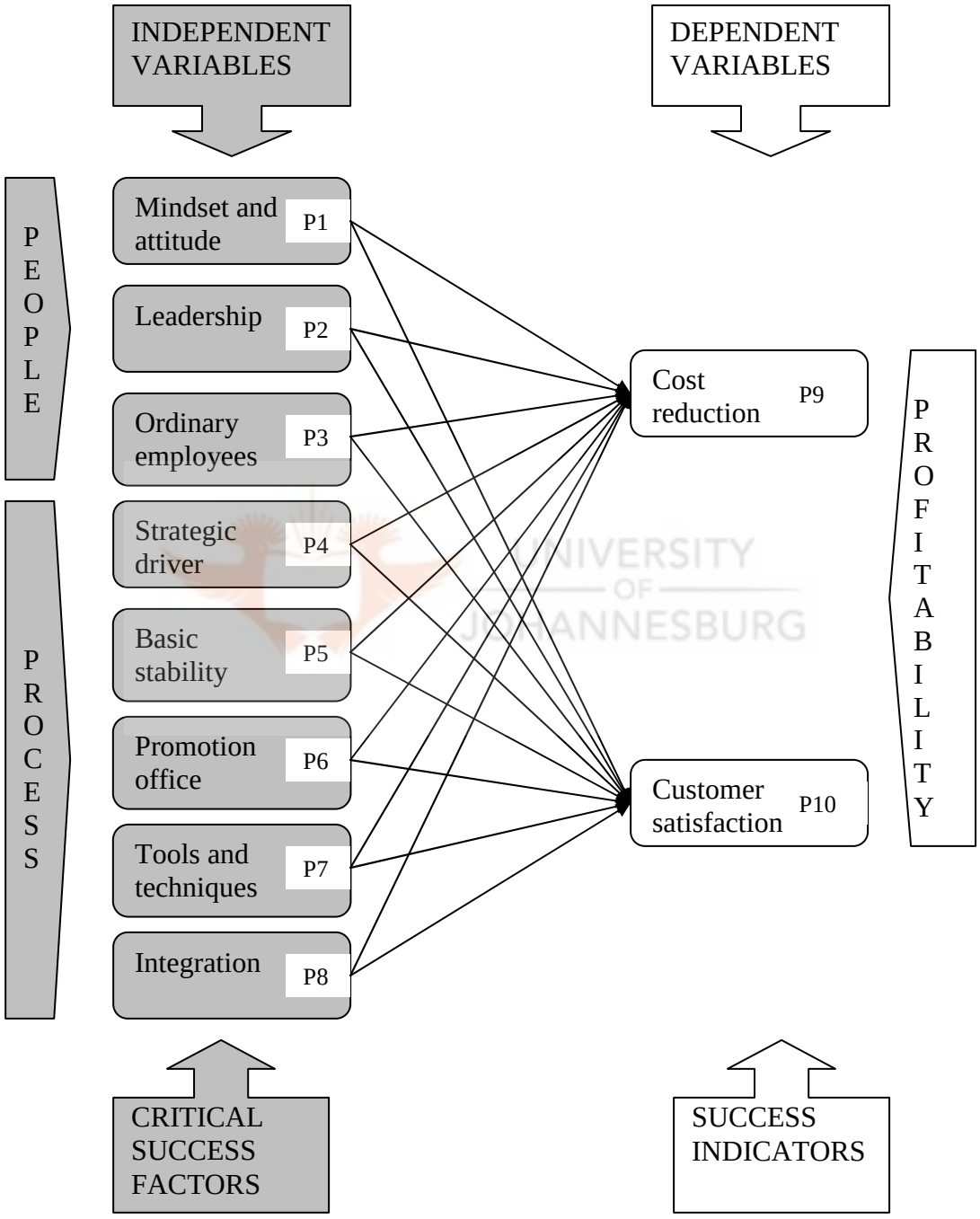
The potential influence of the critical success factors (independent variables) on the success indicators (dependent variables) are depicted in Figure 8.1. Each of the constructs represents one of the ten propositions identified in the preceding discussions.

Against the background of the theoretical linkage established in Figure 8.1 and the propositions formulated, the following hypotheses were formulated for each linkage. These are the hypotheses that will be empirically tested:

H1: A lean mindset and attitude amongst all levels of employees will result in reduction of operating costs (based on P1 and P9).

FIGURE 8.1

THEORETICAL MODEL FOR THE RELATIONSHIP BETWEEN THE CRITICAL SUCCESS FACTORS AND THE SUCCESS INDICATORS



Source: Author developed.

H2: A lean mindset and attitude amongst all levels of employees will result in increased customer satisfaction (based on P1 and P10).

H3: Knowledgeable and committed lean leadership will result in reduction of operating costs (based on P2 and P9).

H4: Knowledgeable and committed lean leadership will result in increased customer satisfaction (based on P2 and P10).

H5: Having lean people in the organisation will result in reduction of operating costs (based on P3 and P9).

H6: Having lean people in the organisation will result in increased customer satisfaction (based on P3 and P10).

H7: Considering lean as one of the organisation's strategic drivers will result in reduction of operating costs (based on P4 and P9).

H8: Considering lean as one of the organisation's strategic drivers will result in increased customer satisfaction (based on P4 and P10).

H9: Basic stability in manpower, machine, material and methods will result in reduction of operating costs (based on P5 and P9).

H10: Basic stability in manpower, machine, material and methods will result in increased customer satisfaction (based on P5 and P10).

H11: Having a full-time lean promotion office will result in reduction of operating costs (based on P6 and P9).

H12: Having a full-time lean promotion office will result in increased customer satisfaction (based on P6 and P10).

H13: The correct application of the appropriate lean tools and techniques will result in reduction of operating costs (based on P7 and P9).

H14: The correct application of the appropriate lean tools and techniques will result in increased customer satisfaction (based on P7 and P10).

H15: Implementing lean in a fully integrated systems approach will result in reduction of operating costs (based on P8 and P9).

H16: Implementing lean in a fully integrated systems approach will result in increased customer satisfaction (based on P8 and P10).

8.6 DEVELOPMENT OF THE QUESTIONAIRE

Given the nature of the problem statement, the stated objectives, as well as the nature of the population to be studied, it was decided to use a structured questionnaire to collect the primary data (see Annexure C).

The realised sample was analysed according to the occupational category of the respondents, the manufacturing sector in which the respondent's organisation operates, the role in which lean experience was gained, and the level of success with lean implementation. As such the questions to facilitate the former analysis were included in the questionnaire.

In order to assess the respondent's practical experience with lean or qualifying related programmes a qualifying question was included in the questionnaire. The question regarding the respondent's manufacturing sector also served as a qualifying question as only respondents with experience in the manufacturing sector were included in the study.

The possibility of a follow up questionnaire was not ruled out and as such respondents were asked to provide contact details should they agree to be part of any possible

follow up study. A follow up study was shown not to be required.

8.6.1 Primary objective

The research methodology adopted, dictates that the constructs for the independent as well as the dependant variables be subjected to an empirical study in a pencil – and - paper type format by asking respondents what their experience are. In other words, a questionnaire was sent to respondents in which they were required to indicate their experience of the influence the independent variables will have on the potential success of lean implementation, as well as their experience of the indicators of successful lean implementation, that is the dependent variables.

As such a number of questionnaire items were self generated for each construct, requiring the respondent to rate each item on a 7-point Likert scale, ranging from strongly disagree (1) to strongly agree (7).

The drafting of questions, as per Terre Blanche *et al* (2006:485) is a critical aspect of developing any assessment instrument. According to Saunders, Lewis and Thornhill (2003) the reliability and validity of the data collected largely depend on the design of the questions and the structure of the questionnaire.

In the final questionnaire the items were randomly shuffled so that the theoretical constructs could not be determined by the respondents, also that the respondents do not develop a particular response style by for example noting that the first few items are positive and than responding in the same manner to all items in the questionnaire. Statements or questionnaire items were formulated for each of the propositions. These statements or questionnaire items are listed below according to the ten propositions.

8.6.1.1 Mindset and attitude (P1)

- The mindset and attitude or behaviour of people is fundamental to lean success. (MA1)

- An organisation implementing lean must face and embrace the various attitudinal aspects of lean. (MA2)
- For lean to be successfully implemented all levels of employees must be obsessed with lean. (MA3)
- The cognitive dimensions of lean are key to successful lean implementation. (MA4)

8.6.1.2 Leadership (P2)

- Leadership at all levels in the organisation must drive, live and demonstrate lean behaviour. (LS1)
- Lean leadership begets lean manufacturing. (LS2)
- Knowledgeable committed executive leadership is the absolute *sin qua non* for lean success. (LS3)
- The difference between lean success and failure starts with leadership. (LS4)

8.6.1.3 Ordinary employees (P3)

- The goals of lean can only be achieved through the efforts of its people. (EM1)
- Lean people make a lean organisation, and as such the people have to get lean before the organisation can get lean. (EM2)
- The essence of lean is people working within the lean philosophy and principles. (EM3)
- Ultimately it is the knowledge, skills, involvement and commitment of ordinary people that will make the difference to lean success. (EM4)

8.6.1.4 Strategic issue (P4)

- Lean philosophy and principles must be reflected in the organisation's business strategy. (SI1)
- There must be a clear link between the organisational goals, key objectives and lean activities. (SI2)

- Lean implementation must be driven as a high priority strategic business initiative. (SI3)
- Lean should be implemented as a business strategy and not a tactic. (SI4)

8.6.1.5 Basic stability (P5)

- At the beginning of a lean transformation the organisation needs lots of basic stability before it can proceed with the more sophisticated elements of lean. (BS1)
- General predictability and consistent availability in terms of manpower, machines, materials and methods is a pre-condition for lean implementation. (BS2)
- Work must be standardised before embarking on a lean journey. (BS3)
- Stability in operating systems is a pre-requisite for lean transformation. (BS4)

8.6.1.6 Lean promotion office (P6)

- An organisation embarking on a lean journey will need the support and guidance of full-time facilitators with substantial experience with lean implementation. (PO1)
- An internal lean systems builder is needed to sustain lean after the external expert has left. (PO2)
- A lean promotion office where senior experts of lean can be located must be established in the organisation. (PO3)
- A full-time dedicated project leader or facilitator will have a positive impact on the success of lean implementation. (PO4)

8.6.1.7 Lean tools and techniques (P7)

- Key to sustainable lean performance is having the right lean tools and techniques in place. (TT1)
- The selection and application of the appropriate lean tools are critical for

successful lean implementation. (TT2)

- It is important to understand the organisation's processes and only apply the lean tools and techniques applicable to that specific process type. (TT3)
- The application of lean tools and techniques by itself will ensure lean success. (TT4)

8.6.1.8 Integration (P8)

- The organisation must integrate the soft issues (such as culture, mindset and behaviour) of lean with the hard issues (such as systems, structure, processes and tools) of lean. (IS1)
- All business systems, programmes and structures must be aligned with the lean philosophy, principles, practices and methods. (IS2)
- The effectiveness of the lean operating system comes from the integrated nature of its practices and methods. (IS3)
- The organisation must use all of the goals, methods, techniques, and foundation elements of lean in combination. (IS4)

8.6.1.9 Cost reduction (P9)

- Successful lean implementation will result in continually declining manufacturing costs. (CR1)
- Successful lean implementation will free up resources (e.g. cash tied up in inventory). (CR2)
- Successful lean implementation will make the organisation's products more cost competitive. (CR3)
- Successful lean implementation will impact on the organisation's bottom line results (increase profitability). (CR4)

8.6.1.10 Customer satisfaction (P10)

- Successful lean implementation will result in the organisation delivering on-

time-in-full to its customers. (CS1)

- Successful lean implementation will increase customer satisfaction. (CS2)
- Successful lean implementation will result in the customer getting the right products at the right time, place, and price, with the right quality. (CS3)
- Successful lean implementation will result in the organisation providing value, as defined by the customer, to the customer. (CS4)

8.6.2 Secondary objective

In order to assess the one secondary objective, being the general success of lean in South African manufacturing organisations the respondents were asked to categorise their organisations in terms of the categories devised by the Aberdeen Group (2006a), namely *best in class* (those organisations who have embraced lean and made it part of their corporate culture), *industry average* (organisations that have implemented lean in some facets of the organisation but have yet to complete the journey), and *laggard* (those organisations who are just learning about lean and/or are meeting with some resistance). The researcher has added a fourth, namely *failed* (organisations that have embarked on the lean journey but have given up or stagnated).

The categorisation, as described above, of the respondents helped to confirm, or otherwise, the general success of lean in South African manufacturing organisations, as well as providing another possibility for analysing the realised sample.

The impact of trade unions on successful lean implementation was assessed by the inclusion of a question requiring the respondent to indicate the impact of trade unions as strong positive, limited positive, no impact, limited negative impact, and strong negative impact.

A pilot study was done and the questionnaire circulated to 10 respondents. The pilot study highlighted no areas of concern relating to the interpretation of the items. It was also found that no logistical problems were experienced using e-mail and it was decided to use this method rather than to distribute hard copies in administering the questionnaire.

8.7 SAMPLING AND SAMPLING PROCEDURE

The quality of a piece of research not only stands or falls by the appropriateness of the methodology and instrumentation but also by the suitability of the sampling strategy that has been adapted (Cohen, Manion & Morrison, 2000:92).

The survey assessed practical experience and knowledge, instead of perceptions; therefore the sample population was required to be knowledgeable and experienced in the implementation of lean thinking or programmes considered as based on the philosophy, principles, tools and techniques of lean, being 20 Keys, MDWT and TRACC. From the literature (Womack & Jones, 2003:148; Roper, 2004; & Rink, 2005a) it was evident that it generally takes two to three years to implement lean thinking and as such only individuals with more than two years practical experience with lean were included in the sample population. The study was, furthermore, conducted in South African manufacturing context, and as such the target population was individuals with two or more years of practical experience in implementing lean in a South African manufacturing organisation.

The sampling framework included potential respondents obtained from the client base of lean or related programme consulting organisations, delegates to the Lean Summit Africa 2007 held in Cape Town, members of the Lean Enterprise Institute – Africa, as well as from the employees of South African manufacturing organisations which have implemented lean or related programmes. Questionnaires were addressed (by e-mail) to the individual by name. The respondents were requested in the covering letter to the questionnaire to forward the questionnaire to any colleague and associate who have interest in lean. Respondents could e-mail, fax or post the completed questionnaires. All completed questionnaires were received via e-mail.

The sample drawn was thus a convenient sample, that is a non- probability sample. Any convenient sample has disadvantages associated with it, the most important of these being the inability to generalise the findings of the study beyond the actual sample surveyed.

8.8 CHAPTER SUMMARY

In this chapter the hypotheses to be empirically tested in pursuit of the stated primary objective of this study were formulated, the questionnaire or measuring instrument was constructed, and the sampling population defined.

The next step in giving effect to the objectives of this study is to conduct the empirical research and do the statistical analysis of the data. The following chapter will detail the description of the realised sample, the data collection and the statistical analysis of the collected data.

CHAPTER 9

RESEARCH RESULTS

9.1 INTRODUCTION

The research design and research methodology were reported in the previous chapter.

