LEARNING, CONTINUOUS IMPROVEMENT, WORLD CLASS MANUFACTURING AND THE SOUTH AFRICAN PLASTICS INDUSTRY

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DECLARATION

I, Alon Saban, submit this thesis for the Degree of Master of Industrial Administration. I claim that this is my original work and that it has not been submitted in this or any similar form for a degree at any university.

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ABSTRACT

South African manufacturers are re-entering the global market where competition is fierce. Greater and faster learning is necessary for organisational survival in the turbulent global market. Learning is understood to be a continuous cycle of activities. Continuous Improvement is shown to be a continuous learning cycle. World Class Manufacturing methodologies are described as being an effective manner to make performance improvements as they are based on Continuous Improvement.

Reviews of Learning, Continuous Improvement and World Class Manufacturing methodologies and techniques used by companies in international industry are presented. Examples of implementations are focused on the plastics conversion industry. This industry has a record of poor performance in South Africa.

Questionnaires were prepared to test for implementation of World Class Manufacturing improvements. The South African plastics conversion industry was surveyed. The results of this survey are discussed and it appears that South African plastic converters have not achieved World Class Manufacturing performance.

A model for the transformation process to World Class Manufacturing using Learning and Continuous Improvement is proposed. The model is demonstrated with a case study of improvements in setup time made in a South African plastics converter.

Conclusions were drawn from the literature, the survey results and the implementation case study. The suggested transformation is that South African plastics conversion companies should implement World Class Manufacturing using Learning and Continuous Improvement. This is so that local manufacturers will be able to compete in the global market. Recommendations for improvements are made to industry and to the Plastics Industry Training Board.

Summaries of relevant methodologies and techniques are included for the reader's interest.

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1. INTRODUCTION

The plastics conversion industry is growing rapidly, the number of companies in this industry is also growing rapidly and this means more competition in the future. With the globalisation of markets, imports are also putting pressure on the local companies. The evidence shows that South African companies are not highly productive and exposed to increased competition from highly productive foreign companies. This thesis aims to answer the following question: How can South African manufacturers transform themselves to be able to compete globally?

1.1 Research Methodology

The research in this thesis is based on three levels: the philosophical, the methodological and the technique. This is the approach recommended by Easterby-Smith et al. (1991). This is necessary as failure to fully understand the philosophy behind implementations can cause them to fail (Deming, 1986). The philosophy which has been chosen is one of Continual Learning and Continuous Improvement. The thesis will show that the Continuous Improvement approach is based on current learning theory. The methodologies described will be those of World Class Manufacturing (Total Quality Management and Just-in-Time amongst others). The thesis will show that World Class Manufacturing is based on continual improvement. The practices or techniques described will be those that support World Class Manufacturing. These include team working, management and shopfloor training, value analysis, quick changeovers (SMED) and error proofing (poka-yoke) among others. The terms will be explained in the relevant sections. The technique/implementation level will focus specifically on the plastics conversion industry.

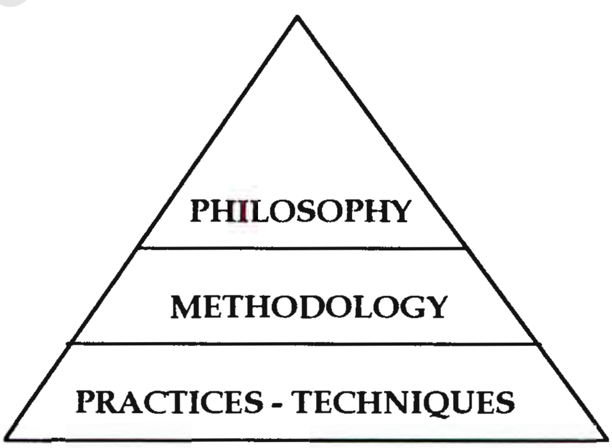


Figure 1: A Hierarchical Representation of the Concepts

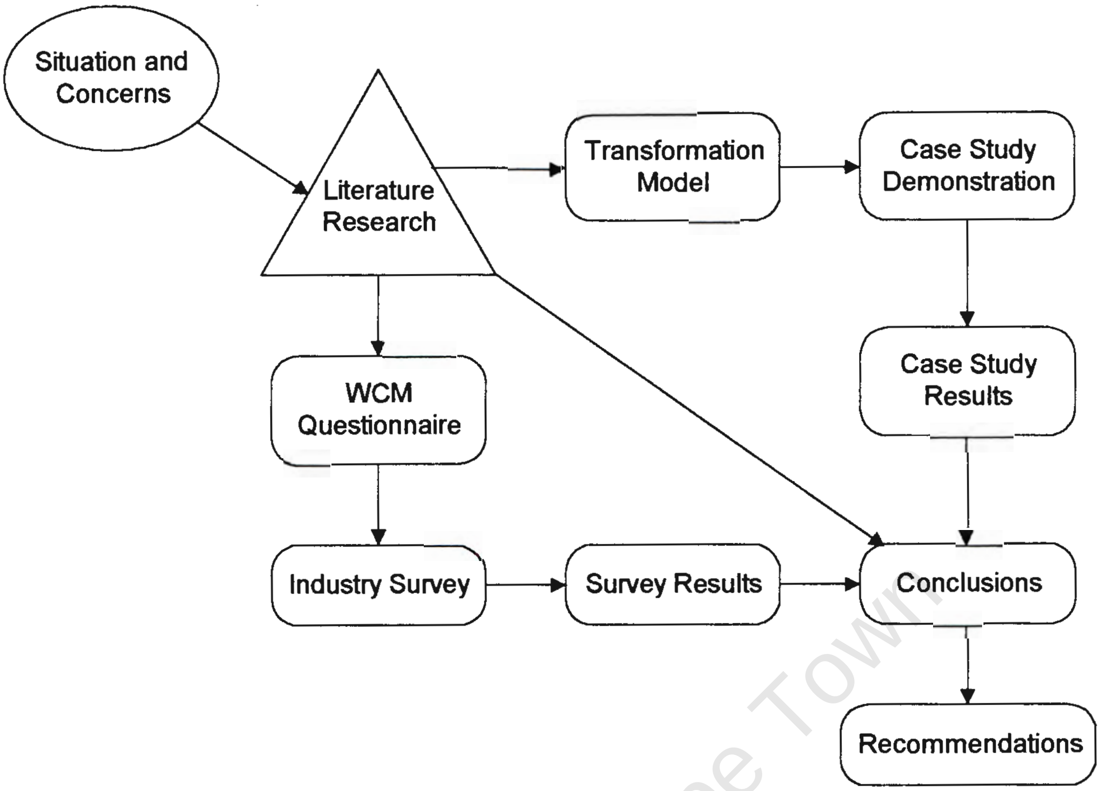


Figure 2: Model of the Research Methodology

Chapter 2 gives an overview of the current situation and sets the context of the thesis. Chapters 3 to 5 give the literature research on Learning, Continuous Improvement and World Class Manufacturing. Implementation concerns are also addressed in Chapter 5. Chapter 6 describes a number of techniques that support World Class Manufacturing. Successful improvement interventions which are specific to the plastics conversion industry are presented in Chapter 7. A questionnaire and survey, to assess the current state of South African plastics conversion companies regarding World Class Manufacturing practices, are described in Chapter 8. The results of the survey are then presented and evaluated in Chapter 9. A model for the transformation process based on the literature, is presented in Chapter 10. The model's relevance is shown in Chapter 11, with a case study of improvements made in a South African company. In Chapter 12, conclusions are drawn from the literature, the survey results and the case study results. Recommendations are made in Chapter 13. These relate to successful transformation of companies in the South African plastics conversion industry and also to training by the Plastics Industry Training Board. The references and appendices are shown in the chapters that follow.

1.2 Relevance of this Thesis

A plastics converter is defined for the purpose of this thesis as an organisation involved in the manufacture of injection mouldings, blow mouldings, extrusions, roto-mouldings and plastic film. Relevance of the interventions proposed in this thesis can apply to companies with 100 or more employees. Smaller companies will probably not have the resources available to implement such interventions. Appendix A describes the general nature of such a company although there might be wide variations in the way companies are actually structured.

The philosophy and methodologies espoused by this thesis are general enough to be applied to most manufacturing organisations and the techniques can be adapted to different plastics converters. The recommendations will also be general enough to be of use to a variety of South African industries. Recommendations regarding training will also be made to the Plastics Industry Training Board as they sponsored this thesis.

2 SITUATION

This chapter describes the context in which this thesis is written.

2.1 The Global Business Situation

Numerous publications speak of the changing environment of manufacturing (Drucker, 1990, Deming, 1986, Hamel and Pralahad, 1994, Goldratt and Fox, 1986). These generally refer to the globalisation of markets and competitors, with the breakdown of import barriers and monopolies, and the move towards a global economy. Numerous examples exist of companies that collapsed, as they lost their local market share when imported products became cheaper than their manufacturing costs. These changes have also been facilitated by the move into the 'Information Age', where purchasers of products can access data on goods from all around the globe. Also, outsourcing or subcontracting of various manufacturing processes is occurring on an international scale. For example, the design and toolmaking are performed in one country and the production runs are performed in a different country.

2.2 The South African Business Situation

South African industry is now in a critical phase of its history. South African industry has been protected for a number of years by government protectionism from within and externally by sanctions. South Africa's re-entry into the global market has forced industry to either make changes in the way that companies operate, or be faced with possible closure due to the inability to compete on a global scale. Evidence of such threats is seen in the South African electronics, automotive, textile and clothing industries.

South Africa's productivity record is disappointing. In manufacturing, which is the sector hoped to be the 'engine of growth' in developing countries, the record is even worse. "Despite strong capital investment, productivity growth in many sectors of South African manufacturing has been weak or negative for a long time." (Liebenberg, 1996, p. VII)

In 1995, World Competitiveness Report of the World Economic Forum evaluated 48 countries using almost 400 criteria. South Africa ranked 42 out of 48 (Liebenberg, 1996). It came last in terms of a number of criteria, mainly those related to 'people' variables, reflecting poor access to education, social services and jobs. South Africa had by far the highest unemployment figure, the highest skills shortage, the lowest levels of computer and economic literacy, and the most skewed income distribution.

Mr. Trevor Manuel, Former South African Trade and Industry Minister, gives the following reasons:

"South African industry developed in a highly protected environment. This highly protected environment has resulted in an accepted fact, that South African manufacturing industry, with few exceptions, is not internationally competitive. South Africa's lack of exposure to international management methods is another thing that is pulling the country down."

"With the present situation in terms of human resources, we have little economic future and certainly no manufacturing future."

"It is ultimately firms that compete with firms. The first winners must be firms. Only when sufficient energy is generated for change at the company level, does a nation succeed."

2.3 The Plastics Conversion Industry

The world plastic product output is growing and this is seen in South Africa as well, with the highest growth rates in both output and employment being in the plastic products sector (Liebenberg, 1996). Evidence in the international plastics conversion industry shows how global competition has forced companies to improve their performance (Michaeli, 1995). Smock (1995, p. 36) explains that as a result of higher customer demands, "supplier ranks are thinning out, but the fittest are surviving and thriving".

The performance of the South Africa plastics conversion industry is relatively poor according to the National Productivity Institute's "Productivity Focus '96" report (Liebenberg, 1996). For example, measures of labour, fixed capital and multifactor productivity growth rates in the plastics products industry, are lowest out of the entire South African manufacturing sector. Greater awareness of the need to improve is shown by this quotation from the President of the Plastics Federation:

"Historically, for obvious reasons, we developed a laager mentality, where local manufacturers enjoyed government protection, offering products at inflated prices. But those days are over. Companies need to adapt or die - remain competitive or yield to international competitors."

"The pattern is clear: we all need to work towards creating a world-competitive export-orientated plastics industry."

"Exports will also keep us on our toes because, if we are to succeed, quality must be world class and our prices must be world competitive. The net result will also be of great benefit to local consumers." (Brown, 1996, p. 1)

3. INTRODUCTION TO LEARNING

"In a time of drastic change, it is the learners who inherit the future, the 'learned' find themselves equipped to live in a world that no longer exists." Eric Hoffer

3.1 Knowledge and Learning

Knowledge indicates a state, i.e., a person or organisation has a certain measure of knowledge which creates the potential for action and decision. Learning indicates some change in the state of knowledge which is often manifested by a change in explanation, decision, or action. Learning must involve an increase in knowledge or a change in something previously known (i.e., correct an error or change from one theory to another). Negative learning (i.e., forgetting) is a decrease in knowledge and is often manifested by a decrease in explanation, decision, or action. Learning also includes the case where something previously known becomes less ambiguous or more certain.

3.2 Individual and Organisational Learning

The literature includes a range of definitions of organisational learning. Senge says "... the basic meaning of a 'learning organisation' - an organisation that is continually expanding its capacity to create its future" (Senge, 1990, p. 14). Senge's definition of learning is similar to Ackoff's concept of planning as a process whereby the organisation continually expands its ability to create its future (Ackoff, 1981).

Organisational knowledge can be defined as knowledge that is shared by two or more members of the organisation. This is termed 'shared meaning' by Senge (1990). There are varying degrees to which organisational knowledge is shared, ranging from two people sharing it to everyone sharing it.

Most of the knowledge that any organisation relies upon is individual knowledge. This individual knowledge ranges from the technician knowing the states of his tools, to the research scientist who is the only one who understands the technical detail of his experiments. Much of the learning that organisations sponsor is individual learning in the form of individual training. On the other hand, some organisations sponsor training for groups of their employees (Flood, 1995). Any training involving two or more members in the same experience could fit a definition of organisational learning.

Training is explicit organisational learning. Yet, every experience involving two or more organisational members is a potential occasion for organisational learning. Experiential organisational learning is thus common. Learning thus provides a platform from which creative individual and organisational actions and decisions become possible (Kolb, 1986). A basic assumption of the thesis is that for most organisations in the near future, more and faster learning is better.

3.3 Learning Cycles

Handy (1990) explains that theories of learning are also theories of change. Learning is understood to be a cycle of different activities and should be a process of discovery. True learning is about answering a question or solving a problem.

This is shown in Handy's Learning Wheel (Handy, 1990):

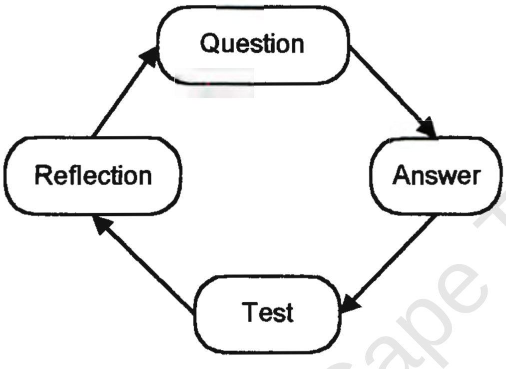


Figure 3: Handy's Learning Wheel

The steps in the cycle are:

1. A question is raised in a particular situation.
2. An answer is given (theory/hypothesis).
3. Test theory by implementing (reality test).
4. Reflect again by reviewing the answer against question.

Learning is stimulated by a need to know. If one is curious about the situation, one will want to discover the factors relating to it. This requires an investigation of possible ideas. Effective learning requires energy, thought, courage and support. The process does not stop at one turn, yet needs to continue on a higher level of understanding or knowledge. This can be envisioned as a spiral, continually turning and rising above the previous understanding or knowledge.

Similarly, other learning cycles include the following:

- Kolb: Experience - Reflection - Generalization - Test
- Pedlar: Experience - Understanding - Planning - Action
- Shewhart: Plan - Do - Check - Act (explained in the next chapter).

3.4 Blocks to Learning and Change

Handy (1990) has identified certain common blocks to the learning process, these are as follows:

- People tend to get caught up in one phase of the cycle, and do not follow through to the next step.
- The 'They' Syndrome. When things do not work as expected, people tend to blame the failures on others.
- The failure of people to invest in themselves. Many people expect others to take care of their learning needs.

Note that success can lead to complacency and stop the learning process. This so-called 'failure of success' is most insidious and is the failure of those who claim to have learnt from successful experience (Argyris, 1991). This is based on the concept that past success equates with future success. This was the case with the American motor industry, until they were in dire financial straits as a result of the Japanese imports taking big slices of their market share. The large American motor companies had not considered trying to provide the customer with better value as a goal of their business (Linstone and Mitroff, 1993).

3.5 Lubricants of Learning and Change

Learning starts with belief in oneself; doubt in one's own ability will stop the learning process, this implies that some self interest is essential (Handy, 1990). One needs to solve problems that are meaningful to oneself, this means that one should take the initiative if one wants to learn from experience. Those who learn best are those who:

1. Take responsibility for learning
2. Have a clear view of what they want to achieve
3. Believe they can change things

Similarly, these points can be extended to team learning. Teams should solve problems that are meaningful to its members. Other lubricants of learning and change are described below:

3.5.1 Purpose

Once the purpose of the change is clear, one should set goals as an incentive to learning. The goals must be aligned to those of the group or organisation. However, realise that self expression is also essential to motivate learning.

3.5.2 Re-framing

Re-framing involves seeing things, like problems in other ways (this is also known as lateral thinking). An effective way of doing this is by using different perspectives, usually from others, on the situation to better understand the question.

3.5.3 Negative Capability

The negative capability is the ability to accept that the unknown may never be completely known. This is the realisation that decisions are not made in a state of complete knowledge of the situation. Nevertheless, the decision must be taken and may result in a mistake. Doubt and mistake should also result in learning to improve decision making in the future.

3.5.4 Mistakes and Forgiveness

To learn effectively one must be capable of accepting success and failure. One should use the mistakes as a positive motivator to learn. People learn from mistakes if they are highlighted. One should also forgive oneself, failures lead to success if we look at them as opportunities to start the learning cycle turning.