This chapter will include comments on the research and practical aspects that were experienced during the research process, the results of the demographic analysis of the sample as well as detailed results of the Factor Analysis that were done on the research data.

Descriptive as well as inferential statistics were employed in this study. According to Trochim (2002) descriptive statistics are simply about describing what data is or what data show. Inferential statistics are about reaching conclusions that extend beyond the immediate data.

The particular statistical procedures were selected on their suitability to test the research hypotheses of the study. These procedures include descriptive statistics, factor analysis, analysis of variance and measure of association. In this chapter the various procedures are documented and main observations made.

9.2 DESCRIPTION OF THE REALISED SAMPLE

It is difficult to determine an accurate response rate for electronically distributed questionnaires since the number of questionnaires forwarded from one participant to a next (as was requested in the covering letter to the questionnaire), cannot be established (Terre Blanche *et al.*, 2006:139). This is referred to as snowball sampling,

which is a process of gradually accumulating a sufficiently large sample through contacts and references. Given the requirements of at least two years practical experience with lean in a manufacturing environment the researcher sent out 861 questionnaires to potential respondents. The number of potential respondents the questionnaire was forwarded to is not known. In total 173 questionnaires were returned electronically, of which 163 could be used in the survey.

The number of subjects in a study can help to decide whether or not the test statistics reaches significance, and small effects can reach significance if the study has a large enough sample (Terre Blanche *et al.*, 2006:139). Hutcheson and Sofraniou (1999) recommend at least 150 to 300 cases. The realised sample of 163 is thus considered sufficient, especially as it equates to a ratio of 4 respondents per questionnaire item.

The data were prepared by transferring the raw data from the questionnaires into electronic format using Microsoft Office Excel before being handed to the Statistical Consulting Services (STRATCON) at the University of Johannesburg for conducting of the statistical analysis.

The composition and description of the realised sample is presented in Table 9.1. The occupational category analysis indicates that the production/manufacturing/operations occupations dominated the sample as 33.7% of the participants came from this occupational category. It is interesting to note that participants from the Human Resources/Training field make up 10.4% (the third highest category) of the respondents. Given the emphasis on the soft or people issues in the literature this can only spell good for the success of lean implementation. The distribution was as expected, that is a skewed distribution towards respondents from direct manufacturing and a fairly even spread amongst the other manufacturing support services.

The manufacturing sector analysis reveals that the majority of the respondents (35%) came from the Metal and Engineering or related manufacturing sector, with a further 25.8% from other manufacturing. A more balanced distribution amongst the sectors was expected.

TABLE 9.1

DESCRIPTION OF THE REALISED SAMPLE

CATEGORY	ITEM	N	%
Occupational category	Production/Manufacturing/Operations	55	33.7
	Engineering/Technical/Maintenance	15	9.2
	Marketing/Sales	1	.6
	Finance/Administration	2	1.2
	Human Resources/training	17	10.4
	Logistics/Distribution/procurement	4	2.5
	Consultant	13	8.0
	CEO/General Management	15	9.2
	Industrial Engineering	18	11.0
	Continuous improvement	14	8.6
	Process Engineering	4	2.5
	Other	5	3.1
	Total	163	100
Manufacturing sector	Motor assembly	27	16.6
	Motor components manufacturing	16	9.8
	Metal and engineering or related manufacturing	57	35.0
	Food and beverage manufacturing	12	7.4
	Chemical and related manufacturing	6	3.7
	Household furniture and appliances manufacturing.	3	1.8
	Other manufacturing	42	25.8
	Total	163	100
Description of experience with lean	As outside consultant	25	15.3
	As internal facilitator	34	20.9
	Manager – all levels of management	83	50.9
	Non-management employees	21	12.9
	Total	163	100
Years of practical experience/involvement with lean.	2 to 5 years	87	53.4
	>5 years	76	46.6
	Total	163	100

The years of practical experienced and/or involvement with lean by the respondents show that the majority (53.4%) of the respondents have between two and five years of experience. If it is considered that respondents with less than two years experience have been excluded from the survey, it could be inferred that lean implementation is in its infancy in the South African manufacturing industry. One could also make an argument that in comparison to the 50 years experience of Toyota with lean the sample could not be representative regarding critical success factors for sustainable lean implementation.

The majority of the respondents' experience was gained as managers (50.9%) and a fairly large percentage (20.9%) as internal facilitators. The latter indicating support for the notion of a full time facilitator or lean promotion office.

The basic conclusion from the description of the realised sample is that the respondents could be considered as having sufficient practical experience and knowledge of lean in a fair balanced of occupational categories and manufacturing sectors. Therefore, it can be said that the realised sample is considered to be representative of the target population and that there is no statistically significance difference between the sample and the population. The data collected could thus be used to draw useful conclusions.

9.3 STATISTICAL ANALYSIS OF THE RESPONSES

The data relating to the primary objective of the study, that is the critical success factors for successful lean implementation, and the indicators of successful lean implementation, were analysed in three stages. Firstly the data were subjected to an exploratory factor analysis (using the Principle Axis Factoring extraction method). Rotation was done using Varimax with Kaiser Normalization. Questionnaire items displaying a measure-sample adequacy (MSA) of smaller than 0.6 were excluded from the analysis.

The second stage of the analysis involved an assessment of the reliability of the

factors by means of an internal consistency measure Cronbach Alpha. According to Terre Blanche *et al.* (2006:154) internal consistency means determining the degree to which each item in a scale correlates with each other item. The closer the value of Cronbach Alpha is to 1 the greater the reliability of the scale. In other words the measuring instrument is capable of consistently reflecting the same underlying constructs. Furthermore, it indicates a high degree of homogeneity amongst the scale items.

The final stage involved regression analysis to assess the impact of the independent variables on the dependent variables, and as such to test the hypotheses.

The data relating to the secondary objectives (that is the general success of lean in South African manufacturing organisations, and the impact of employee groupings and trade unions on lean success) were analysed by way of the recorded mean scores and frequencies of the items.

9.3.1 Descriptive statistics

Descriptive data analysis aims to describe the data by investigating the distribution of scores on each variable, and by determining whether the scores on different variables are related to each other. Descriptive analysis is done first to help the researcher gain an initial impression of the data that were collected (Terre Blanche *et al.*, 2006:193).

In order to determine the sampling adequacy and sphericity, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (MAS) and the Bartlett's Test of Sphericity were respectively carried out on the inter correlation of the 40 items of the measuring instrument. Eleven items were dropped due to recording low MAS, that is scores of less than 0.6 (4 from the theoretical construct *Leadership*, 3 from *Tools and Techniques,* 2 from *People*, and one each from *Basic Stability* and *Promotion Office*). All the items for the theoretical success indictors remained intact.

From Table 9.2 it is clear that the data set complies with the requirements for factor

analysis.

TABLE 9.2
KMO AND BARTLETT'S TEST

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		**.767**
Bartlett's Test of Sphericity	Approx. Chi-Square	1697.856
	df	210
	Sig.	.000

Table 9.3 provides the descriptive statistics of the data for all the questionnaire items. Mean, variance and standard deviation are the most popular descriptive statistics, as they form the basis of most advanced inferential statistical procedures.

Table 9.3 revealed that with the exception of item TT4 all the items recorded very high scores on the 7-Point Likert scale, resulting in the data being negatively skewed. Skeweness indicates the degree to which the shape of the frequency distribution deviates from the symmetry. The data is thus not symmetric, which may cause problems in later statistical procedures.

TABLE 9.3
DESCRIPTIVE STATISTICS

Code	Item	Mean	Std. Deviation	Skewness	Kurtosis
MA1	The mindset and attitude or behaviour of people is fundamental to lean success.	6.47	.631	-.766	-.411
MA2	An organisation implementing lean must face and embrace the various attitudinal aspects of lean.	6.31	.707	-.849	.629
MA3	For lean to be successfully implemented all levels of employees must be obsessed with lean.	5.50	.891	-.732	1.702
MA4	The cognitive dimensions of lean are key to successful lean implementation.	5.71	.866	-.212	-.596

LS1	Leadership at all levels in the organisation must drive, live and demonstrate lean behaviour.	6.78	.445	-1.776	2.204
LS2	Lean leadership begets lean manufacturing.	6.08	.868	-1.418	3.155
LS3	Knowledgeable committed executive leadership is the absolute *sin qua non* for lean success.	6.27	.854	-.852	-.296
LS4	The difference between lean success and failure starts with leadership.	6.48	.688	-.980	-.287
EM1	The goals of lean can only be achieved through the efforts of its people.	6.28	.820	-.905	.043
EM2	Lean people make a lean organisation, and as such the people have to get lean before the organisation can get lean.	5.45	1.263	-1.324	1.857
EM3	The essence of lean is people working within the lean philosophy and principles.	5.96	.884	-1.488	3.367
EM4	Ultimately it is the knowledge, skills, involvement and commitment of ordinary people that will make the difference to lean success.	6.26	.701	-1.417	-.904
SI1	Lean philosophy and principles must be reflected in the organisation's business strategy.	6.50	.715	-1.089	-.209
SI2	There must be a clear link between the organisational goals, key objectives and lean activities.	6.45	.687	-1.106	.879
SI3	Lean implementation must be driven as a high priority strategic business initiative.	6.17	.918	-1.451	2.656
SI4	Lean should be implemented as a business strategy and not a tactic.	6.45	.779	-1.548	2.158
BS1	At the beginning of a lean transformation the organisation needs lots of basic stability before it can proceed with the more sophisticated elements of lean.	5.60	1.153	-.529	-.068
BS2	General predictability and consistent availability in terms of manpower, machines, materials and methods is a pre-condition for lean implementation.	5.38	1.302	-.907	.729
BS3	Work must be standardised before embarking on a lean journey.	4.94	1.297	-.120	-.650
BS4	Stability in operating systems is a pre-requisite for lean transformation.	5.40	1.304	-.686	-.046

PO1	An organisation embarking on a lean journey will need the support and guidance of full-time facilitators with substantial experience with lean implementation.	6.28	.739	-.677	-.230
PO2	An internal lean systems builder is needed to sustain lean after the external expert has left.	6.04	1.048	-.890	.117
PO3	A lean promotion office where senior experts of lean can be located must be established in the organisation.	5.85	.907	-.898	2.446
PO4	A full-time dedicated project leader or facilitator will have a positive impact on the success of lean implementation.	6.17	.938	-.883	-.204
TT1	Key to sustainable lean performance is having the right lean tools and techniques in place.	5.14	1.211	-.464	-.454
TT2	The selection and application of the appropriate lean tools are critical for successful lean implementation.	5.50	1.045	-.436	-.263
TT3	It is important to understand the organisation's processes and only apply the lean tools and techniques applicable to that specific process type.	4.69	1.467	-.369	-.671
TT4	The application of lean tools and techniques by itself will ensure lean success.	2.44	1.019	.532	-.121
IS1	The organisation must integrate the soft issues (such as culture, mindset and behaviour) of lean with the hard issues (such as systems, structure, processes and tools) of lean.	6.05	.980	-1.175	1.335
IS2	All business systems, programmes and structures must be aligned with the lean philosophy, principles, practices and methods.	5.80	1.047	-.740	.008
IS3	The effectiveness of the lean operating system comes from the integrated nature of its practices and methods.	5.76	.929	-.348	-.696
IS4	The organisation must use all of the goals, methods, techniques, and foundation elements of lean in combination.	5.18	1.134	-.703	.441
CR1	Successful lean implementation will result in continually declining manufacturing costs.	6.19	.562	.025	-.150
CR2	Successful lean implementation will free up resources (e.g. cash tied up in inventory).	6.44	.599	-.535	-.613

CR3	Successful lean implementation will make the organisation's products more cost competitive.	6.37	.555	-.119	-.815
CR4	Successful lean implementation will impact on the organisation's bottom line results (increase profitability).	6.39	.715	-1.358	-.150
CS1	Successful lean implementation will result in the organisation delivering on-time-in-full to its customers.	6.25	.629	-.242	-.620
CS2	Successful lean implementation will increase customer satisfaction.	6.39	.680	-.668	-.656
CS3	Successful lean implementation will result in the customer getting the right products at the right time, place, and price, with the right quality.	6.30	.659	-.411	-.735
CS4	Successful lean implementation will result in the organisation providing value, as defined by the customer, to the customer.	6.34	.632	-.429	-.663

9.3.2 Primary objective

The primary objective of the study was to identify the factors or variables that influence and eventually determine the successful implementation of lean as a business management strategy in South African manufacturing organisations. Another objective was to empirically assess and quantify the impact of these factors or variables on successful lean implementation. All 16 hypotheses derived from the theoretical model relate to this primary objective. In this section the data relating to the empirical testing of the hypotheses will be discussed.

9.3.2.1 Factor analysis for success factors

Factor analysis tells the researcher what variables group together or go together based on the premises that observed variables are correlated because they share one or more underlying causes, called factors (Luna, 2005). According to Terre Blanche *et al.* (2006:248) factor analysis is a statistical technique that is used to identify a relatively small number of factors in order to represent the relationship among a set of

interrelated variables.

Factor analysis involves three steps: computing intercorrelations between variables (correlation matrix), extracting initial factors, and rotating the factors to obtain a clearer picture of the factor content.

The 21 items that remained after the MAS were intercorrelated and the eigenvalues calculated. An eigenvalue represents the amount of variance explained by each factor.

Five factors or constructs were postulated according to Kaiser's (1961) criterion of eigenevalues-greater-than-one. The Principle Axis Factoring extraction method was used. The eigenvalues of the five factors are given in Table 9.4. The five factors explain about 65% of the variances in the data.

TABLE 9.4

TOTAL VARIANCE EXPLAINED – EIGEN VALUES

Factor	Initial Eigenvalues		
	Total	% of variance	Cumulative %
1	6.17	29.39	29.39
2	2.47	11.76	41.15
3	2.24	10.67	51.82
4	1.57	7.46	59.28
5	1.15	5.46	**64.74**

The factor matrix was than rotated to simple structure by means of Varimax with Kaiser Normalization method. From Table 9.5 it can be seen that five factors were extracted. Five items loaded on Factor 1, five items on Factor 2, four items on Factor 3, four items on Factor 4, and three items on Factor 5. All factors thus consist of at least three items, which is in line with Thurstone's recommendation of at least three variables per factor for exploratory analysis (Kim & Mueller, 1978:77). Factor loadings indicate, by correlation coefficients, the relationship between variables.

Loadings of greater than 0.35 were considered significant. From Table 9.5 it can be seen that a number of multi loadings occurred, which could have an influence on the planned regression analysis.

At this point (after factor loading), the researcher is faced with the task of deciding whether the factor analytical procedure produced any meaningful results, and whether conceptually sound interpretation can be attached to the results. Each factor has to be identified and appropriately labelled or named.