3.6 The Scientific Method and Management Practice

Revans (1982) explains that there exists a parallel process between the scientific method and good management practice.

The scientific method consists of five iterative steps:

1. Observations from the external world.
2. The formulation of a theory based on these observations.
3. The design and conduct of experiments to test the theory.
4. Comparison of the experimental results with those predicted by the theory.
5. The rejection, modification or confirmation of the theory in accordance with the results of the comparison.

He argues that rigorous adherence to this method has allowed science to progress, as it forms a self-correcting loop. He also argues that this method can be used in industrial management, simply by substituting a technological product for a scientific theory (or, indeed, a management theory). This appears as follows:

1. Determination of what needs exist and what items have already been produced to satisfy these needs (Survey).
2. Decisions about what further or different items to produce (Policy).

3. The establishment of methods of manufacture (Operations).
4. Processes of audit (Inspection).
5. Changes in what items should be produced or in the methods of production (Control).

The managerial process thus sets out to test how far the results of its planned actions compare with those forecast by its policy. Within each step, a similar fivefold structure can also be used.

Management, unlike the scientific process, seeks to fulfill subjective desired aims and values. These should be clear and unambiguous from the outset. A declaration of preferred aims should be formulated from the beginning and this can be used for comparison with the actual results achieved by the actions taken. Revans acknowledges that the result can only be statistically significant, as such situations contain many variables. Only if deviations are persistent, then the theory should be discarded or modified. Finally, the cost of the improvement must not exceed the intended gain.

The scientific method is an iterative self-correcting cycle and is similar to the learning cycles described in the previous section. Figure 4 shows the synthesis of Revans's scientific method, management method and Handy's learning cycle.

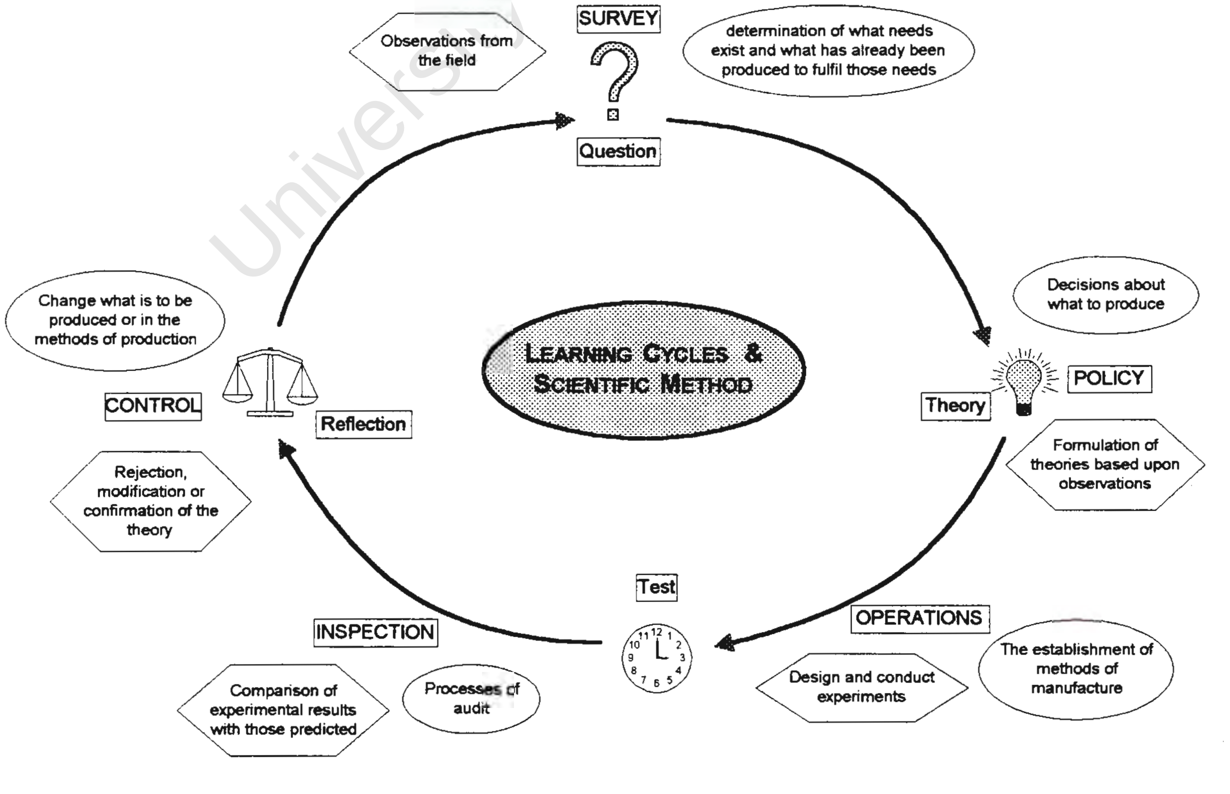


Figure 4: Management and the Scientific Method in a Learning Cycle

3.7 Single and Double Loop Learning

These models link closely with the concept of double and single loop learning put forward by Agyris (1982) (see Figure 5). He proposes that management behaviour is based on beliefs called 'theories-in-use'. Single loop learning takes place when there is a change in management behaviour within a 'theory-in-use'. This is a process of error detection and correction. Double loop learning takes place when the change in management behaviour flows from a change in the 'theory-in-use'. This process involves a change in the beliefs about how the world works and is built on new and innovative insights into ways of dealing with complex problems. This can often be as a result of a failure of the current 'theory-in-use' to deal with the problem satisfactorily. Management issues and decisions can be seen as either single loop or double loop issues and decisions.

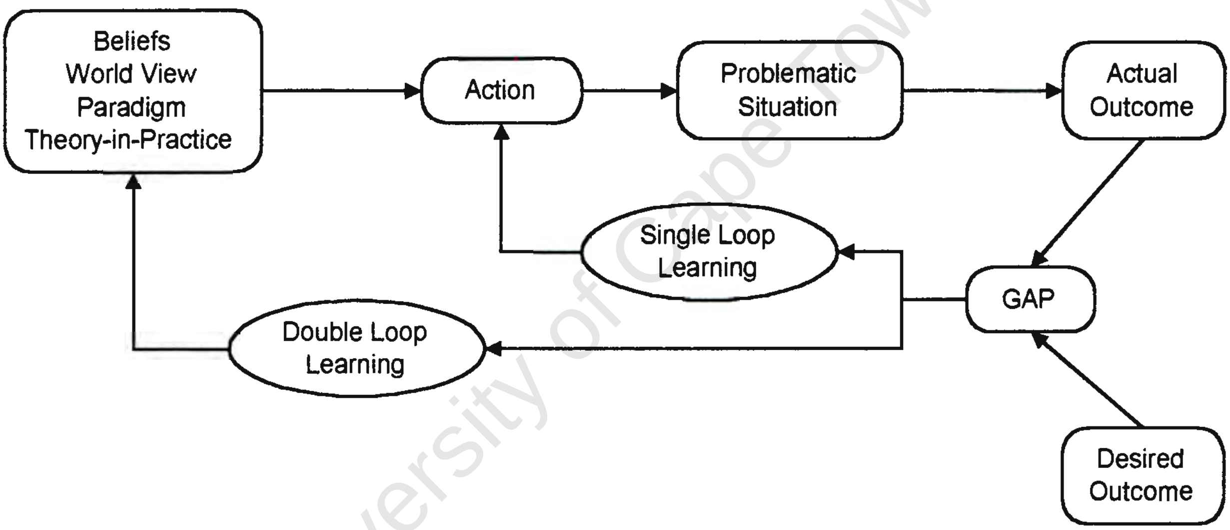


Figure 5: Single and Double Loop Learning

3.8 Summary

Careful consideration of the learning cycles, the scientific method and double loop learning reveals a close similarity between learning, problem solving, inquiry and management in general (Ryan, 1995). They are all continuous self-correcting cycles that seek to improve one's knowledge and understanding of a situation. An extension of this theme on a more practical level is continued in the following chapter.

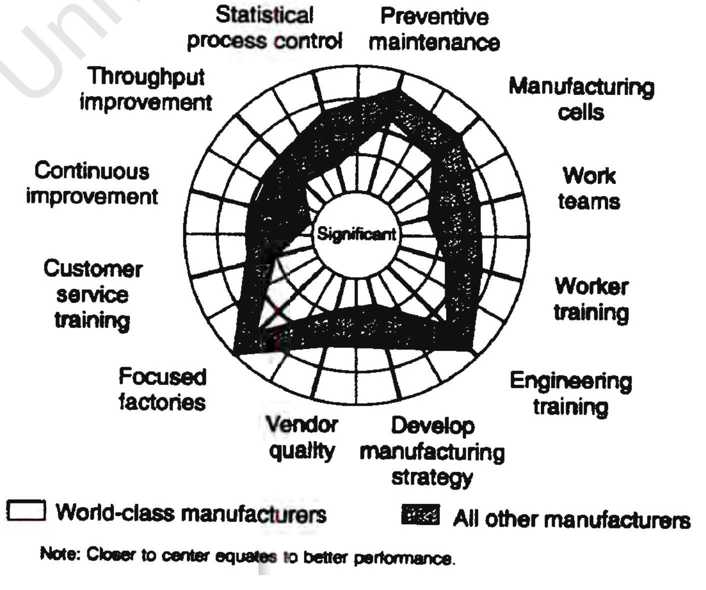
Managerial learning is only meaningful if there is a resultant change in behaviour. It is seldom the result of a single learning experience, it is usually co-produced by a range of learning experiences. Hence, the importance of continuous learning. Reading and evaluating relevant literature also offers opportunities for learning experiences.

4. INTRODUCTION TO CONTINUOUS IMPROVEMENT

"There is no finish line." Goldratt and Fox

In this section, the key managerial elements of Continuous Improvement (CI) and some of the basic tools associated with the Continuous Improvement process are discussed. The PDCA cycle is discussed and the seven basic Continuous Improvement Tools are described.

Continuous Improvement is a management philosophy that approaches the challenge of product and process improvement as a never-ending process of achieving 'small wins' (Piper and Sumukadas, 1994). "Continuous Improvement seeks continual improvement of machinery, materials, labor utilization, and production methods through application of suggestions and ideas of team members" (Chase and Aquilano, 1995). Although it was pioneered by American firms, this philosophy has become the cornerstone of the Japanese approach to operations. It is often contrasted with the traditional Western approach of relying on major technological or theoretical innovations to achieve 'big win' improvements (Imai, 1986). As can be seen in Figure 6, in a recent survey of 872 North American manufacturing managers, the majority of World Class Manufacturers favoured Continuous Improvement over eleven other manufacturing improvement programmes (Giffi and Roth, 1991). Clearly, Continuous Improvement is a successful concept.



Source: Giffi and Roth (1991)

Figure 6: Manufacturing Improvement Programmes

4.1 Distinguishing Features of Continuous Improvement

Based on a review of Continuous Improvement programmes by Melcher et al. (1990), two essential features distinguish Continuous Improvement Systems (CIS) from the traditional, or what has been termed 'Standard Maintaining Systems' (SMS):

1. *Management's view of performance standards of the organisation.* Under Continuous Improvement, management views the performance level of the firm as something to be continuously challenged and incrementally upgraded. Under the Standard Maintaining Systems, management sees performance standards as essentially fixed by the constraints of technology and the existing organisation. These constraints appear unbreakable without a major innovation in technology or production theory.
2. *The way management views the contribution and role of its workforce.* The real potency of Continuous Improvement comes from the people management side of the approach. Managing and operations directors of successful firms believe employee involvement and team efforts are the key to improvement. Such is not always the case with managers who adhere to the standard maintaining approach. Although they certainly say that people are important, they are more likely to view the installation of a new generation of automated equipment as more important. This does not mean that managers practicing Continuous Improvement do not employ advanced technology in their plants, they often do. Rather, it is to point out that the philosophy of continuous improvement makes them think first of how such technology can be used to leverage the performance of the work force. Some specific work force management differences between the SMS approach and the CIS approach are that the latter is characterised by multifunctional work teams, participative management, a group orientation, and participative decision making.

Appendix B contrasts the CIS and SMS views relative to organisational processes in more detail.

4.2 Management Requirements for Successful CI Systems

These suggestions are taken from Schroeder and Robinson (1991) and Chase and Aquilano (1995).

1. *Improvements require a learning period before they yield benefits.* Though Continuous Improvement focuses on quickly implemented small improvements, even small improvements cause dislocations in work patterns and hence reductions in output in the short run.

2. *Labour and management must trust each other to generate the free flow of ideas that drive a Continuous Improvement effort.* Such trust can be broken in several ways: One is by inequitable compensation systems for salaries or improvement awards. A second way is by reducing the budgets of units that have reduced their costs. A third is by not guaranteeing employment for individuals who have made productivity improvements that could eliminate their jobs.

3. *A reward system must promote interdepartmental co-operation.* Process improvements initiated in one department often impact other departments. One sure way to destroy Continuous Improvement is to set up a reward system that penalizes either department. If, for example, an improvement suggested by an assembly team requires additional work by a plastic moulding team, neither group's budget should be affected as a result. Indeed, there should be appropriate recognition and rewards for both as a result of their co-operation.

4. *Continuous improvement equals continuous training.* Continuous training is of two types: training in problem-solving methods that lead to improvements, and training in new procedures necessary to implement the improvements themselves. Training is the major cost in continuous improvement. Costs mount due to employees taking time away from their work activities to engage in group problem solving, temporary assignment to other functions to gain understanding of problems outside their own work groups, and of course, formal Continuous Improvement training programmes.

5. *Continuous Improvement requires an efficient system to handle improvement ideas and administer the reward process.* Without a well-planned means to gather, evaluate, implement, and reward improvement ideas, no continuous improvement program will succeed. This means that ideas must be reviewed quickly, judged quickly, implemented quickly, and rewarded equitably. Feedback on ideas that are not accepted should explain why in a way that expands the contributor's knowledge of the operation. In other words, the improvement suggestion system should provide an opportunity for learning.

4.3 Shewhart's PDCA Cycle

The approaches companies take to the Continuous Improvement process range from very structured systems utilising Statistical Process Control (the Japanese model) to simple suggestion systems relying on brainstorming and 'back-of-an-envelope' analyses. All Continuous Improvement approaches rely on the fundamental Plan-Do-Check-Act (PDCA) cycle and on the analysis of the facts involved.

Shewhart's PDCA cycle, also called the Deming wheel, (see Figure 7) conveys the sequential and continual nature of the Continuous Improvement process.

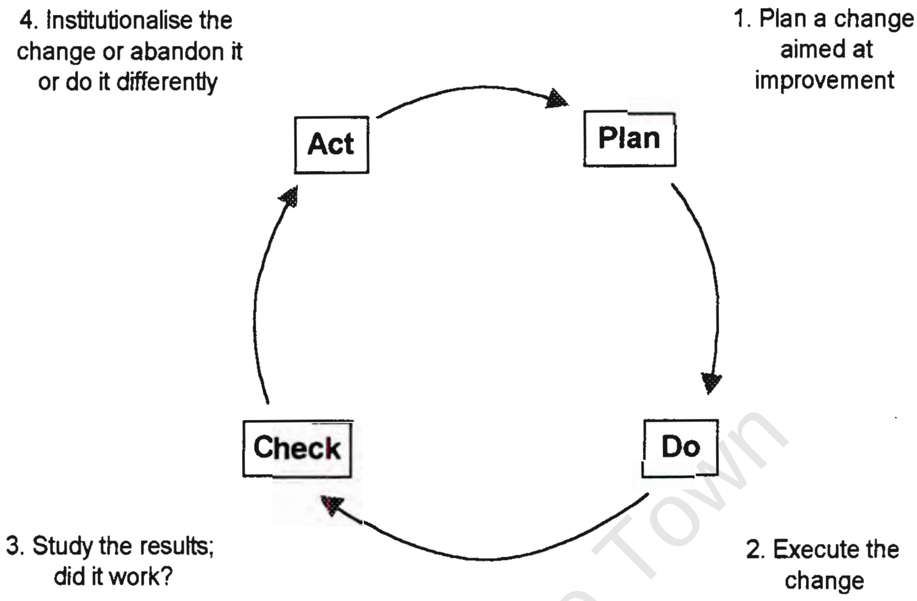
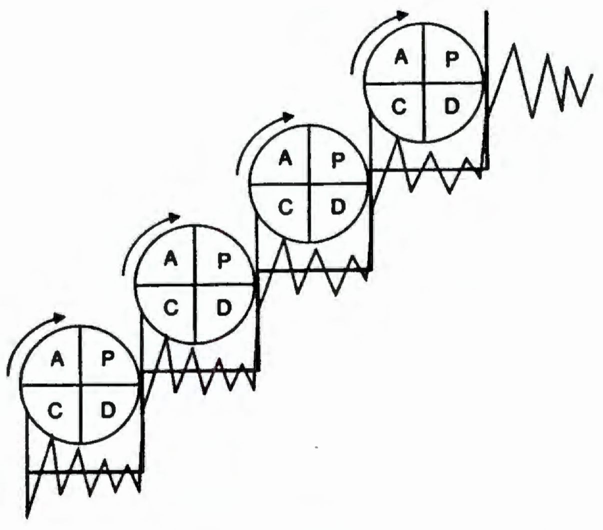


Figure 7: The PDCA Cycle

The 'plan' phase of the cycle is where an improvement area and a specific problem with it are identified. It is also where the analysis is done, using one or more of the Continuous Improvement problem-solving tools. (See the Section 4.5 for a summary of these tools). Workers can use these tools in conjunction with brainstorming approaches such as the 5W2H method shown in Section 4.4 to arrive at ideas for improvements. Typical of many Continuous Improvement applications is the identification of countermeasures directed toward eliminating the cause of a problem, or the barrier to a solution.