TABLE 9.5

ROTATED FACTOR MATRIX – SUCCESS FACTORS

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
BS4	**.783**	.O82	.059	.037	.064
BS2	**.782**	.067	.122	-.090	.250
BS3	**.730**	-.255	.164	.173	-.002
MA4	**.531**	.253	.199	.288	.304
IIS4	**.490**	.191	.129	.104	.013
SI3	-.073	**.682**	.590	.213	.037
MA1	.035	**.638**	.020	.060	-.009
EM1	.016	**.550**	.075	.166	.205
MA3	.176	**.470**	.010	.007	.252
IS3	.357	**.450**	.210	.142	.363
EM3	.213	-.085	**.735**	.128	.250
TT1	.141	.252	**.516**	.152	.136
IS2	.277	.429	**.502**	.190	.271
MA2	.346	.203	**.416**	.160	-.200
SI1	.079	.028	.310	**.832**	-.070
SI2	-.093	.421	-.055	**.702**	.016
SI4	.215	-.072	.534	**.552**	.055
IS1	.259	.136	.125	**.490**	-.003
PO4	.089	-.051	.363	-.165	**.653**
PO1	.072	.184	-.049	.018	**.633**
PO2	.112	.384	.199	.054	**.600**

The five factors that emerged could be named as depicted in Table 9.6.

TABLE 9.6

NAMING OF EMERGED FACTORS

Factor	Name	Items
1	Basic stability	Stability in operating systems is a pre-requisite for lean transformation. (BS4)
		General predictability and consistent availability in terms of manpower, machines, materials and methods is a pre-condition for lean implementation. (BS2)
		Work must be standardised before embarking on a lean journey. (BS3)
		The cognitive dimensions of lean are key to successful lean implementation. (MA4)
		The organisation must use all of the goals, methods, techniques, and foundation elements of lean in combination. (IS4)
2	People or soft issues	Lean implementation must be driven as a high priority strategic business initiative. (SI3)
		The mindset and attitude or behaviour of people is fundamental to lean success. (MA1)
		The goals of lean can only be achieved through the efforts of its people. (EM1)
		For lean to be successfully implemented all levels of employees must be obsessed with lean. (MA3)
		The effectiveness of the lean operating system comes from the integrated nature of its practices and methods. (IS3)
3	Philosophy and principles	The essence of lean is people working within the lean philosophy and principles. (EM3)
		Key to sustainable lean performance is having the right lean tools and techniques in place. (TT1)
		All business systems, programmes and structures must be aligned with the lean philosophy, principles, practices and methods. (IS2)
		An organisation implementing lean must face and embrace the various attitudinal aspects of lean. (MA2)

4	Strategic driver	Lean philosophy and principles must be reflected in the organisation's business strategy. (SI1)
		There must be a clear link between the organisational goals, key objectives and lean activities. (SI2)
		Lean should be implemented as a business strategy and not a tactic. (SI4)
		The organisation must integrate the soft issues (such as culture, mindset and behaviour) of lean with the hard issues (such as systems, structure, processes and tools) of lean. (IS1)
5	Promotion office	A full-time dedicated project leader or facilitator will have a positive impact on the success of lean implementation.(PO4)
		An organisation embarking on a lean journey will need the support and guidance of full-time facilitators with substantial experience with lean implementation. (PO1)
		An internal lean systems builder is needed to sustain lean after the external expert has left. (PO2)

The factors that emerged differ from the factors in the theoretical model that was to be subjected to an empirical assessment. In other words a number of the items did not load as expected. The factors that remained intact are *Basic Stability*, *Strategic Driver* and *Promotion Office*, whilst the theoretical factors *Tools and Techniques* and *Integration* were rejected. The theoretical factors of *Mindset and Attitude*, *Leadership* and *Ordinary Employees* have emerged as one factor which was labelled *People or soft Issues*.

Reliability or internal consistency can be measured in different ways. In this study the internal reliability or consistency was assessed by means of the Cronbach Alpha. The generally agreed lower limit, to be able to claim an instrument to be reliable, for the Cronbach Alpha coefficient is 0.70, although the limit may be lowered to 0.60 in the case of exploratory research (Hair *et al.*, 1988:118).

Table 9.7 provides the Cronbach Alpha scores for each of the postulated factors. With the exception of Factor five (0.689) all the factors recorded scores of more than 0.70.

As Factor five was only marginally below the cut off point of 0.70 it was decided to retain the factor. By deleting one item from Factor one the Cronbach Alpha was marginally increased from 0.813 to 0.819.

Based on the results reported above, the questionnaire items used to measure the five factors could be considered as reliable.

9.3.2.2 Factor analysis for the success factors

The same procedure was followed for the success indicators as was for the success factors. The descriptive statistics is presented in Table 9.3. A Kaiser-Meier-Olkin Measure of Sampling Adequacy score of .732 was recorded for the success factors.

TABLE 9.7

CRONBACH ALPHA VALUES

Construct	Cronbach Alpha
Basic stability	.819
People or Soft issues	.748
Philosophy and principles	.713
Strategic driver	.754
Promotion office	.689

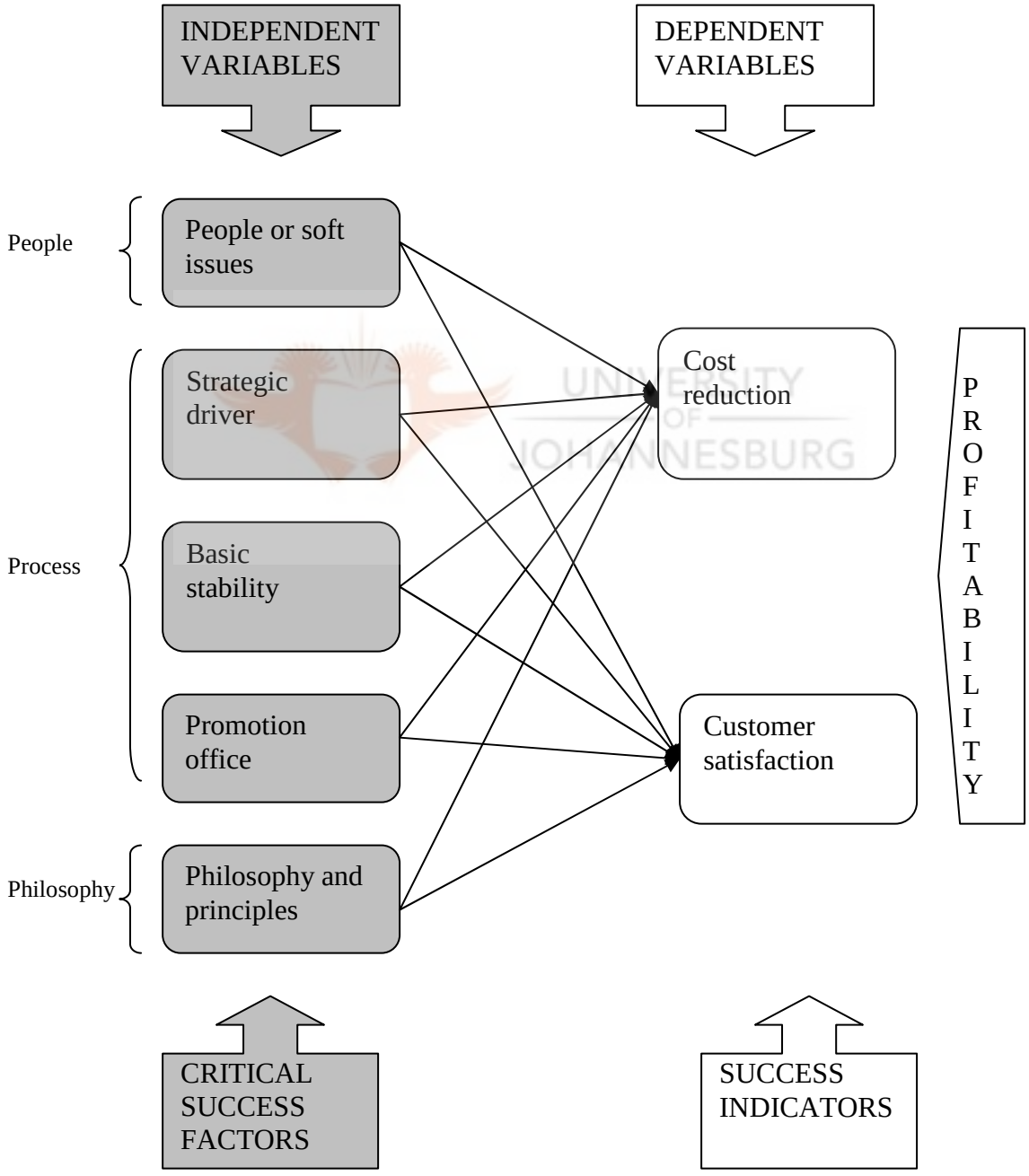
The factor analysis could not extract any factor, in other words the items did not load on any construct or factor. It was expected in the theoretical model that two factors, namely *Cost Reduction* and *Customer Satisfaction* would emerge.

It was decided to continue with the calculation of the Cronbach Alpha for the two theoretical success indicator factors. *Cost Reduction* recorded a Cronbach Alpha of .665 and *Customer Satisfaction* recorded .706 (after deleting one item which increased the score from .687).

Based on the Cronbach Alpha results of the theoretical success indicator factors the emerged factors are considered to be reliable and it was decided to change the theoretical model accordingly. The re-drafted model is depicted in Figure 9.1.

FIGURE 9.1

RE- DRAFTED THEORETICAL MODEL FOR THE RELATIONSHIP BETWEEN THE CRITICAL SUCCESS FACTORS AND THE SUCCESS INDICATORS



9.3.2.2 Testing of the re-drafted model by means of a multiple regression analysis

In order to empirically evaluate the various relationships in the re-drafted model (see Figure 9.1) a multiple regression analyses needed to be conducted. As such the influence of each of the five critical success factors or independent variables on each of the two success indicators or dependent variables needed to be assessed. Multiple regression analysis is one of the most commonly used mutilvariate procedures, and is used to build models for predicting scores on one variable, the dependent variable, from scores on a number of other variables, the independent variables (Terre Blanche *et al.*, 2006:255).

Unfortunately there were a number of indicators that an ordinary regression model could not be conducted, in other words the ability of the data to meet the statistical assumptions specific to multivariate techniques is suspect. For example the scatter plots indicate that there is not enough variations to describe a linear relationship and non of the success factors indicated a normal distribution (as indicated by the histograms drawn from the descriptive statistics). Hair *et al.* (1998) asserts that the most fundamental assumption in multivariate analysis is normality. If the variation from the normal distribution is sufficiently large, all resulting statistical tests are invalid. There is also very high multiple loadings of the success factors, and the factor analysis for the success indicators extracted no clear factors.

The formulated hypotheses could thus not be accepted or rejected by the empirical study. However, the theoretical factors *Tools and Techniques*, and *Integration* did not emerge as factors and therefore all the related hypotheses could safely be rejected.

However, based on the results of the factor analysis for the success factors and the high Cronbach Alpa recorded by each of the factors that emerged, it was decided to accept the five factors that emerged as the empirically tested critical success factors for successful lean implementation in South African Manufacturing organisations. Support for this decision comes from Terre Blanche *et al.* (2006:237) whom argues that statistics, especially inferential statistics, receive far more weight in the overall

interpretation of research than they deserve. There is always uncertainty involved in inferring facts about populations from observed samples. There is always a chance that the inference will be incorrect as inferential statistics are statistics of chance.

All the emerged factors will be interpreted in Chapter 10.

9.3.3 Secondary objectives

As part of the exploratory research the general success of lean in South African manufacturing organisations, the impact of different employee groupings on lean success, as well as the impact of trade unions on successful lean implementation was also assessed. The analysis of the responses will be analysed hereunder and the major findings reported. A detailed discussion of the results will be conducted in the next chapter, as part of the managerial implications and recommendations.

The data relating to the success with lean implementation was analysed by means of the frequency distribution of the responses and is reported in Table 9.8. Frequency distribution is the simplest distribution method and lists every value of a variable and the number of persons who had each value (Hair *et al.*, 1998). The striking observation is that 53.4% of the respondents reported their lean initiative as laggard, whilst 12.9% reported failed initiatives. It can thus be inferred that a staggering 66.3% of all lean initiatives reported on did not realise the expected results.

Table 9.9 reports the results of the ranking of the impact of the various employee groupings on successful lean implementation. A score was used to determine a ranking (for example 84 respondents answered ‘1’; 24 answered ‘2’; 6 answered ‘3’; 4 answered ‘4’; and 4 answered ‘5’ giving a score of 84x1 plus 24x2 plus 6x3 plus 4x4 plus 4x5 = 191). As the scale ran from ‘1’ for most impact to ‘5’ for the least impact the category with the lowest score must receive the highest ranking in terms of impact on successful lean implementation.

TABLE 9.8

SUCCESS WITH LEAN

Classification	Frequency	%
Best in class (those organisations who have embraced lean and made it part of their corporate culture)	7	4.3
Industry average (organisations that have implemented lean in some facets of the organisation but have yet to complete the journey)	48	29.4
Laggard (those organisations who are just learning about lean and/or are meeting with some resistance)	87	53.4
Failed (organisations that have embarked on the lean journey but have given up or stagnated)	21	12.9
Total	163	100

TABLE 9.9

IMPACT OF EMPLOYEE GROUPINGS

Employee Grouping		Most				Least		
		1	2	3	4	5	Total	Score
Executive leadership	Count	84	24	6	4	4	163	186
	%	51.5	14.7	3.7	2.5	27.6	100	
Senior management	Count	28	44	37	42	12	163	455
	%	17.2	27.0	22.7	25.8	7.4	100	
Middle management	Count	19	37	79	18	10	163	452
	%	11.7	22.7	48.5	11.0	6.1	100	
First line supervisor	Count	15	34	28	74	12	163	1625
	%	9.2	20.9	17.2	45.4	7.4	100	
Front line employee/operator	Count	17	24	14	24	84	163	1379
	%	10.4	14.7	8.6	14.7	51.5	100	

Executive leadership is considered by the respondents to have the most impact, with first line supervisors by far the least. Based on the theory first line supervisors were expected to have the biggest impact on lean success.

The impact trade unions have on successful lean implementation is presented in Table 9.10. Trade unions are considered to have more of a positive than a negative impact, however mostly a limited positive impact.

TABLE 9.10

IMPACT OF TRADE UNIONS

Impact	Frequency	%
Strong positive impact	34	20.9
Reasonable positive impact	23	14.1
Limited positive impact	49	30.1
No impact at all	22	13.5
Limited negative impact	27	16.6
Reasonable negative impact	7	4.3
Strong negative impact	1	0.6
Total	163	100

The results will be discussed in more detail in Chapter 10.

9.4 CHAPTER SUMMARY

In this chapter the results of the various statistical procedures were documented and main observations made. The results of descriptive statistics, factor analysis, analysis of variance and measures of association were portrayed.

The results of the descriptive statistics revealed that the distributions are all negatively skewed. The results of the sampling adequacy and sphericity tests revealed that the data set complied with the prerequisites for factor analysis. The factor analysis resulted in five factors, which differ from the theoretically determined eight factors. Accordingly the theoretical model was re-drafted.

A multiple regression could not be conducted, and as such the influence of the independent variables on the dependent variables could not be determined. The hypotheses could thus not be accepted or rejected.