The 'do' phase of the PDCA cycle deals with implementing the change. It is recommend that the plan be implemented on a small scale first, and that any changes in the plan be documented. The 'check' phase deals with evaluating data collected during the implementation. The objective is to see if there is a good fit between the original goal and the actual results. The 'act' phase is where the improvement is instituted as the new standard procedure and replicated in similar processes throughout the organisation.

The PDCA cycle operates on the same basis as the other learning cycles and thus is a powerful tool to facilitate single loop learning. Smith (1995) and Conway (1993) show how it is the fundamental learning cycle in the practice of Total Quality Management. Figure 8 shows how the systematic application of the PDCA cycle can lead to continual improvement.



Source: Conway (1993)

Figure 8: Improvement by Turning the PDCA Cycle

Appendix C summarises the Continuous Improvement steps in an example of a group quality improvement process.

4.4 The 5W2H Method

A number of simple guidelines have been developed to help people or groups generate new ideas. These guidelines urge one to question everything, from every conceivable angle. The table from Robinson (1991, p. 245) below, outlines the 5W2H Method, which stands for the five "w's" (what, why, where, when, and who) and the two "h's" (how and how much).

Type	5W2H	Description	Countermeasure
Subject matter	What?	What is being done? Can this task be eliminated?	Eliminate unnecessary tasks
Purpose	Why?	Why is this task necessary? Clarify the purpose.	Eliminate unnecessary tasks
Location	Where?	Where is it being done? Does it have to be done there?	Change the sequence or combination
Sequence	When?	When is the best time to do it? Does it have to be done then?	Change the sequence or combination
People	Who?	Who is doing it? Should someone else do it? Why am I doing it?	Change the sequence or combination
Method	How?	How is it being done? Is this the best method? Is there some other way?	Simplify the task
Cost	How much?	How much does it cost now? What will the cost be after improvement?	Select an improvement method

4.5 The Seven Basic Continuous Improvement Tools

1. *Pareto analysis* applies the 80/20 rule to identify the significant few causes that account for most of the problems. It separates the 'vital few' from the 'trivial many'. All potential causes or variation problems are ranked according to their contribution to cost, variation, or some other measure.
2. *Process flow charts* depict the relevant steps in a process and aid understanding of a process. See Appendix D for examples.
3. *Check sheets* provide quantitative evidence of the frequency of events. For example, they can be used to verify that what people believe is a problem, really is a problem.
4. *Cause-and-effect diagrams* depict and organise the potential causes of an undesired or desired effect. See Appendix E for an example.
5. *Histograms* display the distribution of a number of real variables, such as weight, in frequency form. This is a way to evaluate the data visually.
6. *Scatter diagrams* help to study the relationship between data.
7. *Control charts* are used to determine the nature of the cause of variation (i.e., common causes or special causes).

The seven basic tools sometime combine histograms with Pareto and add run charts or stratification of data diagrams (Chase and Aquilano, 1995).

4.7 Summary

"Continuous Improvement is not rocket science" (Chase and Aquilano, 1995, p. 900)

Examination of the concepts in this section should convey the fact that Continuous Improvement does not require great genius. Theoretically, it is an inherently simple process that any organisation can use with success. It does require commitment to improvement, a willingness to change and perseverance in implementation. Where it appears to need higher level thinking is in the area of breaking down organisational barriers and conflicting reward systems that inhibit co-operation between work groups.

5. WORLD CLASS MANUFACTURING

"The action you're proposing:
Will it increase throughput?
Will it decrease inventory?
Will it decrease operating expense?"
Eliyahu Goldratt

5.1 Overview of World Class Manufacturing

Strategy is a set of plans and policies by which a company aims to gain advantages over its competition (Skinner, 1969). All effective manufacturing companies require some sort of manufacturing strategy in order to produce their goods and services and to keep them abreast, or preferably, ahead of their competitors. This strategy should detail "a strategic vision on how the firm's productive resources relate to one another and to the environment". (Chase and Aquilano, 1995, p. 957).

If one defines these relationships in terms of the concept of World Class Manufacturing (WCM), then according to Chase and Aquilano (1995, p. 957), this entails "continual interactions with customers and suppliers, and integrated manufacturing through appropriate blending of Total Quality Control (Total Quality Control), Computer Integrated Manufacturing (Computer Integrated Manufacturing) and Just-in-Time (JIT) production".

Just-in-Time is further described in Appendix F, while more on Total Quality Management can be found in Appendix G.

According to Schonberger (1986), World Class Manufacturing encompasses the following:

- Just-In-Time (JIT) production, small lot sizes with the ideal batch size equal to one. "JIT production exposes problems otherwise hidden by excess inventories and stock." (Schonberger, 1982, p. 15).
- Total Quality Control (TQC), do it right the first time, i.e., zero defects. "Quality begins with production and requires a company-wide habit of improvement." (Schonberger, 1982, p. 47).
- Total Preventative Maintenance (TPM), ensuring no mechanical breakdowns of machinery.
- Involving operators in activities that previously only involved supervisors, inspectors, technicians or managers. For instance, quality circles are aimed at improving quality and productivity through employee involvement.

- Improvement of supplier, customer, and labour relations.
- Effective and efficient shop floor layout and organisation. "Simplify, and goods will flow like water." (Schonberger, 1982, p. 103).
- Minimising transport of work-in-progress, i.e., "travel light and make numerous trips." (Schonberger, 1982, p. 157).
- Improved product design, i.e., designing for simpler manufacturing.

World Class Manufacturing, interpreted by Maskell (1991, p. 4), "generally includes the following:

- A new approach to product quality.
- Just-in-Time production techniques.
- Change in the way the work force is managed.
- A flexible approach to customer requirements."

Hayes, Wheelwright and Clark (1988) identify the following key attributes of World Class Manufacturers:

- Becoming the best competitor.
- Growing more rapidly and being more profitable than competitors.
- Hiring and retaining the best people.
- Developing a top-notch engineering staff.
- Being able to respond quickly and decisively to changing market conditions.
- Adopting a product and process engineering approach which maximises the performance of both.
- Continually improving.

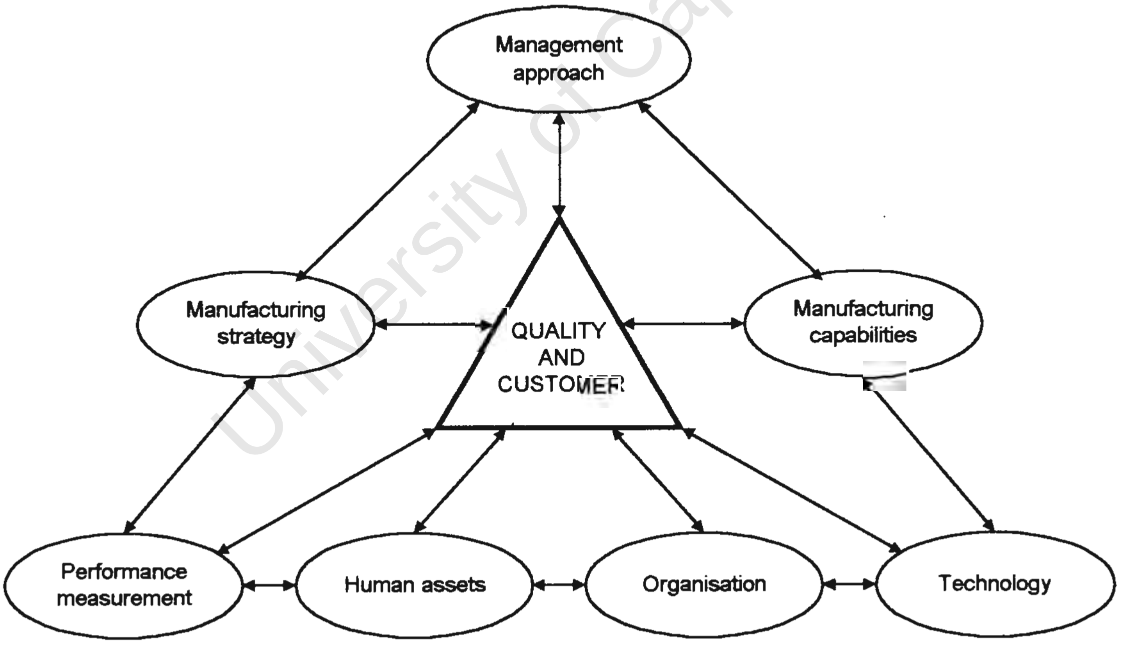
According to the Baldridge Award criteria (Brown, 1994), World Class Manufacturing organisations have the following:

- A 'quality' culture.
- Healthy profits.
- Happy employees.
- High quality products
- Delighted customers.

According to Hamel and Prahalad (1994), quality is not what will give companies a competitive advantage in the future, having quality products and services will be the price of entrance into any market. The most successful companies will be those that can anticipate customer needs and design new products and services to meet those needs.

Crucial to integration of World Class Manufacturing is a system perspective, as Gunn (1987, p. 28-29) points out, "manufacturing consists of the entire range of activities from product and process design, through manufacturing planning and control, through the production process itself, through distribution, and through after-sales service and support in the field. This is one continuous spectrum. No activity can be performed along this spectrum without affecting some other part of it either upstream or downstream."

Giffi et al. (1990) describe the common operating principles for World Class Manufacturing that came out of their research. These have quality and a customer focus at their centre. Their recommendations are described in Appendix H. Figure 9 illustrates the integrated relationship between their dimensions.



Source: Giffi et al. (1990)

Figure 9: World Class Manufacturing Framework

What is described above, adequately encompasses what is involved in a company's quest for attaining the status of 'World Class Manufacturer', as defined and interpreted by various 'experts' on the subject.

WORLD CLASS MANUFACTURING

World Class Manufacturing can be described as the manufacture of high quality products reaching customers quickly at a low cost to provide high performance and customer satisfaction.

Providing a world class product means satisfying the customer in terms of at least three dimensions, these being Quality, Cost and Delivery. Moreover, according to Piper and Sumukadas (1994), "Organisations must continually improve cost, quality and timeliness of their output if they are to remain competitive." Timeliness here means the delivery lead time to the customer. This could either be the time it takes from receiving an order to delivery, or the time required for new product development. Other dimensions could include: flexibility, after-sales service and aesthetic appeal. These are shown in Figure 10 below.

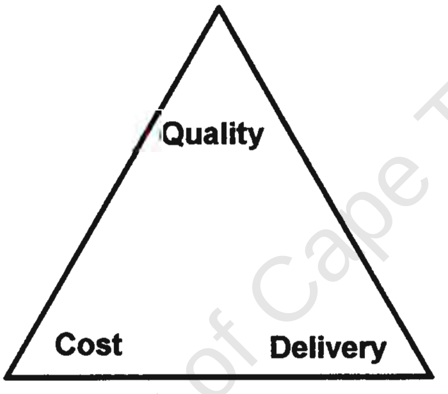
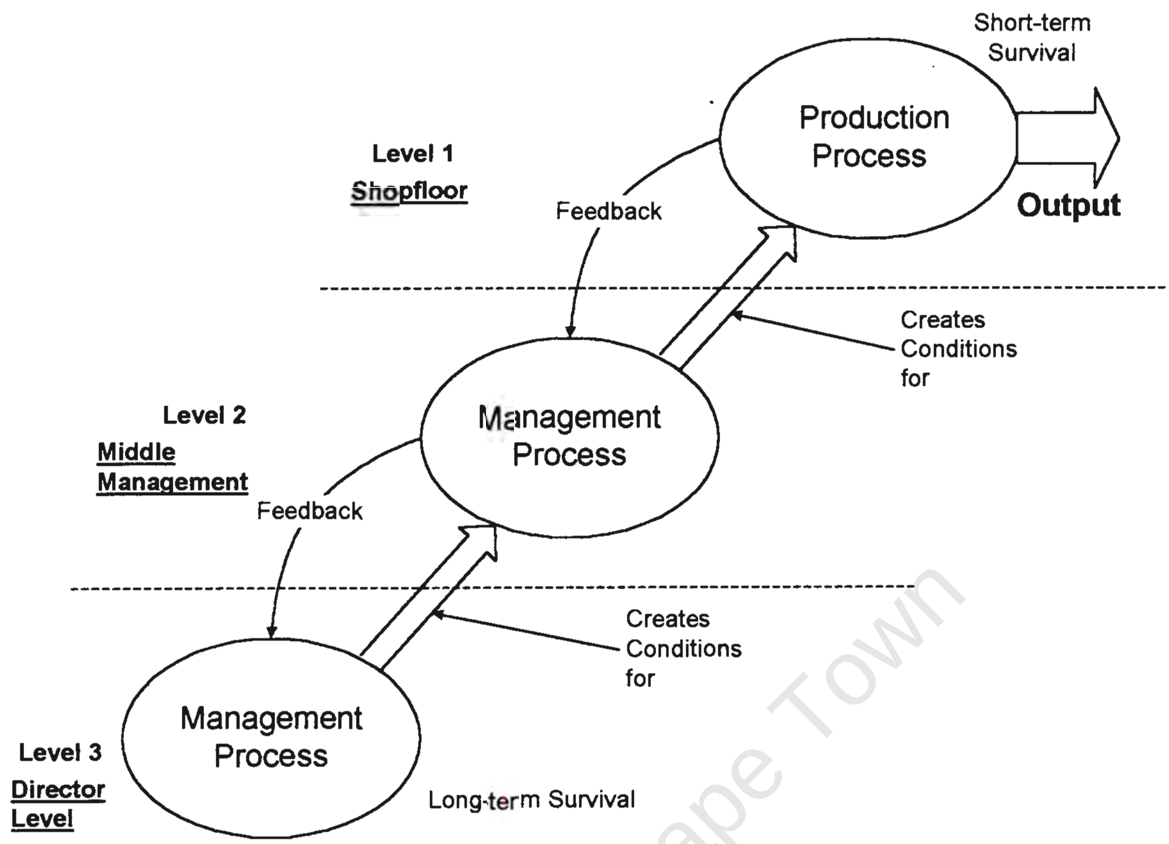


Figure 10: The Primary Dimensions of Quality, Cost, Delivery

Hoebeke (1994) provides us with a valuable paradigm for encouraging a customer focus. Here the shopfloor level of the company is recognised as the most important part, as it provides the product that satisfies the customer. This is in direct opposition to the 'command and control' manner of management, with the lower level in the hierarchy having the implicit purpose of serving the higher levels. Here, the higher levels have the purpose of creating the conditions that allow the lower levels to operate. They promote the efficiency of the lower levels and they monitor the effectiveness of its outputs. This is shown in Figure 11 on the next page.



Source: Hoebeke (1994)

Figure 11: Work Systems Process Levels

In a company claiming to be a World Class Manufacturer, all obstacles and de-motivators must be removed and as many operations as possible must be simplified. In order to achieve this, I suggest that World Class Manufacturing aims to achieve the following objectives, which are desirable in the plastics conversion industry:

- Re-design of the layout of the production line to facilitate process flow, to improve communication and to reduce any bottlenecks
- Enabling work to flow through the plant without bottlenecks or idle time.
- Reduction of work-in-progress and buffer stocks.
- Reduction of the size of batches - facilitated by attempting to manufacture only to order and not for stock.
- Scheduling to rate and not by lots.
- Procedures or fail-safe (poka-yoke) mechanisms to detect errors early in the production cycle.
- Neatness and tidiness of the production line. Every tool and implement should have a designated place where it is stored when not in use.

- Multi-skilling of production workers and fewer job classifications
- Self-checking - operators need to check their own work, while they are performing their particular task in the production process. This means fewer inspectors are necessary
- Simple visual displays comparing production targets with good production output.
- Less formal reporting.
- Reduction of set-up times of machines or operations.
- Development of in-house equipment and processes, as far as possible, before investing in expensive equipment.
- Reduction of component count per product.
- Simplification of as many production processes as possible.
- Reduction of the number of suppliers - develop a good relationship with them.
- Reduction of waste and non-value adding activities.
- Improvement of quality in products and services (internal and external).

It appears that all of the above principles could be simply implemented, resulting in miraculous improvements. However, any of the principles of World Class Manufacturing that management wishes to implement, will require the mutual co-operation and trust of everybody involved in the manufacturing process. It is therefore necessary to involve all employees in the development of a World Class Manufacturing programme, right from the beginning. It must also be considered that the enthusiasm from everybody involved needs to be sustained for any change to be effective in the long term. The next section provides a discussion of the problems of World Class Manufacturing, leading to issues regarding people involvement, commitment and trust. These are vital to any process of organisational change, such as World Class Manufacturing.

5.2 Problems with Implementation of World Class Manufacturing

Following their research into organisational change, Beer et al. (1993) state that most change programmes do not achieve the expected results. This is usually due to the changes operating in isolation and not as part of an integrated approach. Another common failing is that the change is implemented as a set of generalised 'buzzword'-type programmes, and is not seen as a process of continuous improvement dealing with key business problems. Often, the necessary competencies and skills are also not available to support the changes.

In his study of various organisations, Wilkins (1989) states that many of the companies have tried to implement generally praiseworthy ideas or practices from successful companies, such as quality circles, statistical process control, and Just-in-Time inventory reduction methods. However, this resulted in cynicism amongst the employees, rather than the hoped-for productivity improvements.

He says that such new programmes may fail to meet expectations for many reasons: the programmes require different skills, they are not appropriate for the existing conditions, there are no rewards to motivate participation in these programmes, or they threaten to give some people less influence. Results from Wilkins' study of companies in the United States using quality circles, indicated that most of the companies showed a great deal of excitement initially, but the motivation and enthusiasm began to fade. Managers stopped paying close attention to the groups, and eventually showed no interest, due to the considerable time required to support them, especially with regard to training.