The five postulated factors were accepted as the empirically tested critical success factors for successful lean implementation in South African manufacturing sector.

It was established that, according to the respondents, lean is not successful in South African manufacturing organisations. Executive leadership has the biggest impact on lean success, whilst trade unions are considered to have mostly a limited positive impact on the success of lean.

In the next chapter the five critical success factors will be interpreted and discussed, and practical recommendations will be made for the successful implementation of lean in South African manufacturing organisations. The results of the secondary objectives will be incorporated in these discussions and recommendations.

CHAPTER 10

CONCLUSIONS AND RECOMMENDATIONS

10.1 INTRODUCTION

A commonsense understanding of science, as per Terre Blanche *et al.* (2004:4), is that progress occurs through a process of falsification: incorrect theories are rejected on the basis of empirical evidence, leaving, over time, correct theories that stand the truth.

A scientist must thus begin with a theory about a specific topic. Theories are general truth statements that scientists put to empirical test by deriving hypotheses about particular observations. The process by which hypotheses are derived follows principles of deductive logic; that is, drawing conclusions about particulars from knowledge of the general. In this study the former process was applied in Chapters 1 to 8.

After subjecting the hypotheses to empirical testing an inductive logic phase ensues, which is when the findings of the empirical study are interpreted and the theory justified to fit the newly discovered facts. In some cases the theory is disproved and has to be rejected. In this study the empirical testing phase was described in the preceding chapter.

This final chapter integrates all the aspects documented in the study by interpreting the five identified critical success factors for successful implementation of lean as a business management strategy in South African manufacturing organisations, which is the stated primary objective of this study. The discussions will include practical recommendations for the successful implementation of lean (conclusions drawn from both the literature study and the empirical research), which was a secondary objective of the study. In other words this chapter will translate the findings of the empirical

research into broad guidelines for use by lean implementers, as well as outlining practices that are likely to sustain lean activities.

The other stated secondary objectives, being the general success of lean in South African manufacturing sector, the impact of the various employee groupings on lean success, and the impact of trade unions on lean success will be incorporated in the discussions of the identified critical success factors.

Finally, the value of the study, which includes a summary of the main findings and recommendations, will be discussed; the limitations of the study will be pointed out; and recommendations for further research will be made.

10.2 SUCCESS OF LEAN

In paragraph 1.1 it was submitted that the effectiveness of lean as a business management strategy is beyond question, and that lean has become a competitive necessity for many organisations. It was also stated that although many organisations attempt to go lean, few succeed, in other words lean, in most cases, never achieved what it could or should have achieved. The generally accepted lean success rate recorded in the literature is between 10% and 20%.

Given the apparent low success rate of lean transition, the primary objective of this study was defined as the identification of the critical success factors, not the general success factors, for the successful implementation of lean in South African manufacturing organisations.

No authoritative statistics on the success or failure rates of lean implementation in the South African manufacturing sector, or any other sector for that matter, could be found and it was decided to as part of the exploratory research assess the general success of lean in South African manufacturing organisations. The results of this study, as depicted in Table 9.8 (see paragraph 9.3.3), show that successful lean implementation is also in the South Africa manufacturing sector the exception rather than the rule.

Only 4.3% of the respondents reported success (Best in Class), whilst 12.9% have failed. A further 53.5% are struggling (Laggards) with only 29.4% still on track (Industry Average), in other words still in with a chance of success.

The above stated results thus support the reasons or justification for conducting this study. In today's environment of global competition and intense cost pressures, this low rate of successful lean transformation is worth investigation. The results also indicate that organisations should be very concerned whether a suitable environment for successful lean implementation exists, and whether the organisation has the necessary skills and experience to implement lean.

10.3 PHILOSPHY AND PRINCIPLES

Lean *Philosophy and Principles* emerged from the empirical study as one of five critical success factors for lean implementation. This factor was not identified in the theoretical model of critical success factors (see Figure 8.1).

The empirical results thus support the 4P Model of lean (Philosophy, People, Process and Problem Solving) as proposed by Liker (2004) and reported in paragraph 2.5, in that not only did *Philosophy and Principles* emerged as a critical success factor but also *People*, whilst *Basic Stability* and *Lean Promotion Office* are key Process issues. It is interesting to note that reference to the lean philosophy and principles, only start appearing in the lean literature as recently as the year 2004. The research thus supports recent literature. It is also noted that the programmes mostly used in South Africa as platforms for lean implementation (20 Keys, MDWT and TRACC) do not make any reference to the lean philosophy. The former observations tend to strengthen the case for *Philosophy and Principles* as a critical success factor, as well as providing some insights into the low success rate of lean reported by the respondents to this study.

The empirical results thus supports Liker and Meier (2006:6 & 8) when stating that it is a strong philosophical mission orientation that has defined Toyota from its beginnings

as a manufacturing organisation, and often separated Toyota from its competitors. This philosophy is the foundation for all other principles and is the missing ingredient in most organisations trying to emulate Toyota.

At the most fundamental level Toyota regards the organisation as a vehicle for adding value to customers, society, the community, and its employees, and every effort in the organisation is measured against this philosophy and principles.

The lean philosophy entails:

- having a philosophical sense of purpose that supersedes any short-term decision making;
- work, grow and align the whole organisation toward common purpose that is bigger than making money;
- understand the history of the organisation and work to bring it to the next level; generate value for the customers, society and the economy;
- evaluate every function in the organisation in terms of its ability to generate value; be responsible;
- strive to decide own fate;
- act within self-reliance and trust in own abilities; accept responsibility for own conduct;
- maintain and improve the skills that enable the organisation to produce added value.

Lean should thus be approached as a comprehensive, fully integrated management and manufacturing system which must be consistently practiced throughout the organisation. The organisational culture must incorporate and support the lean philosophy and principles, in other words the essence of lean is individuals and teams who work within the lean philosophy.

Unfortunately, according to Liker and Meier (2006: 23) simply writing down Toyota's philosophy will not be enough. The organisation will have to develop its own philosophy and than live it. A starting point is for the leaders of the organisation to get

together to take stock of the current situation in the organisation by applying the principles of *genchi genbutshu*, which says you must go and see for yourself and understand the actual situation. Determine the real organisation culture and the roots of the culture (the current state), determine the future state based on the Toyota philosophy, indentify the gaps, decide on the activities to close the gap, and than live the philosophy.

Continuing success of lean thus stems from a deeper business philosophy based, inter alia, on understanding of people and human motivation. *People* (soft issues) are another critical success factor for lean implementation that emerged from the empirical study.

10.4 PEOPLE OR SOFT ISSUES

The theoretical model identified *Mindset and Attitude*, *Leadership* and *Ordinary Employees* as three separate potential critical success factors. These three theoretical factors however emerged from the empirical study as one factor, which was labelled *People or Soft Issues*.

The results of the empirical research thus concurs with the inferences from the literature study that the goals and objectives of lean can only be achieved through the efforts of people, as it is lean people that make a lean organisation, it is the people that bring the lean system to life. The mindset and behaviour of people operating the lean system, leadership and the quality of the people are thus fundamental to lean success. The basic lean philosophy in which the human dimension is the single most important element for lean success is thus supported by the study.

People issues are very complex issues, spanning over a varied number of related issues, for example discipline, training and development, the impact of lean on people, lean leadership, trade unions, performance management, job security, safety, morale, and recruitment, to mention a few. These issues have been discussed, in a lean context, in the report on the literature study and will not be repeated here.

It would thus appear from the results of the empirical study that Liker and Hoseus (2008:xxi) are correct in stating that if there is magic in lean then it is the successful implementation of human resources policies that create the buy-in and engagement of people necessary to run such a simple but intricate lean system.

This finding is contrary to the writings of the father of lean Ohno (1988) who focussed very much on the application of the lean toolbox, but supportive of recent Toyota managers like Convis (2001) and ideas written in recent literature.

The importance placed by the empirical results on the role of people in lean success necessitates a re-look at the role of the Human Resources department in a lean organisation. The Human Resources function at Toyota goes way beyond hiring people and administering policies related to pay, promotion, and benefits. It seems that in many South African organisations the role of the Human Resources function is largely to act as people accounting systems administrators. Since people are so integral to the lean philosophy, it stands to reason that the Human Resources function should be one of the most important and powerful departments in an organisation.

At Toyota Human Resources Managers typically enter the department by way of job rotations, such as production management and production control, so they have an understanding of the core value-adding processes, something that is unheard of in South Africa. Toyota has intertwined Human Resources with its production department, and as such, Human Resources people are involved in daily concerns of team members on the shop floor. The role of Human Resources is partnering with manufacturing, while facilitating ownership by manufacturing.

Human Resources practitioners should be assigned to specific areas of the organisation and are expected to spend the majority of their time in those areas of the organisation to gauge the culture and develop team members. Human Resources practitioners spending the majority of their time in front of a computer, thereby isolating themselves from the people who perform the value-adding work, is alien to the Toyota way.

Human Resources should thus focus on the people value stream, defined by Liker and Hoseus (2008:76) as delivering the right people, in the right amount, at the right time, in line with organisational needs. Human Resources should furthermore act as the guardians of fairness and consistency, making the work environment fair and positive for all the people. Instead of managing from the administrative ivory towers Human Resources must be sent to the floor to work directly with management in order to reach the organisation's goals. The former would most certainly require a restructuring of the Human Resources department, and redefining the roles and skills of Human Resources practitioners.

Lean management will furthermore almost inevitably involve changes to Human Resources policies. Human Resources need to understand lean and the rationale for converting to lean, and should be involved as early as possible as much as possible.

It is pleasing to note from Table 9.1 that 10,4% of the respondents to this study are from the Human Resources function.

From Table 9.9 (see paragraph 9.3.3) it is clear that leadership or management is considered by the respondents to this survey as having the most impact on lean success, with executive leadership considered to have by far the biggest impact of all the employee groupings. Surprisingly the first line supervisor/team leader is considered to have the least impact. Considering that lean as a strategic business driver has also emerged as a critical success factor it is thus not surprising that executive leadership is rated as having the most impact on lean success. After all, it is executive leadership who is responsible for setting and implementing strategy in the organisation. It is leadership, according to Rubrich and Watson (1998:22), who is responsible to adjust people's mindset by making sure that mindset and behaviours are given the same attention as operating systems.

South Africa is woefully short of people who can really lead an organisation beyond the basics of lean. If one add the skills shortage, especially in artisan and engineering fields, and the employment equity requirements it is clear that the human dimensions needs to be seriously considered and attended to as part of the lean implementation

strategy. Training and development practices need to be seriously reviewed, in fact the whole people value stream, as the people development process needs to be linked with the overall lean improvement effort.

Lean must thus be the organisation's top strategic driver and leadership must cultivate a corporate culture accomplished in lean thinking. It thus stands to reason that the top level leadership requirement must be in place before the lean implementation begins, failing which the lean initiative is doomed from the start. Pieterse (2007) seems to be correct in stating that the challenge in a lean implementation is how to infect leaders with an enthusiasm for lean. Waddel (2005) is also in support, submitting that: "…the resistance to lean in factories is trivial compared to the resistance we are likely to encounter in the ivory towers".

The results of the study clearly show that the difference between lean success and failure starts with leadership.

Given the critical role played by people, it could be argued that people are also the biggest barrier to lean implementation, especially in a unionised environment like the South African manufacturing sector.

As such it is interesting to read from Table 9.10 that trade unions are generally considered by the respondent to this survey as having a positive impact on lean success. Trade unions should thus be involved from the outset in the lean implementation as partners. This relationship must be based on trust, build through open and honest communication and by treating everyone with respect, as well as a mutual commitment to the future of the organisation (as discussed under Philosophy in paragraphs 2.5.1 and 10.3). The latter again emphasises the crucial role to be played by the Human Resources department in the lean transformation.

10.5 STRATEGIC DRIVER

As expected, the empirical research supports the findings of the theoretical study that for lean to be successful it should be implemented as one of the organisation's strategic business drivers. Any strategic issue obviously requires the commitment of the executive leadership, as discussed in the previous section, as such commitment is needed for adherence to the lean philosophy and principles of lean (which emerged as a one of the critical success factors), and for the allocation of resources (including the establishing of a lean promotion office, which also emerged as a critical success factor).

What is required is a clear link (goal alignment) between the organisational goals, key objectives and lean activities; lean implementation must be driven as a high priority strategic business initiative; and the lean philosophy and principles must be reflected in the organisation's business strategy.

Hosni Kanri, or policy deployment should thus be embraced by leadership of the organisation to operationalise lean in a strategic context, culminating in all levels of the organisation and all functions and divisions working together to define and achieve their shared goals.

In order to ensure lean gets its rightful place as a strategic issue the organisation needs to appoint a highly visible senior executive to oversee the lean planning and implementation. This executive must have a strong lean leadership style, be knowledgeable and committed to lean, and command respect from top management.

10.6 BASIC STABILITY

The respondents to this study consider basic stability; which is general predictability and consistent availability of manpower, machines, methods and materials, as a critical prerequisite for successful lean implementation. In other words the manpower, machines, methods and materials must be capable, available and flexible to produce

consistent results over time.

In order to ensure lean success management will thus have to focus on cementing the building blocks of stability, namely standardised work, standardised processes, levelling of demand and production, skilled people and the appropriate organisational structure. To achieve the former, in other words to reduce variability, the correct application of the appropriate lean tools and techniques is required. Thus, although lean tools and techniques did not emerge as a critical success factor (as was predicted by the theory) these tools and techniques still have a very important place in establishing the critical lean success factor labelled *Basic Stability*.

Management must thus resist the temptation to move to soon to the more sophisticated lean concepts of pull and flow before a basic level of stability has been achieved, they must thus not 'outrun their own headlights' in rushing to short-term gains. The initial focus of the lean implementation should thus be on establishing the required level of basic stability. Monitoring the progress towards achieving the required level of basic stability in order to know when the organisation can move towards the more advanced lean concepts would obviously require a basic stability measurement and tracking system, which should include the Overall Equipment Efficiency measure discussed in paragraph 3.16, the skill levels of people, and discipline to adhere to standardised work and 5S.

It is interesting to note that the Toyota Production System described by Ohno (1988) assumes that all processes are stable and therefore under control, and as such Ohno does not deliver a strategy on how to reach basic stability.

10.7 LEAN PROMOTION OFFICE

The results of the empirical study concurs with the theoretical model that successful lean implementation requires full-time expert lean facilitators located in a lean promotion office. In other words both the literature and this study results support the importance of the availability of a good facilitator or change agent. Establishing such

an office is also a sure way of indicating executive leadership commitment, in other words considering lean as a strategic business driver.

The lean promotion office should be the repository of lean expertise and have general responsibility for lean implementation. However, it is critical that the ultimate responsibility for lean implementation remains with the line managers.

The respondents showed that they have a sound knowledge of the theory of lean and a sound understanding of what is needed to make a success of lean. What seems to be lacking is practical experience of successful lean implementation (only 4% of the respondents have experience with a successful lean implementation).