Wilkins (1989, p. 13) insists that "unless managers are willing to adapt borrowed ideas and programs and struggle through the development of execution skills, they will see little improvement from applying the latest programs".

In summary, it is not likely that a company's management can just implement all the activities, procedures and principles pertaining to World Class Manufacturing and expect miraculous results. In other words, a simple 'recipe' for their implementation will not work.

As Schonberger has stated (see above), World Class Manufacturing includes:

- The improvement of supplier, customer and labour relations.
- A change in work culture and the unleashing of natural tendencies.

In addition, according to Maskell (1991, p. 4): "A change in the way the workforce is managed" is required.

Hence, it is necessary to look at the 'people' side of the issues; to take the 'human side' of an organisation into account and to consider their relationships. These issues are dealt with in the next section.

5.3 Importance of People Involvement

People are the active force in any organisation, according to Senge (1990). That is, it is mainly the people that constitute an organisation, without them, an organisation is non-existent. He expresses that people have their own ways of thinking, which must be recognised by management. It is not necessary for management to constantly tell employees what to do. By encouraging employee involvement, people will be able to make more of their own decisions and will thus become more motivated.

Managers today are under much more pressure to cut costs and trim the fat. Yet, more critical in improving competitiveness, is the need to develop and maintain employee faith in the fairness and the ability of the organisation.

It is clear that the growing union membership in South African industry, indicates a loss of employee faith in the fairness of the organisation. Wilkins (1989) calls this ingredient of organisational culture 'social capital', which can be created or spent, just like financial capital. Therefore, it seems that South African management has been spending more social capital than it has been creating.

Wilkins (1989) says when trust is lacking between people in an organisation, much effort and creativity goes into checking up on each other, producing cynicism and spreading rumours, rather than into constructively building the organisation. He also says that it is important to determine the perspectives and beliefs that currently influence actions and choices made in the organisation. "We want to know the extent to which beliefs are shared and how they relate to changes the organisation needs to make." (Wilkins, 1989, p. 33).

All World Class Manufacturing methodologies are based on a participative company culture, one with genuine shared vision. This is common in many Japanese companies, yet lacking in many Western companies, resulting in the failure of 'transplantation' on the World Class Manufacturing methodologies into many Western companies.

Schonberger, who introduced the term 'World Class Manufacturing', believes that the challenge for Western managers is to "undo the harm, to change a work culture and unleash natural tendencies." (Schonberger, 1986, p. 16).

5.4 Critical Path for an Effective Change Process

Following their analysis of problems with implementation, Beer et al. (1993) propose a 'critical path' in effective change:

1. *Mobilise commitment to change through joint diagnosis of business problems.* Proper involvement of all levels of employees is necessary before a more complete picture can be formed and strategic decisions made.

2. *Develop a shared vision of how to organise and manage for competitiveness.* Once a core group of people is committed, the general manager can lead employees toward a task aligned version of the organisation that defines new roles and responsibilities.

3. *Foster consensus for the new vision, competence to enact it and cohesion to move it along.* This is when strong leadership is crucial. Real commitment to change needs to be demonstrated, competencies for the new roles and responsibilities need to be developed and the improvement effort needs to be co-ordinated.
4. *Institutionalise revitalisation through formal policies, systems and structures.* This is the point where one has to consider how to institutionalise change that the process continues even after the initial achievements are made. The new policies, systems and structures must ensure that the new approach becomes entrenched, the right people are in place and the team is up and running.
5. *Monitor and adjust strategies in response to problems in the revitalisation process.* The purpose of change is to create an asset that did not exist before: a learning organisation capable of adapting to a changing competitive environment. An oversight team should keep continuous watch over the process and plan in response to new challenges.

5.5 Summary

The definition of World Class Manufacturing is topic of much discussion today, as is the path to effectively becoming a real World Class Manufacturer. Regardless of the definition chosen, the World Class Manufacturer seeks to apply manufacturing concepts designed to demolish obsolete methods and cultures that have impeded its competitive progress. World Class Manufacturers have a common attribute, they are able to create high-value products and earn a superior return over the long run (Giffi et al., 1990). This is achieved through the successful implementation of competitive manufacturing strategies that win orders in the global marketplace.

The principles of World Class Manufacturing have been described and problems identified. It is recognised that more emphasis needs to be placed on the 'human side' of any process of organisational change, such as World Class Manufacturing. It is realised that any World Class Manufacturing methodologies that management wishes to implement will require the mutual co-operation and trust of everybody involved in the manufacturing process. It is therefore necessary to ensure full employee involvement in order for any changes to be effective in the long-term.

"The principle of continual improvement is threaded throughout the concept of Total Quality." (Conway, 1993, p. 14). "A great deal of continual learning, training and implementation is essential to the realisation of this management concept." (Conway, 1993, p. 1). "Continuous Improvement - kaizen in Japanese - is a crucial part of both quality-based and time-based competitive strategies."

(Piper and Sumukadas, 1994, p. 42). Total Quality Management and the other World Class Manufacturing methodologies stress that they be continually applied as part of a process of ongoing improvement. This process is cyclical and infers that their nature is one of learning and self correction. There is an implicit coherence between current learning theory, the Continuous Improvement approach and the World Class Manufacturing methodologies. They are all founded on the same basis: continuous striving to be better.

A manufacturing company should operate as a synchronised system, with all parts in harmony and supporting each other. Marketing, finance, production, and engineering (as well as all the other functional staff and administrative entities) are all necessary parts of the system, and should all seek to continuously improve and achieve the common goals of the company. This does not imply that World Class Manufacturing can only be implemented in large organisations with support staff. Phillips and Ledgerwood (1994), amongst others, show how World Class Manufacturing practices have been appropriately implemented in small as well as large companies.

The following chapter discusses practical measures that companies can take to aid them towards World Class Manufacturing performance.

6. TECHNIQUES AND PRACTICES TOWARDS WORLD CLASS

"Quality is never an accident, it is always the result of intelligent effort."

John Ruskin

The following sections describe techniques and practices that help companies achieve World Class Manufacturing performance.

6.1 Improving Quality

Quality improvement can be defined as an approach to achieving and sustaining high quality output. Quality improvement is viewed by many as an important first step in an integrated approach towards World Class Manufacturing (Shores, 1993).

There are a number of world-renowned quality 'gurus' including Deming, Ishikawa, Juran and Crosby (see the references in Section 14). They do not completely agree in their approaches to achieving quality improvement, but they do agree on three key issues:

- A pervasive responsibility for quality.
- Prevention and not detection of failures.
- Analysis of problems and not blame.

Total Quality Management and techniques like Statistical Process Control can be implemented to improve quality. Shingo has argued that Statistical Quality Control methods do not prevent defects (Shingo, 1986). Although they provide data to describe probabilistically when a defect will occur and are after-the-fact. The way to prevent defects from coming out at the end of a process is to introduce controls within the process. This is what Shingo calls Zero Quality Control. Central to this approach is the difference between errors and defects. Defects arise because people make errors. Even though errors are inevitable, they will not turn into defects if feedback leading to corrective action takes place at the error stage. Such feedback and action require source inspection which should be done on 100 percent of the items produced. As with the Just-in-Time approach, information on defects gives immediate feedback for the worker who produced the product, who then makes the repair. Source inspection relies on controls consisting of fail-safe procedures or devices called 'poka-yoke'. This is described in the next section.

6.2 SMED and Poka-Yoke

Shingo has developed two practices which have received great attention: One is how to accomplish drastic cuts in equipment setup times by 'single minute exchange of die' (SMED) procedures. The other, is the use of the 'poka-yoke' system to achieve zero defects.

"To maintain market share in this competitive age, you must expand your market offerings by increasing your line of products, while also offering small-volume deliveries that fit the increasingly stringent demands of the consumers. Rather than trying to avoid more frequent changeovers, many companies have opted to improve their quick changeover technology to the point that it is economically viable to have frequent changeovers" (Kobayashi, 1990, p. 59). Saving in setup times is used to reduce batch sizes, which makes the use of Just-in-Time production feasible.

SMED is the name given to the process of reducing to single digit setup times (i.e., less than 10 minutes). Shingo (1987) separates setup time into two segments:

- Internal - that part that must be performed while the machine is stopped, and
- External - that part that can be done while the machine is operating.

Simple tasks, like the preparation of replacement moulds, fall into the external category, which can represent half of the usual setup time. Another 50% can be saved by the application of time and motion studies and the use of low cost items, such as quick couplings, amongst others.

Michaeli et al. (1996), find that setup downtime due to poor procedures and a lack of expertise is more significant than that due to technological factors. They suggest a thorough analysis of the setup procedures and training for employees.

Poka-yoke attempts to ensure that faults do not occur through a process of systematic elimination, often with the use of purpose built devices (Shingo, 1986). It does not ask "How can I eliminate this fault?", but rather "What must I do to ensure that this fault does not occur in future?" As such, it supports the move towards zero defects espoused by the Total Quality Management methodology. The use of poka-yoke is recommended when the following conditions occur:

- The fault can occur abruptly, i.e., it is not constantly present.
- The fault is attributable to human error.
- The fault can be prevented by a cost effective 100% test

Poka-yoke includes such things as check lists or special tooling that:

1. prevents the worker from making an error that leads to a defect before starting a process or,
2. gives rapid feedback of abnormalities in the process to the worker in time to correct it.