Given the limited number of successful lean implementations in South Africa (4% as per Table 9.8), and the lack of practical experience in lean of the respondents to this survey (53% of the respondents has, as derived from Table 9.1, less than 5 years lean experience) it is envisaged that South African manufacturing organisations will struggle finding suitable facilitators in South Africa. The alternative is to recruit an experienced facilitator or *sensei* from abroad and let this facilitator lead the lean implementation, and at the same time train and coach internal facilitators.

South African organisations should thus take head of the statement by Drew *et al.* (2004:105) that care should be taken in deciding on a person to lead the lean initiative as many people claim to have designed a lean system, but few have successfully implemented a successful one.

This lack of experienced lean facilitators could be one of the major contributing factors to the high failure rate of lean as reported in Table 9.8.

10.8 REJECTED THEORETICAL FACTORS

Although *Integration* was rejected by the empirical results as a critical success factor it could still be a very important factor if considered within the context of the critical

success factor *Strategic Driver*. Strategy is often all about integrating all the relevant or important issues and role players into one system focussed on reaching the specific goal or objective. The above discussion of the emerged critical success factors, as well as the literature study, clearly highlighted the integrated nature of all the elements of lean. In comparison with the survey data this aspect is where the biggest gap between reality and theory exists.

However, the above may have to do with the time the respondents' organisations have spent on lean so far. Knowing that the majority of the respondents have less than 5 years experience with lean it could still be the case that they are planning further integrations and with that become more successful. Further research could verify or reject hypothesis on the correlation of lean success and integration.

Lean *Tools and Techniques* was rejected as a critical success factor by the empirical study, even though tools and techniques play important roles in the operationalised critical success factor *Basic Stability*. By rejecting tools and techniques as a critical success factor the respondents to this study showed that the popular misconception that lean is a toolbox to be cherry picked from by people who fall in love with some of the tools is not so strong any more. This misconception may have been due to the fact that Ohno (1988) in his writings on the Toyota Production System, and Shingo (1989) in his following study of the Toyota Production System concentrated on the tools and techniques of lean, ignoring the fundamental philosophy of lean.

The respondents thus disagree with Spear and Bowen (1999) who argue that people confuse the lean tools with the lean system itself.

10.9 VALUE OF STUDY

This study has theoretical, practical, and methodological value for successful lean implementation in South African manufacturing organisations. Not only have the critical success factors for successful lean implementation as a business management strategy been empirically assessed and operationalised, but the study also ads to the

current body of knowledge of lean in South Africa. The results of the study further allow for viable conclusions to be drawn regarding sustainable lean implementation.

If the results of the study is considered and incorporated in the lean implementation methodology it should lead to more successful lean implementations in the South African manufacturing sector, and as such should contribute to the growth of the South African economy, inter alia as a result of increased productivity, improved international competitiveness, and job creation.

The critical success factors for lean implementation in South African manufacturing organisations was identified as adhering to the lean *Philosophy and Principles*; lean as a *Strategic Driver*; first establishing *Basic Stability* in manpower, machines, methods and materials; the *People* of the organisation; and a full-time *Lean Promotion Office* staffed with experienced lean facilitators.

10.10 MANAGERIAL IMPLICATIONS

Emanating from the literature study and the results of the empirical study discussed above the following practical recommendations are considered essential or critical for sustainable lean success:

- The leadership of the organisation must be knowledgeable and totally committed to the lean philosophy and principles, and must ensure that by means of policy deployment the lean philosophy is integrated and consistently practiced throughout the organisation, most importantly by living the philosophy themselves. Strong senior management availability on the shop floor is mandatory if an organisation seeks to implement lean on a sustainable basis.
- The very complex and broad aspects relating to all the people or soft issues are fundamental to lean success and the human dimensions should be given top priority (or at least the same priority as the operating system), and aligned to the lean philosophy and principles. Lean leadership is absolutely essential.
- The role, function and skills of the Human Resources function and practitioners

should be seriously re-considered and re-focused to managing the people value stream as partners with manufacturing. Human Resources should from the outset be deeply involved with the lean initiative and has to support the cultural change aspects of the lean transformation. A matrix should be designed to determine the success of the Human Resources function and the support processes.

- A senior executive must be appointed and empowered to oversee the lean implementation.
- Lean and the lean philosophy must feature prominently as a strategic business driver. Before starting with the introduction of lean implementation actions it is strongly recommended to first of all make sure that the whole workforce thoroughly understands the lean philosophy and principles.
- Achieving a basic level of stability must be the initial focus area of the lean implementation methodology or roadmap. The implementation process should be tracked using focused metrics that gauge stability improvement (reduction in variation), not simply tool deployment.
- The application of lean tools and techniques is not the objective of a lean implementation, nor should the lean tools and techniques be considered as the secret weapons for transforming the organisation to lean. The tools and techniques are only the tactical or operations aspects of becoming lean; the critical issue is to select the appropriate tools and techniques for the specific problem at the appropriate time.
- An experienced full-time lean facilitator or *sensei* should be allocated in a lean promotion office to assist line managers with lean implementation. South Africa has a critical shortage of lean facilitators with practical experience with successful lean implementation, making the finding of an experienced facilitator so much more important.

10.11 LIMITATIONS

Although this study has provide interesting insights into the theory of lean and the critical success factors for successful lean implementation it is important to recognise

the limitations associated with this study.

Firstly, the impact of the independent variables (critical success factors) on the dependent variables (success indicators), in other words the various relationships between the independent and the dependent variables, could not be assessed as a regression analysis could not be conducted. As a result the formulated hypotheses could not be empirically tested and could thus not be accepted or rejected based on empirical grounds.

The second limitation is that the findings and conclusions cannot be generalised or extrapolated to a wider context than the South African manufacturing sector, for example to the services or health sector in which there is a growing interest in lean.

The third limitation is that there will always be uncertainty in inferring facts about populations from observed samples, there is thus always a chance that the inference will be incorrect. In other words the weakness of drawing data related findings from a survey that is mostly based on opinions limits the significance and explanatory power of conclusions drawn out of it.

Fourthly, the research approach does not allow one to come to a decision on which critical success factor is the most important.

The results of the survey should thus be considered to be more of a general indication rather than a statistical proof that certain aspects are more critical to successful lean implementation. However, as most of the findings of the literature review were reflected by the empirical study, it can still be said that the applicability of the theory to South African manufacturing organisations could be confirmed.

10.12 RECOMMENDATIONS FOR FURTHER RESEARCH

Given that the relative impact of the independent variables on the dependent variables could not be empirically assessed, resulting in the formulated hypotheses not being

accepted or rejected, it is recommended that this aspect be clarified by further research.

It is recommended that research (preferably qualitative) be conducted with strong focus on two sets of data: one with a sample taken from organisations which were successful with their lean efforts, and one set of data with organisations which did not have lean success. However, in this case it would be necessary to define success with relevant performance parameters to make the data sets comparable.

The importance of the people issues in a lean transformation opens a number of areas for further research. The most important area is considered to be the role of the Human Resources function in a lean transformation, as well as the impact this new role will have on the skills required in the Human Resources function and on Human Resources practices and policies. Another aspect that needs to be subject to further research is a clear definition or description of leadership in a lean context with the view to develop lean leaders.

Given the emphasis placed on viewing lean as a strategic business driver, as well as the apparent lack of experienced lean facilitators in South Africa, the need for lean to be included in tertiary education, especially in business schools, and the availability of lean training and education in South Africa should be scientifically assessed. The research could include the feasibility of a South African Lean Academy or a Lean Institute to promote and facilitate successful lean implementation.

Toyota takes the best of every culture and distils that into a system that really works effectively in every culture where Toyota does business. Future research should concentrate on developing such a system for South Africa. Special focus should be on the lean philosophy and how it could be incorporated into the South African business culture and ethics, especially so in light of the recent spate of scandals in the South African business sector, for example ESKOM and the power crisis, price fixings exposed in a number of sectors, and high profile corruption cases.

10.13 CHAPTER SUMMARY

In this final chapter the critical success factors for successful lean implementation in the South African manufacturing sector that emerged from the empirical study were conceptualised and translated into practical guidelines for the use by lean implementers. In other words the primary and secondary objectives of this study were achieved.

The findings of this study do not only provide valuable insights into the theory of lean, thereby contributing to the body of lean knowledge, but also serves as a guide to lean practitioners in implementing lean more successfully. The value of the study was put into perspective and recommendations for future research made. The latter is considered of utmost importance for the general success of lean in South Africa as one of the inferences that can be made form this study is that lean is not a codified body of knowledge, but rather the cumulative behaviour and experience of the people who practice lean.

Key to long-term success is a combined effort that includes a deep understanding and commitment to the primary lean philosophy, or concept, an effective integrated strategy that necessitates the philosophy, a lean promotion office that provides expert guidance and a methodology for applying the philosophy, and lean thinking people, especially lean leadership.

Generally it can be concluded that the findings of this study confirm the theories reported in recent literature.

BIBLIOGRAPHY

ABERDEEN GROUP. 2006a. The *Lean Benchmark Report. Closing the Reality Gap*. www.aberdeen.com. Date of access: 5 May 2006.

ABERDEEN GROUP. 2006b. *The Manufacturing Performance Benchmark Report.* www.aberdeen.com. Date of access: 10 July 2006.

ABERDEEN GROUP. 2006c. *Roadmap to Lean Success: Measurement and Control Benchmark Study.* www.aberdeen.com Date of access: 16 August 2006.

AHRENS, T. 2006. *Lean Production: Successful implementation of organisational change in operations instead of short term cost reduction efforts.* www.leanalliance.com. Date of access: 2 July 2008

ALUKAL, G. 2006. All About Lean. *Quality Progress*, 39(2):74, February.

ANDERSO-NACKERMAN, I. & NDERSON, D. 2002a. *Mindset: The Unseen Reason Why Enterprise-wide Change Efforts Fail.* http://www.beingfirst.com/resultsfromchange/pastissues/print.php?I=10. Date of access: 19 April 2006.

ANNIS, A. 2006. *A powerful approach to organisational excellence.* www.lean.org/community. Date of access: 26 June 2006.

AXELSON, B. 2007. *Lean Champions*. http://www.the manufacturer.com/us/content/4973/Lean_champions. Date of access: 2 April 2007.

BALLE, M. 2005. Lean Attitude. *IEE Manufacturing Engineer*, 14-19, April/May.

BALLE, F.& BALLE, M. s.a. *Lean or Sigma?* www.lean.org. Date of access: 2 December 2005.

BICHENO, J. 2004. *The New Lean* Toolbox. Buckingham: Picsie Books.

BLEBY, M. 2006. Will “the biggest thing in 20 years” be enough to keep SA’s clothing industry viable? *Business Day*: 10, July,10.

BOTHA, D. 2003. *Lean case Study Aspen Pharmacare*. http://www.ccint.net/newsroom/ontraccnewsletter/2003vol1/pg6.htm. Date of access: 22 May 2006.

BOYER, J.E. 2004a. *Six ways to make your lean operation more lean*. http://www.jeboyer.com/articles_list.html. Date of access: 30 January 2006.

BOYER, J.E. 2004b. *Should we use lean manufacturing or ERP?* http://www.jeboyer.com/articles_list.html. Date of access: 30 January 2006.

BOYER, J.E. 2004c. *Connecting S&OP to the shop floor: here’s how!* http://www.jeboyer.com/articles_list.html. Date of access: 30 January 2006.

BOYER, J.E. 2004d. *The future of ERP and Manufacturing Management*. http://www.jeboyer.com/articles_list.html. Date of access: 30 January 2006.

BUTCHER, D.R. 2006. *7 Sins of Muda*. http://news.thomasnet.com/IMT/archives/print/2006/04/7_sinsof_muda.html. Date of access: 27 July 2007.

CHANGE WRIGHT CONSULTANTS. 2001. http://changewright.co.za. Date of access: 20 July 2002.

COHEN, L. MANION, L. & MORRISON, K, 2002. *Research Methods in Education*. 5th Ed. London: Routledgefalmer.

COLLINS, J. 2001. *Good to Great*. London: Random House Business Books

COMPETETIVE CAPABILITIES INTERNATIONAL. s.a. http://www.ccint.net. Date of access: 10 May 2006.

COMPETETIVE DYNAMICS INTERNATIONAL. s.a. www.cdi.biz. Date of access: 10 May 2006.

CONVIS, G. 2002. *Role of management in a lean manufacturing environment*. Learning to Think Lean, 01-1014, 2001.

CRONJE, G.J.deJ., DU TOIT, G.S. & MOTLATLA, M.D.C. 2004. *Introduction to Business Management. 6th revised edition*. Cape Town: Oxford University Press.

DAVIES, M. 2006. Manufacturing a trade pact with China. *Business Day*: 13, April, 3.

DEPARTMENT OF TRADE AND INDUSTRY. 2008. *South African Trade – China*. http://www.thedti.gov.za/econdb/raportt/R10048.4.html. Date of access: 18 February 2008.

DE VOS, A.S. Ed. 1998. *Research at Grass Roots*. Pretoria: Van Schaick.

DONOVAN, R.M. 2005a. *Lean Manufacturing: Is it Worth it?.* www.industryweek.com/Media/whitepapers/LeanManufacturingworthIT.pdf Date of access: 12 February 2006.

DONOVAN, R.M. 2005b. *Are you getting lean fast enough?.* http://www.rmdonovan.com/pdf_2005/Lean_6.pdf. Date of access: 30 January 2006.

DONOVAN, R.M. 2005c. *Lean manufacturing as a competitive strategy*. http://www.rmdonovan.com. Date of access: 30 January 2006.

DONOVAN, R.M. 2005d. *Redesign supply chain process for breakthrough results.* www.rmdonovan.com/articles/pdf_2005/Reading%20Supply%20Chain%20Process.pdf. Date of access: 30 January 2006.

DREW, J., McCALLUM, B. & ROGENHOFER, S. 2004. *Journey to Lean – making operational change stick*. Hampshire: Pallgrave Macmillan,

DRICKHAMER, D. 2004. Lean Manufacturing: The third generation. *Industry Week*, March 2004.

DRUCKER, P. 1993. *Post-capitalist society*, London: Butterwoth-Heinemann.

DUVENHAGEN, D. 2005. *Nampak Kenya – World Class performance Initiative*. http://www.ccint.net/newsroom/ontraccnewsletter/2005vol2/pg6.htm. Date of access: 22 May 2006.

FAULL, N. 2004. *Delivering and implementation on manufacturing*. http://www.ccint.net/newsroom/inthenews/delivering.htm. Date of access: 23 May 2006.

FAULL, N. & WHELAN, K. 2003. *Implementing operations strategy – an eight factor approach.* http://www.ccint.net/newsroom/ontraccnewsletter/2003vol2/pg5.htm. Date of access: 22 May 2006.

GODFREY, P. 2002. *OEE – The Business Case*. http://www.oee.co.za/live/content.php?Item_ID=205. Date of access: 20 July 2006.

GOLDRATT, E.M. 1990. *What is this thing called Theory of Constraints and how should it be implemented.* Massachusetts: North River Press.

GREIFF, M. 1991. *The Visual Factory: Building participation through shared information.* New York: Productivity Press.

GREIMEL, H. 2007. Toyota overtakes GM for first time, taking lead in global sales. *Business Report: 2*5, April, 24.

HAIR, J.F., ANDERSON, R.E., TATHAM, R.L. & BLACK, W.C. 1998. *Multivariate Data Analysis*. 5th Ed. New Jersey: Prentice Hall.

HAZELHURST, E. 2006a. SA is shifting towards a knowledge economy. *Business Report*: 4, May, 11.

HAZELHURTS, E. 2006b. SA is slipping in WEF competitiveness index. *Business Report:* 1, September.

HAZELHURTS, E. 2007. Factories must work longer. *Business Report*: 1, November, 2.

HENDERSON, B.A. & LARCO, J.L. 2001. *Lean Transformation*. 1st Ed. Virginia, The Oaklee Press.

HINES, P. & TAYLOR, D. 2000. *Going Lean: A Guide to Implementation*. Cardiff Business School.

HIRANO, H. 1995. *5S for Operators – 5 Pillars of the visual workplace*. New York: Productivity Press.

HOWARDELL, D. 2004. *Seven skills people need to create a lean enterprise*. www.lean.org. Date of access: 26 June 2006.

HUGHES, B. 2004. *A new perspective on Business Centred Maintenance*. http://www.ccint.net/newsroom/ontraccnewsletter/2004vol1/pg1.htm. Date of access: 22 May 2006.

HUTCHESON, G. & SOFRONIOU. N. 1999. *The Multivariate Social Scientist: Introductory Statistics Using Generalized Linear Models*. Thousand Oaks, CA: Sage Publications.

IACOCCA, L. & NOVAK, W. 1984. *Iacocca: An Autobiography*. New Cork: Bantam Books.

IMAI, M. 1986. *Kaizen*. New York: Random House.

JABLANSKI, J.R. 1992. *Implementing TQM. Competing in the Nineties Through Total Quality Management*. 2nd ed. San Diego: Pfeiffer & Company.

JONES, D.T. 2003a. *The meaning and future of lean*. http://www.ccint.net?newsroom?ontraccnewsletter/2003vol1/pg2.htm. Date of access: 22 May 2006.

JONES, D.T. 2003b. *The beginners guide to lean*. http://www.ccint.net?newsroom?ontraccnewsletter/2003vol1/pg2.htm. Date of access: 24 January 2006.

JONES, D.T. 2003c. *We have been (lean) thinking*. http://www.ccint.net?newsroom?ontraccnewsletter/2003vol1/pg2.htm. Date of access: 22 May 2006.

JONES, D.T. 2004a. *LEA e-letter – 20 December 2004*. www.leanuk.org/articles. Date of access: 20 January 2006.

JONES, D.T. 2004b. *Is lean so hard?* www.leanuk.org/articles. Date of access: 20 January 2006.

JONES, D.T. 2004c. *Beyond cost cutting*. www.leanuk.org/articles. Date of access: 20 January 2006.

JONES, D.T. 2004d. *Beyond the lean tool box*. www.leanuk.org/articles. Date of access: 20 January 2006.

JONES, D.T. 2004e. *Lean beyond manufacturing*. www.leanuk.org/articles. Date of access: 20 January 2006.

JONES, D.T. 2005a. *Lean Lessons for 2006*. www.leanuk.org/articles. Date of access: 24 January 2006.

JONES, D.T. 2005b. *Frontiers of Lean*. www.leanuk.org/articles. Date of access: 24 January 2006.

JONES, D.T. 2005c. *Process leadership*. www.leanuk.org/articles. Date of access: 24 January 2006.

JONES, D.T. 2005d. *Competing with China*. www.leanuk.org/articles. Date of access: 24 January 2006.

JONES, D.T. 2005e. *Supply chain walks*. www.leanuk.org/articles. Date of access: 24 January 2006.

JONES, D.T. 2005f. *Lean from the top*. www.leanuk.org/articles. Date of access: 24 January 2006.

JONES, D.T. 2005g. *Beyond squeezing margins*. www.leanuk.org/articles. Date of access: 24 January 2006.

JONES, D.T. 2006a. *Developing problem Solvers*. http://www.leanuk.org. Date of access: 17 March 2006.

JONES, D.T. 2006b. *Heijunka: Levelling Production*. http://www.sme.org. Date of access: 2 November 2006.

JONES, J., AGUIRRE, D. & CALDERONE, M. 2004. *The 10 Principles of Change Management*. http://www.strategy-business.com. Date of access: 12 May 2006.

KAISER, H.F. 1961. A note on Guttman's lower bound for the number of common factors. *British Journal of Statistical Psychology*, 14(1):1.

KAUFMAN GLOBAL GROUP. 1999. *Defining World -Class Practices*. www.kaufmanglobal.com. Date of access: 17 August 2004.

KAUFMAN GLOBAL GROUP. 2003a. *Creating Lean Leaders*. www.kaufmanglobal.com. Date of access: 17 August 2004.

KAUFMAN GLOBAL GROUP. 2003b. *Lean Six Sigma*. www.kaufmanglobal.com. Date of access: 17 August 2004.

KAUFMAN GLOBAL GROUP. 2003c. *Integrating Lean & Six Sigma*. www.kaufmanglobal.com. Date of access: 17 August 2004.

KERLINGER, F.N. 1973. *Foundations of Behavioural Research*. 2nd Ed. New York: Holt, Rinehart & Winston, Inc.

KIM, J. & MUELLER, C. 1978. *Factor Analysis*. London: Sage Publications.

KOBAYASHI, I. 1995. *20 Keys to workplace improvement. Revised Edition.* Portland: Productivity Press.

KOENIGSAECKER, G. 2006. Strategy Deployment: Linking Lean to Business Strategy. *Manufacturing Engineering,* 136(3): March.

LEAN ENTERPRISE INSTITUTE. 2007. New *Survey: Middle Managers are Biggest Obstacle to Lean Enterprise*. www.lean.org. Date of access: 18 November 2007.

LIKER, J.K. 2004. *The Toyota Way*. New York: Mc Graw-Hill.

LIKER, J.K. 2007. *Toyota Talent: Developing Your People the Toyota Way*. New York: McGraw-Hill.

LIKER, J.K. & HOSEUS, M. 2008. Toyota *Culture: The Heart and Soul of The Toyota Way*. New York: Mc GrawHill.

LIKER, J.K. & MEIER, D. 2006. *The Toyota Way Field Book*. New York: McGraw-Hill.

LOUBSER, C. 2003. *Six Sigma Readiness Assessment*. http://www.ccint.net/newsroom/ontraccnewsletter/2003vol2/pg2.htm. Date of access: 22 May 2006.

LUNA. 2005. Factor Analysis. http://cas.usf.edu/mbrannic/files/pmet/factor1.thm. Date of access: 13 September 2005.

MANN, D. 2005. *Creating a Lean Culture: Tools to Sustain Lean Conversions*. New York: Productivity Press.

MARX, *et al.* 2001. *Business Management*. 2nd ed. Van Schaik.

MASKELL, B.B. & BAGGALEY, B. 2003. *Practical lean accounting: A proven system for measuring the lean enterprise.* New York.

MECER MANAGEMENT CONSULTING. 2006. *So you want to get lean*. http://www.mecermc.com/Perspectives/Perspectives_pdfs?Persp06leanKK.pdf . Date of access: 5 June 2006.

MEYER, K., WALL, C., WADDEL, B., & MARKOVITZ, D. 2007. *Stop the Flow of Blood*. http://Superfactory.typepad.com/blog/2005/11/stop_the_flow_0.html. Date of access: 27 July 2007.

MOKOPANELE, T. 2006. Productivity fails to foster jobs. *Business Report:* 5, August, 29.

MOKOPANELE, T. 2007. SA Loses out to rivals as competitiveness slides. *Business Day*: 1, November, 1.

MOODY, P.E. 1997. *Leading Manufacturing Excellence: a Guide to state-of-the art Manufacturing*. New York: John Willey & Sons Inc.

MOUTON, J. 2001. *How to Succeed in your Master's and Doctoral Studies. A South African Guide and Resource Book.* Pretoria: Van Schaick.

NAIDOO, S. 2006. Productivity just too low, pay too high. *Business Times: 12,* September, 3.

NEUMAN, W.L. 1994. *Social Research Methods: Qualitative and Quantitative Approaches*. Boston: Allyn & Boron.

NIEMAN, G. & BENNETT, A. Ed. 2002. *Business Management. A value chain approach.* Van Schaik.

NJOBENI, S. 2006. Boom promise may fade on lack of skills*. Business Day:* 4. June, 13.

NPI. 2007. *South Africa's economic performance catapults into higher World Competitiveness ranking*. http://www.npi.co.za/pebble.asp?relid+50. Date of access: 30 January 2007.

OHNO, T. 1988. *Toyota Production System: Beyond Large Scale Production.* Portland: Productivity Press.

ODI. 2004. *Key 11 Training Material for 20 Keys Programme*. Available from Organisational Development International, Pretoria.

PADLASEK, J. 2006. *Taking the value stream perspective when purchasing machines.* www.lean.org/Community. Date of access: 26 June 2006.

PARIS, M. 2000. Don't abandon the shop floor. *Manufacturing Engineering*, November 2000, 136.

PARKER, D. 2003. *Leaning towards world class standards*. http://www/ferret.com.au/articles/a5/Oc03Oa5.asp. Date of access: 10 June 2006.

PARKS, C.M. 2002. Instil lean thinking. *Industrial Management*, September – October 2002, 15-18.

PIATKOWSKI, M. 2006. *Training recommendations for implementing lean*. www.lean.org. Date of access: 26 June 2006.

PIETERSE, K. s.a.a. *Barriers to Implementation*. http://www.nmmu.ac.za/busschool/new_page_1.htm. Date of access: 27 July 2006.

PIETERSE, K. s.a.b. *Living with the lean diet – experiences of a selected group of manufacturing companies in the Eastern Cape Province.* http://www.nmmu.ac.za/busschool/Lean/Implementation%20article.pdf. Date of access: 27 July 2006.

PIETERSE, K. 2006. *Leaning the South African Way*. Port Elizabeth: Trilean Publishing.

PIETERSE, K. 2007. *The Lean Letter – July 2007*. http://www.ac.za/busschool/Lean/Newsletter2007. Date of access: 23 November 2007.

PRATTEN, L. 2002. *Ola – a modern day fairy tale*. http://www.ccint.net/newsroom/ontraccnewsletter/2002vol2/pg3.htm. Date of access: 22 May 2006.

RIEK, T. 2002. *A spirit of teamwork at Lockwood Security products – Setup Time Blitz.* http://www.ccint.net/newsroom/ontraccnewsletter/2002vol1/pg3.htm. Date of access: 22 May 2006.

RINK, J. 2005a. *Lean Manufacturing Certification Accelerating the Pace of Business Improvement.* www.rmdonovan.com.articles/pdf_2005/Lean_Manufacturing_Cetification_2.pdf. Date of access: 10 December 2005.

RINK, J. 2005b. *Lean Manufacturing can save American manufacturing*. www.rmdonovan/articles/pdf_2005/Lean_Manufacturing.American%Manufacturing.pdf. Date of access: 30 January 2006.

ROBINSON, A. Ed. 1991. *Continuous Improvement in Operations*. Portland: Productivity Press.

ROPER, W. 2004. *The Missing Link of Lean Success.* http://sae.org/topics/leanmay02.htm. Date of access: 4 November 2004.

ROTHER, M. & SHOOK, J. 2003. *Learning to See*. Brookline, Massachusetts: The lean enterprise institute.

RUBRICH, L. 2004. *How to Prevent Lean Implementation Failures*. Indiana: WCM Associates.

RUBRICH, L. & WATSON, M. 1998. *Implementing World Class – A Bridge to Your Manufacturing Survival*. Indiana: WCM Associates.

SAUNDERS, M., LEWIS, P & THRONHILL, A. 2003. *Research methods for business students*. 3rd Ed. Prentice Hall.

SCHIFFERES, S. 2007. *The Triumph of Lean Production*. http://newsvote.bbc.co.uk/mpapps/pagetools/print/news.bbc.co.uk/2/hi/nusiness/6346315. Date of access: 2 April 2007.

SCHURINK, W.J. & SCHURINK, E.M. 2001. *Deciding to use Qualitative Research Approaches: Models of Qualitative Research Training Course*. Paper presented at a seminar on "Leadership in performance and change". University of Johannesburg. Johannesburg.

SHINGO, S. 1981. *Study of Toyota production System from Industrial Engineering Viewpoint.* Cambridge, MA: Productivity Press, Inc.

SHINGO, S. 1986. *Zero Quality Control: Source Inspection and the Pokayoka System*, Productivity Press.

SHINGO, S. 1989. *A study of the Toyota Production System*. Productivity Press, Portland.

SINNICKS, M. 2005. *Ensuring a successful Six Sigma implementation.* http://www.ccint.net/newsroom/ontraccnewsletter/2005vol2/pg9.htm. Date of access: 22 May 2006.

SMALLEY, A. 2005. *Basic Stability is Basic to Lean Manufacturing Success*. www.lean.org. Date of access: 10 January 2006.

SMALLEY, A. 2006. *Summary Notes from Art Smalley Interview with Mr. Harada. Topic: Equipment Maintenance & TPS*. www.artoflean.com. Date of access: 1 December 2006.

SPEAR, G.J. & BOWMEN, H.K. 1999. Decoding the DNA of the Toyota Production System. *Harvard Business Review*, Sept – Oct 1999, 97-106.

STATS SOUTH AFRICA. 2008. *Unemployment Statistics*. www.statssa.gov.za. Date of access: 27 February 2008.

STONE, J. & WATSON, V. 1999. *Measuring return on investment for training*. http://www.ccint.net/newsroom/ontraccnewsletter/2003vol1/pg3.htm. Date of access: 22 May 2006.

STRAUSS, A. & CORBIN, J. 1998. *Basics of Qualitative Research*. London: Sage Publications.

TERRE BLANCHE, M. DURRHEIM, K., & PAINTER, D. Ed. 2006. *Research in Practice. Applied methods for the Social Sciences.* 2nd Ed. Cape Town: University of Cape Town Press.

TEMKIN, S. 2006. Chinese boom feared, but welcome by some. *Business Day*. April, 12.

THE FOUNDATION FOR QUALITY. 1991. *Total Quality Management*. Training manual for course presented to Bonnita employees during 1992.

THE TOYOTA PRODUCTION SYSTEM BASIC HANDBOOK. s.a. www.artoflean.com. Date of access: 12 March 2007.

TRACC. 2002. *Have you heard?* http://www.ccint.net/newsroom/ontraccnewsletter/2002vol2/pg7.htm. Date of access: 22 May 2006.

TRACC. 2003. *Staff development at PET project at Thermopac*. http://www.ccint.net/newsroom/ontraccnewsletter/2003vol2/pg3.htm. Date of access: 22 May 2006.

TROCHIM, W.M.K. 2002. *Descriptive Statistics*. http://trochim.human.cornell.edu/kb/statdesc.htm. Date of access: 14 October 2002.

VAUGHAN - JONES, J. 2003. *Practices make Perfect*. http://www.ccint.net/newsroom/ontraccnewsletter/2003vol2/pg4.htm. Date of access: 22 May 2006.

VAUGHAN - JONES, J. 2005. *TRACC Users Group 2005 – Australia*. http://www.ccint.net/newsroom/ontraccnewsletter/2005vol2/pg3.htm. Date of access: 22 May 2006.

WADDELL, B. 2005. *Delphi's sobering message to us all*. Superfactory article. http://www.superfactory.com/articles/Waddell_delphi.htm. Date of access: 27 July 2007.

WICKENS, P.D. 1999. *Energise your enterprise*. London: MacMillan Press.

WICKENS, P.D. 1998. *The Ascendant Organisation*. *Revised edition*. London: Macmillan Press Ltd.

WICKENS, P.D. 1995. *The Ascendant Organisation*. London: MacMillan Press.

WILLATS, P. 2005. *The Gold Mine – a novel of lean turnaround.* Brookline: Lean Enterprise Institute.

WOMACK, J.P. 2003*. How lean compares with Six Sigma, Re-engineering, TOC, TPM, etc, etc. www.lean.org*. Date of access: 8 February 2006

WOMACK, J.P. 2004a. *Walking through lean history*. www.Leanuk.org/articles. Date of access: 24 January 2006.

WOMACK, J.P. 2004b. *Creating basic stability*. www.leanuk.org. Date of access: 23 January 2006.

WOMACK, J.P. 2004c. *Lean beyond manufacturing*. www.leanuk.org. Date of access: 23 January 2006.

WOMACK, J.P. 2005. *The Tower of Babel*. www.lean.org. Date of access: 26 January 2006.

WOMACK, J.P. 2006a. *Just-in-time, Just-in-case, and Just Plain Wrong* www.leanuk.org. Date of access: 23 January 2006.

WOMACK, J.P. 2006b. *A tale of two business systems*. www.lean.org. Date of access: 8 February 2006.

WOMACK, J.P., JONES, D.T. & ROSS, D. 1991. *The Machine that Changed the World.* New York: Harper Perennial.

WOMACK, J.P. & JONES, D.T. 2003. *Lean Thinking. Revised edition*. London: Simon & Schuster.

WOMACK, J.P. & JONES, D.T. 2005. *Lean Solutions*. London: Simon & Schuster.

YUDELOWITZ, J. 2006. Time for a skills blueprint for SA. Business Day Management Review. *Supplement to Business Day*: 11, July.

ZAYKO, M. 2006. *A systematic View of Lean Principles: Reflection on the Past 16 years of Lean Thinking & Learning*. www.lean.org. Date of access: 28 November 2006.

ANNEXURE A

SUCCESS FACTOR ELEMENTS

Number	Success Factor Element Description	Core success elements
SFE1	Lean implementation must be considered as an integral part of the organisation's strategy deployment process.	Strategic
SFE2	The goals and objectives of the organisation must be aligned and shared by all in the organisation.	Goal alignment Strategic Integrated approach
SFE3	There must be a clear link between organisational goals, key objectives and lean activities.	Goal alignment
SFE4	Value must be defined by the ultimate customer.	Value
SFE5	The organisation must continually revisit the definition of value to ensure it is still the best definition.	Value Structure
SFE6	The identification and management of a whole value stream for a specific product.	Value stream
SFE7	Identification of all activities considered as waste and eliminating it.	Waste
SFE8	For lean to be successfully implemented the product must be manufactured in one continuous flow in a value stream.	Flow Structure Value stream
SFE9	A pull system must be introduced, meaning that no one upstream should produce a good or service until it is needed by someone downstream.	Pull
SFE10	Complete elimination of waste through endless steps.	Waste
SFE11	Transparency so that everyone can see everything.	Transparency Leadership

SFE12	Continuous radical incremental improvement.	Continuous improvement
SFE13	A vision what the organisation wants to be (policy deployment)	Strategy
SFE14	To select a few projects to work on instead of on everything at once.	Focused implementation Methodology
SFE15	Lean should be considered a long-term philosophy, even at the expense of short-term financial gains.	Philosophy
SFE16	Evaluate every function or activity in the organisation in terms of its ability to create value for the customer.	Value Eliminate waste
SFE17	Redesign processes to achieve high value-added continuous flow.	Value Flow Structure
SFE18	Let customers pull what they want, when they want it in the amounts they want it.	Pull
SFE19	Be responsive in day to day shifts in customer demands.	Flexibility People
SFE20	Level out workload of all processes.	Levelling
SFE21	Build culture of stopping the line to fix problems.	Culture People
SFE22	Problem detection and solving ability build into machines and culture.	Poke-yoke
SFE23	Standardised tasks and processes.	Standardised work
SFE24	Culture of continuous improvement.	Culture Continuous improvement
SFE25	Simple visual control systems to bring problems to the fore.	Visual management
SFE26	Use only reliable, thoroughly tested technology that serves the people and the processes.	Technology

SFE27	Develop leaders who understand and follow the lean philosophy.	Leadership Knowledge
SFE28	Train and develop people in lean philosophy and principles – build knowledge.	Knowledge People
SFE29	Use cross-functional teams to solve problems and improve.	Problem solving Teams People
SFE30	Create a culture of shared values and goals.	Culture People
SFE31	Respect suppliers and treat them as partners.	Suppliers
SFE32	Manage on the floor by walking the floor, see things for yourself.	*Gemba* Leadership
SFE33	Consensus decision making.	Involvement People
SFE34	Relentless elimination of waste.	Waste
SFE35	Seek to prevent problems and waste, rather than to inspect and fix.	Waste
SFE36	Use time as the best overall measure.	Measurement
SFE37	True participation by all, including operators.	Involvement
SFE38	Trust amongst all stakeholders.	Trust
SFE39	Simple, movable, scalable, low-cost, focused equipment.	Technology
SFE40	The correct application of the applicable lean tools and techniques is essential for successful lean implementation.	Tools and techniques
SFE41	A complete value stream mapping exercise must be conducted.	Value stream Tools.
SFE42	People actually working in the process must be involved in analysing the current state and design of future state.	Involvement People
SFE43	To run the whole production process precisely to *takt* time.	Tool

SFE44	Continuous improvement must become part of everyone's normal function.	Continuous improvement People
SFE45	Radical improvement (blitz or *kaikaku*) must be considered as important as kaizen.	*Kaikaku*. Tool.
SFE46	For lean to be successful an effective Just-In-Time system must be in place.	Tool
SFE47	The demand from the customer, and thus the workload, must be levelled at some point.	Levelling
SFE48	For lean to be successful a problem solving and root cause analysis mindset is imperative.	Mindset People
SFE49	A questioning attitude is essential for lean success.	Attitude People
SFE50	Measurement of performance against targets/goals is essential for lean success.	Measurement
SFE51	Customer-focussed measurements at each level of the organisation must be aligned to support overall business goals.	Measurement
SFE52	Visual management is critical for successful lean implementation.	Visual measurement
SFE53	For lean to be successful the organisation must implement single minute exchange of dies (SMED) on its machines and equipment.	Tool Basic stability
SFE54	Total Productive Maintenance must be implemented as a critical pre-condition for many elements of lean manufacturing.	Tool Basic stability
SFE55	For lean to be successful all work processes must be standardised.	Standardised work Basic stability People
SFE56	For lean to be successful the implementation of *poka-yoke* devises is essential.	Tool

SFE57	The introduction of a *kanban* system will ensure lean success.	Tool
SFE58	For lean to be successful levelling of demand is essential.	Levelling
SFE59	The measurement of the OEE would result in successful lean implementation.	Tool
SFE60	The 5S system is a cornerstone for successful lean implementation.	Tool
SFE61	Adhering to the PDCA cycle.	Tool
SFE62	The ability to align people issues with operating systems.	People
SFE63	Ownership, buy-in and commitment of the people.	People
SFE64	Only the efforts of people will ensure success.	People
SFE65	Knowledge workers are essential for lean success.	Knowledge People
SFE66	Quality of leadership is essential for lean success.	Leadership People
SFE67	Quality of people is essential for lean success.	People
SFE68	People must become lean before the organisation can get lean.	People
SFE69	People need to be knowledgeable of lean tools and techniques.	Knowledge
SFE70	People need to be experienced in their own function.	People
SFE71	All employees must be skilled in their jobs.	People
SFE72	Everyone in the organisation should be focused on creating customer value.	Value Philosophy
SFE73	Process or enterprise thinking orientation is essential for all employees.	Mindset People
SFE74	People must be adaptive and flexible	People
SFE75	People must be innovation and creative.	People
SFE76	Consensus decision making must be the norm in the organisation.	Culture Leadership

SFE77	A culture of discipline is essential for lean success.	Discipline Culture
SFE78	For lean to be successful the impact of lean on people need to be properly managed.	People
SFE79	An investment in training of people is essential for lean success.	People
SFE80	Each manager or supervisor must be skilled in on-the-job coaching.	People
SFE81	Training must be according to the Toyota training methodology.	Training People
SFE82	Leadership and team leader development is of utmost importance.	Leadership
SFE83	People to be trained in *kaizen* workshops.	Tool Knowledge People
SFE84	A lean mindset and attitude is critical for lean success.	Mindset Attitude
SFE85	People must change their basic believes about work	Mindset Attitude
SFE86	People must be obsessed with lean.	Mindset
SFE87	“Go see for yourself” attitude must prevail.	*Gemba* Attitude
SFE88	Focus should be on real problem solving and root cause analysis.	Problem solving
SFE89	A sensei must be involved with lean implementation.	Sensei Method
SFE90	The organisation should start from the top and involve all functions from the outright (no pilot) in lean implementation.	Pilot Method
SFE91	Organisation must face and embrace the various attitudinal aspects of lean	Attitude

SFE92	Involving the trade unions in lean planning and implementation is critical for lean success.	Trade union. Involvement.
SFE93	Trust between the organisation and the trade union is critical for lean success.	Trust Trade union
SFE94	If unions are not prepared to work with the organisation they should be resisted.	Trade unions
SFE95	Strong committed executive leadership is an absolute requirement for successful lean implementation.	Leadership
SFE96	Leadership on all levels must live and demonstrate lean behaviour.	Leadership
SFE97	Transformational leadership must be present at all levels in the organisation.	Leadership
SFE98	Leadership must actively take part in implementation activities on the shop floor.	Leadership
SFE99	Team Leaders should be professionals at managing people and processes.	Leadership
SFE100	The Team Leader must focus on proactive process improvement rather than on reactive behaviour	Leadership
SFE101	For lean to be successful security of employment must be guaranteed to the employees.	People Philosophy
SFE102	The organisation must deal upfront with excess people.	People
SFE103	The organisation must get rid of people that cannot adjust to the lean way of doing things (anchor draggers).	People
SFE104	The organisation's performance management system must support the lean objectives.	People
SFE105	A safe and hazardous free workplace is essential for lean success.	Tool
SFE106	An environment of mutual respect, trust and cooperation must exist in the organisation.	Trust. Attitude People

SFE107	Appointment of value stream manager to manage the complete value stream.	Structure
SFE108	Reorganise the organisation by product family and value stream.	Structure
SFE109	A focused cellular structure must be introduced for lean to be successful.	Structure
SFE110	The organisation must be organised into teams that support value streams.	Structure
SFE111	The organisation must transfer the maximum number of tasks and responsibilities to the employees actually adding value to the product.	Structure Involvement
SFE112	Dynamic team work is a pillar of lean success.	Team work
SFE113	The organisation must not implement work teams before the systems and culture to support teams are in place.	Culture
SFE114	It is important to understand the organisation's processes and apply only what is applicable to that specific process type.	Process focus Tools
SFE115	The organisation must build brilliant processes and manage it as a whole, not separately.	Structure. Process Integrated approach
SFE116	Basic stability in machine, manpower, materials and methods is essential for successful lean implementation.	Basic stability
SFE117	The complete elimination of waste.	Waste
SFE118	A constant focus on waste identification and elimination by all.	Waste
SFE119	Technology is essential for successful lean implementation.	Technology
SFE120	Technology should be considered as a tool to support people and processes, not as enabler of lean.	Technology

SFE121	The organisation should convert from standard costing and accounting model to throughput accounting model.	Accounting system
SFE122	Close relationship with suppliers.	Suppliers
SFE123	Long-term relationship with suppliers.	Suppliers Philosophy
SFE124	Supplier development programmes.	Suppliers
SFE125	Supplier to implement lean thinking.	Suppliers
SFE126	Constantly challenge suppliers to improve.	Suppliers
SFE127	Sales and operations planning systems must be in place.	Structure
SFE128	The whole organisation should be date driven.	System
SFE129	In all cases dates must be valid.	System
SFE130	Data must be flawless.	System. Technology
SFE131	Lean practices must be adapted to fit the local culture and conditions.	Culture People Integrated approach
SFE132	South Africa should capitalise on the Ubuntu concept in the implementation of lean.	Ubuntu. Culture People
SFE133	To implement lean successfully South African organisations have to find a solution for the skills shortage.	People Knowledge
SFE134	For lean to be successful South Africa will have to find answers to the unemployment issue.	People Leadership
SFE135	Elimination of large, inflexible machines that requires operating in a batch mode is critical for successful lean implementation.	Technology Model machine
SFE136	For lean to be successful machines and products must be designed for manufacture, considering ease of assembly, minimal change over, and so forth.	Technology Model machine

SFE137	For lean to be successful the lean implementation methodology should incorporate change management principles	Change management Method
SFE138	Six Sigma methodologies should be incorporated in the lean implementation plan.	Integrated approach
SFE139	TOC principles must be incorporated in the lean implementation methodology.	Integrated approach
SFE140	TQM principles and tools must be incorporated in the lean toolbox.	Integrated approach
SFE141	Lean implementation must be considered as an evolving continuous process	Methodology
SFE142	An overall lean implementation framework or plan/methodology must be followed.	Methodology
SFE143	The selection and application of appropriate lean tools is critical for lean implementation	Tools
SFE144	Change management methodology must be followed with lean implementation	Change management Method
SFE145	Lean Implementing methodology to be adapted to suite the peculiar circumstances of the organisation	Methodology
SFE146	Lean must be integrated with other business systems and programmes	Integrated approach
SFE147	Lean must not be seen as just the application of lean tools and techniques	Tools
SFE148	All lean tools, techniques, methods and principles must be integrated into one whole system	Integrated system
SFE149	An active lean implementation steering team should be responsible for lean implementation	Promotion office Method
SFE150	Active top management involvement in lean implementation	Leadership

SFE151	A lean promotion office to facilitate the lean implementation process must be established	Promotion office Method
SFE152	An outside experienced lean consultant must assist the organisation with lean implementation	Facilitator Sensei
SFE153	Line management must always retain the authority and responsibility for lean implementation.	Leadership
SFE154	An expert full-time lean facilitator is critical for successful lean implementation.	Facilitator. Sensei Method
SFE155	All the senior managers in the organisation must master the lean philosophy, principles and tools.	Knowledge. Leadership
SFE156	An internal systems builder must be developed to sustain lean implementation after the external agent has left.	Facilitator Method
SFE157	Lean implementation must be considered a continuous process or journey, not as a destination.	Strategy
SFE158	A pilot rollout implementation methodology must be followed.	Pilot run. Methodology
SFE159	A clearly defined business case or case for change must be formulated for the lean initiative.	Business case. Change management
SFE160	A burning platform or crisis is needed for successful lean implementation.	Burning platform. Business case.
SFE161	A detailed assessment of the current status of the organisation in order to identify the improvement areas and desired outcomes.	Focused improvement. Methodology.
SFE162	Before embarking on lean implementation a sensitisation process must be followed.	Sensitisation. Methodology People
SFE163	Internal lean capacity and knowledge on all levels of the organisation must be created.	Knowledge People

SFE164	Regular review and measurement of progress against pre-determined targets and expectations.	Measurement. Change management

ANNEXURE B

POTENTIAL CRITICAL SUCCESS FACTORS

Potential critical success factor	**Core success element**	**Possible questionnaire items**
Front-line employees	Discipline. Knowledge. Way of life. Mindset. Attitude. Commitment. Involvement – people and unions. Capacity. Trust. Culture. Skills.	Build internal lean capacity. Complete commitment by everyone in the organization. Lean is not a technical project only. Front line Team Leaders are the lynchpin of improved operational performance. Support and engagement of all levels from shop floor to boardroom early in the process. Union involvement. Build capacity by effective training at all levels. Sensitisation of employees before implementation. Dedication and commitment of staff. Involve the entire workforce in the process. Transparency. Train and develop people in lean philosophy and principles. Trust amongst all stakeholders. Only the efforts of people will ensure success. Knowledge workers are essential for

		success. Quality of people is essential. People must get lean before the organisation can get lean. Process and enterprise thinking. Culture of discipline. Impact of lean on people identified and managed. Coaching skills. Lean mindset and attitude. People obsessed with lean. Face and embrace the various attitudinal aspects of lean. Security of employment to be guaranteed. Get rid of anchor draggers. Embrace the lean culture.
Leadership	Commitment. Lean leadership at all levels. Mindset. Attitude. *Gemba*. Strategy. Knowledge. Engage with employees. Personal investment. Structure.	Active involvement by senior leadership. Leadership to be role models. Leadership on all levels must live and demonstrate lean behaviour. Actively driven by knowledgeable lean leadership at all levels. Senior leadership to fully understand lean. Drive and commitment from senior management and their ability to create a sense of urgency. Active, ongoing commitment and involvement of middle management. Quality of leadership is essential. Strong committed executive leadership.

Basic stability.	Availability. Capability. Flexibility. Standardised work.	First step in creating a lean process is to achieve a basic level of process stability. Standardised processes. Standardised work. Levelling of demand. Employees skilled in their jobs. People adaptive and flexible. Cellular structure with value stream managers.
Integration	Not only tools and techniques. Integrated connected initiatives. Systems Structures Methodology Technology Other programmes	Willingness to challenge sacred cows not conducive to lean. Align systems and structures. Must see the whole picture, not only tools and techniques that optimise operations, but also the infrastructure and behaviours that support them. Instead of optimising individual parts of the process, the organisation must seek to improve the whole system. Ability to align people issues with operating systems. Technology considered as a tool to support people and processes, not as an enabler. Lean must be integrated with other business systems and programmes.
Strategic driver.	Management support. Resources allocation. Strategy deployment. Goal alignment. Long-term philosophy. Business case.	Institutionalise lean practices. Lean principles are reflected in the corporate strategy. Drive implementation as a real strategic initiative, and manage and resource accordingly.

		Lean implementation must be considered an integral part of the organisation's strategy deployment process. Goals and objectives of the organisation must be aligned and shared by all in the organisation. There must be a clear link between organisational goals, key objectives and lean activities. A vision what the organisation wants to be. Considered a long term philosophy, even at the expense of short term financial gains. Lean implementation must be considered a continuous process or journey and not just a destination. Business case or case for change. Burning platform.
Lean promotion office	Full time facilitator to co-ordinate the lean implementation process. Sensei. Change management principles must be followed. Knowledge. Measurement.	Lean expertise, not just in tools and techniques, but also experience of implementation. Full-time support during lean implementation. Effective change management. Effective change implementation structure. Change management principles must be followed. A lean promotion office to facilitate the lean implementation.

		Implementation must be the direct responsibility of line management. Full-time dedicated project facilitator. Equip people to deal with change. Task-force team to act as the driving force behind the implementation. Measurement of performance against targets. Visual management. An outside experienced consultant. Expert full-time lean change agent or facilitator. Internal systems builder to sustain lean after external expert has left.
Lean tools and techniques	Tools. Techniques.	5S is cornerstone of lean implementation. Understand the organisation's process and apply only what is applicable to that specific process type. Lean practices must be adapted to fit the local culture and conditions. Selection and application of the appropriate tools.

ANNEXURE C

QUESTIONNAIRE

Dear Respondent

SURVEY ON THE CRITICAL SUCCESS FACTORS FOR THE IMPLEMENTATION OF LEAN THINKING IN SOUTH AFRICAN MANUFACTURING ORGANISATIONS.

Report after report indicates that SA manufacturing organisations are far from being competitive in world-class terms. There is furthermore a growing opinion amongst international and local experts that SA is losing the battle to compete with other developing nations in global markets, mainly as organisations struggle with best practice implementation. It could thus be argued that SA manufacturing organisations are on a burning platform, requiring immediate and focused action.

Lean thinking is widely considered to be the solution immediately available that can produce the results on the scale required, especially as lean thinking has proofed to dramatically boost productivity while reducing defects, inventories, on-the-job accidents, space requirements, time-to-market for new products, production lead times, the cost of extra product variability, and costs in general.

It thus appears that lean thinking has become, for many SA manufacturing organisations, a competitive necessity, which, if correctly executed, can produce impressive results. However, even amongst the pioneers and advocates of lean thinking there is uncertainty as to the reasons why lean thinking implementations sometimes fail or do not achieve the same results as is the case at Toyota, and as such what are the critical success factors for the successful implementation of lean thinking.

The primary objective of this doctoral study, conducted under the auspices of the Faculty of Management at the University of Johannesburg, is to identify the factors or variables that influence and eventually determine the successful implementation of lean as a business management strategy in SA manufacturing organisations.

Please take a few moments to complete the attached questionnaire, which should not take longer than 15 minutes of your valuable time and return as indicated on the questionnaire by not later than 31 January 2008. If you are aware of any colleagues and associates who have an interest in lean and best practice or who have been involved in lean implementation it will be appreciated if you would forward a copy of this questionnaire to them for completion.

Should you wish to receive a summary of the research findings and the managerial implications, or be invited to attend a presentation of the findings please indicate so by providing your e-mail address in the space provided.

Thank you in advance for your time and willingness to participate. Your valued contribution will provide SA manufacturing organisations with empirically tested insight on how to implement lean more successfully.

DANIE VERMAAK

SECTION A: INSTRUCTIONS FOR COMPLETION

1. Complete all the sections and questions.
2. Forward the questionnaire to as many as possible of your colleagues/associates for completion and forwarding to the researcher.
3. Forward completed questionnaire by not later than 31 January 2008 by means of any of the following: Fax: 011- 406 1062

   e-mail: dvermaak@aberdare.co.za

   Post: TD Vermaak

   PO Box 5093

   Johannesburg

   2000

4. Should you wish to receive a summary of the research findings and the managerial implications, or be invited to attend a presentation of the findings please indicate so by entering your e-mail address below:

   ……

SECTION B: GENERAL INFORMATION

Which of the following best describe your occupational category? – Please tick one.	
Production/Manufacturing/Operations	
Engineering/Technical/Maintenance	
Marketing/sales	
Finance/Administration	
Human Resources/Training	
Logistics/Distribution/Procurement	
Consultant	
CEO/General Management	
Information Technology	
Industrial engineering	
Continuous improvement	
Process Engineering	
Other (please specify):	

Please indicate the number of years of practical experience/involvement you have with lean (which includes experience in the Mission Directed Work Teams, 20 Keys and TRACC programmes)	
<2 years	
2 – 5 years	
>5 years	

Which of the following best describe your experience with lean – may tick more than one category.	
As outside consultant	
As internal facilitator	
Manager – all levels of management	
Non – management employee	

Which of the following best describe your manufacturing sector? – Please tick one.	
Motor assembly	
Motor components manufacturing	
Metal and engineering or related manufacturing	
Food and beverage manufacturing	
Chemical and related manufacturing	
Household furniture and appliances manufacturing	
Other manufacturing	
Non-manufacturing	

Which of the following best describe your organisation's success with lean implementation? Please tick one.	
Best in class (the organization has embraced lean and made it part of its corporate culture)	
Industry average (the organization has implemented lean in some facets of the business but have yet to complete the journey)	
Laggard (the organization is still learning about lean and/or is meeting with some resistance).	
Failed (the organization has embarked on the lean journey but have given up or stagnated).	

SECTION C: CRITICAL FACTORS OR VARIABLES FOR SUCCESSFUL LEAN IMPLEMENTATION

Listed below are factors that could influence and eventually determine the successful implementation of lean as a business management strategy.

Using the following scale please indicate to what extend you agree or disagree with the statements by circling the appropriate number in each row: 1 = Strongly disagree: 2 = Disagree: 3 = Somewhat/slightly disagree: 4 = Neither agree nor disagree (neutral): 5 = Somewhat/slightly agree: 6 = Agree: 7 = Strongly agree.

Code	Item	Strongly disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Strongly agree
MA2	An organisation implementing lean must face and embrace the various attitudinal aspects of lean.	1	2	3	4	5	6	7
LS1	Leadership at all levels in the organisation must drive, live and demonstrate lean behaviour.	1	2	3	4	5	6	7
EM2	Lean people make a lean organisation, and as such the people have to get lean before the organisation can get lean.	1	2	3	4	5	6	7
MA1	The mindset and attitude or behaviour of people is fundamental to lean success.	1	2	3	4	5	6	7

EM4	Ultimately it is the knowledge, skills, involvement and commitment of ordinary people that will make the difference to lean success.	1	2	3	4	5	6	7
SI1	Lean philosophy and principles must be reflected in the organisation's business strategy.	1	2	3	4	5	6	7
EM1	The goals of lean can only be achieved through the efforts of its people.	1	2	3	4	5	6	7
SI2	There must be a clear link between the organisational goals, key objectives and lean activities.	1	2	3	4	5	6	7
MA3	For lean to be successfully implemented all levels of employees must be obsessed with lean.	1	2	3	4	5	6	7
LS2	Lean leadership begets lean manufacturing.	1	2	3	4	5	6	7
SI3	Lean implementation must be driven as a high priority strategic business initiative.	1	2	3	4	5	6	7
BS1	At the beginning of a lean transformation the organisation needs lots of basic stability before it can proceed with the more sophisticated elements of lean.	1	2	3	4	5	6	7
LS4	The difference between lean success and failure starts with leadership.	1	2	3	4	5	6	7
BS4	Stability in operating systems is a pre-requisite for lean transformation.	1	2	3	4	5	6	7
MA4	The cognitive dimensions of lean are key to successful lean implementation.	1	2	3	4	5	6	7
SI4	Lean should be implemented as a business strategy and not a tactic.	1	2	3	4	5	6	7
PO1	An organisation embarking on a lean journey will need the support and guidance of full-time facilitators with substantial experience with lean implementation.	1	2	3	4	5	6	7
EM3	The essence of lean is people working within the lean philosophy and principles.	1	2	3	4	5	6	7
BS2	General predictability and consistent availability in terms of manpower, machines, materials and methods is a pre-condition for lean implementation.	1	2	3	4	5	6	7

PO4	A full-time dedicated project leader or facilitator will have a positive impact on lean implementation.	1	2	3	4	5	6	7
TT2	The selection and application of the appropriate lean tools are critical for successful lean implementation.	1	2	3	4	5	6	7
IS2	All business systems, programmes and structures must be aligned with the lean philosophy, principles, practices and methods.	1	2	3	4	5	6	7
PO2	An internal lean systems builder is needed to sustain lean after the external expert has left.	1	2	3	4	5	6	7
IS3	The effectiveness of the lean operating system comes from the integrated nature of its practices and methods.	1	2	3	4	5	6	7
TT3	It is important to understand the organisation's processes and only apply the lean tools and techniques applicable to that specific process type.	1	2	3	4	5	6	7
PO3	A lean promotion office where senior experts of lean can be located must be established in the organisation.	1	2	3	4	5	6	7
IS1	The organisation must integrate the soft issues (such as culture, mindset and behaviour) of lean with the hard issues (such as systems, structure, processes and tools) of lean.	1	2	3	4	5	6	7
TT4	The application of lean tools and techniques by itself will ensure lean success.	1	2	3	4	5	6	7
BS3	Work must be standardised before embarking on a lean journey.	1	2	3	4	5	6	7
TT1	Key to sustainable lean performance is having the right lean tools and techniques in place.	1	2	3	4	5	6	7
IS4	The organisation must use all of the goals, methods, techniques, and foundation elements of lean in combination.	1	2	3	4	5	6	7
LS3	Knowledgeable committed executive leadership is the absolute *sin qua non* for lean success.	1	2	3	4	5	6	7

SECTION C: INDICATORS OF SUCCESSFUL LEAN IMPLEMENTATION

Listed below are factors or variables that could indicate the successful implementation of lean as a business management strategy.

Using the following scale please indicate to what extend you agree or disagree with the statements by circling the appropriate number in each row: 1 = Strongly disagree: 2 = Disagree: 3 = Somewhat/slightly disagree: 4 = Neither agree nor disagree (neutral): 5 = Somewhat/slightly agree: 6 = Agree: 7 = Strongly agree.

Code	Item	Strongly disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Strongly agree
CR3	Successful lean implementation will make the organisation's products more cost competitive.	1	2	3	4	5	6	7
CS2	Successful lean implementation will increase customer satisfaction.	1	2	3	4	5	6	7
CR1	Successful lean implementation will result in continually declining manufacturing costs.	1	2	3	4	5	6	7
CS1	Successful lean implementation will result in the organisation delivering on-time-in-full to its customers.	1	2	3	4	5	6	7
CR2	Successful lean implementation will free up resources (e.g. cash tied up in inventory)	1	2	3	4	5	6	7
CS3	Successful lean implementation will result in the customer getting the right products at the right time, place, and price, with the right quality.	1	2	3	4	5	6	7
CR4	Successful lean implementation will impact on the organisation's bottom line results (increase profitability).	1	2	3	4	5	6	7
CS4	Successful lean implementation will result in the organisation providing value, as defined by the customer, to the customer.	1	2	3	4	5	6	7

SECTION E: IMPACT OF EMPLOYEE GROUPINGS

Please rank the following groupings of employees in order of the impact each will have on the successful implementation of lean in a South African manufacturing organisation. Rank the grouping with the biggest impact as 1 and the least impact as 5:

Employee grouping	Ranking
Executive leadership	
Senior management	
Middle management	
First line supervision	
Front line employees/operators	

Please indicate the impact trade unions will have on the successful implementation of lean in a South African manufacturing organisation by ticking the applicable block:

Strong positive impact	Reasonable positive impact	Limited positive impact	No impact at all	Limited negative impact	Reasonable negative impact	Strong negative impact

THANK YOU