There are a wide variety of poka-yoke techniques, ranging from checklists or kitting parts from a bin (to ensure that the right number is used in assembly), to sophisticated detection and electronic signalling devices. Due to its complexity, injection moulding is an ideal application for poka-yoke. Bourdon (1996) shows examples of poka-yoke devices used specifically in injection moulding. See the figures he provides below.

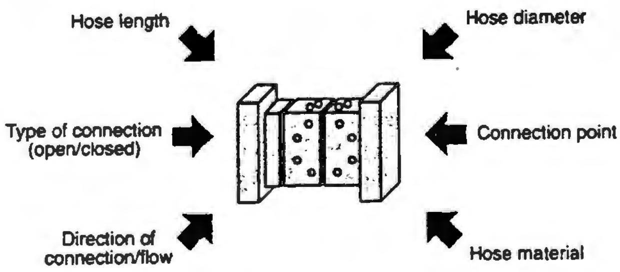


Figure 12: Potential Areas for Mould Connection Poka-Yoke

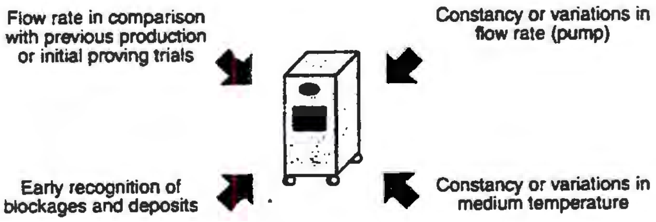


Figure 13: Potential Areas for Temperature Controller Poka-Yoke

6.3 The Theory of Constraints

The Theory of Constraints, developed by Goldratt (1990), likens each production system (company) to a chain, or a network of chains. In any chain there is one weakest link which limits the performance of the entire chain. This weakest link is the system's constraint. Improving the performance (throughput) of the chain requires strengthening that weakest link. Improving any other link will cost money (increase operating expense) but will not contribute to the increased strength of the entire chain, as long as the weakest link is ignored. However, as soon as that weakest link is strengthened to the degree that it is no longer the weakest link, (i.e., the constraint is broken), the next weakest link becomes the brake or constraint which limits overall system performance.

The primary benefit of the Theory of Constraints approach is its orientation toward the output of the entire system, rather than a compartmentalised look at components. Many components may have little or no positive effect on overall performance, because of the system constraint that overshadows all other deficiencies in the system. With this kind of system level focus, the system's constraint can be precisely located, whether it resides within the company or outside of it (e.g., the market place). If the constraint is internal, it can be readily ascertained whether the constraint is physical (e.g., a machine, person, or facility) or a policy that inadvertently discourages improved throughput. Efforts to break the constraint can then be applied without delay or distraction.

Goldratt (1990) offers some powerful tools for dealing with system constraints. Foremost among them is a five-step process which ensures that improvement efforts remain on track toward system level improvement, rather than digressing into non-productive sub-optimisation of system components. The following five steps provide reliable markers en route to effective improvement:

1. Identify the system's constraints. Determine what limits the system's performance.
2. Decide how to exploit the system's constraint. Eliminate inefficiency from the constraint.
3. Subordinate everything else to the above decision (step 2). Make effective management of the existing constraint the top priority.
4. Elevate the system's constraint. Break the constraint by increasing its capacity above the level of demand.
5. If, in the previous steps, a constraint has been broken, go back to step 1, but do not allow inertia to cause a new constraint. Go back and find the next weakest link which limits system performance.

In this context, Goldratt defines a constraint as anything that limits a system from achieving higher performance versus its goal (Goldratt, 1992). These steps also form a Continuous Improvement cycle, as shown in the diagram below.

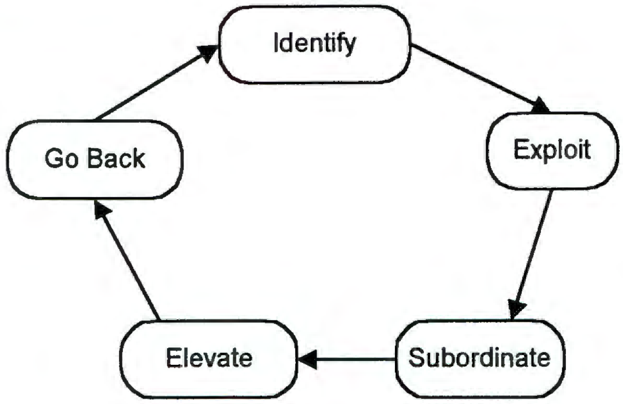


Figure 14: Theory of Constraints Improvement Cycle

This general theory of constraints directs companies to find what is stopping them from moving toward their goals and finding ways to get around this limitation. If, in a manufacturing environment, the limitation is insufficient capacity, then ways to break the constraint might be redesigning product or process, specialised tools, supporting equipment, exceptionally skilled workers, subcontracting, alternate routings, overtime and so on.

With the ongoing improvement process defined, Goldratt (1994) has introduced a rigorous five-stage logical thinking process, which focuses on what to change, what to change to, and how to effect the change with a minimum of errors and false starts. These processes are the current reality tree, the evaporating cloud, the future reality tree, the prerequisite tree, and the transition tree. In concert with the five focusing steps mentioned above, these logical thinking processes provide a contextual basis from which to apply more commonly known quality tools, such as statistical process control, design of experiments, quality function deployment, and other structured problem solving methods (Dettmer, 1995).

When properly implemented, throughput improvements can often have the quickest benefit for a company, by speeding up the flow of product through the system. This, however, requires a significant paradigm shift from the traditional cost accounting view of production, which emphasises the cost cutting approach to improving the productivity equation (Goldratt, 1992). Goldratt's approach to production scheduling is described in Appendix I.

6.4 Implementing Teamwork through Work Structuring

A well proven method of improving productivity and interpersonal co-operation is by implementing teamwork (Lippitt, 1980 and Devanna, 1994). This empowers employees through participative decision-making and releases the power of multiple perspectives and group synergy. It also creates a sense of ownership of the process and the team's results.

Work Structuring is primarily concerned with the design of viable working organisational structures. It uses a holistic approach to match all the various factors involved to enable people and technology to combine to produce work outputs most effectively (Shumacher, 1993).

Work Structuring analyses tasks according to the operations performed on the raw material (this can also be paperwork or a service) and identifies operations that should be performed by the same group of people in the same location. The techniques used are Transformation Analysis and TIED Analysis. This creates 'whole tasks' that a Work Group takes responsibility for and also plans their own work and evaluates their own performance. This is facilitated by a leader who is accountable to the organisation and participative teamworking structures.

This approach enables individual and group job satisfaction and direct participation in the organisation's common tasks. This also creates individual empowerment and therefore ownership and responsibility for something that they can control.

Other benefits include that it provides a coherent philosophy and methodology for organisational design based on the work performed. Transformation Analysis provides a powerful tool for making operational process more task orientated. Teamwork and interpersonal communication should be greatly improved if its principles and techniques are implemented. The principles of Work Structuring are described in Appendix J.

6.5 Training and Competence

"Only by drawing on the combined brain power of all its employees can a firm face up to the turbulence and constraints of today's environment."

"This is why our large companies give their employees three to four times more training than yours. This is why they foster within the firm such intensive exchange and communication. This is why they seek constantly everybody's suggestions and why they demand from the educational system increasing numbers of graduates as well as bright and well-educated generalists, because these people are the lifeblood of industry." Konosuke Matsushita

Intensive management and shop floor training are crucial to the development of World Class Manufacturing competencies. This should ideally include courses on 'learning how to learn' and the seven basic Continuous Improvement Tools, as well as all the necessary technical skills. Training and development in teamwork, interpersonal communication and surfacing mental models is also considered crucial to accelerate organisational learning (Senge et al., 1994). As noted in

Section 4.2, Continuous Improvement implies continuous training. If continuous learning and knowledge transfer are central to success, it is the manager's responsibility to create and nurture an environment that allows them to happen. Practices that help create this environment include establishing minimum thresholds for educational levels in work teams and encouraging employee participation in training programmes.

"Today, most companies recognise that World Class Manufacturing companies' most valuable asset is educated workers and, as such, must be a part of the continuous process of operational improvement." (Czajkiewicz and Wielicki, 1994, p. 91)

Implementing innovative change proposals and empowering the workforce assume that the people involved have the necessary competence to manage themselves and their new tasks. If this is not the case, then implementation of changes is bound to be ineffective (Flood, 1995). This lesson was learnt a long time ago in Total Quality Management, especially by the Japanese. Successful implementation of World Class Manufacturing methodologies is normally supported by well thought out training programmes. This enables those involved to effectively participate in improvement initiatives. For example, Ishikawa (1976) insists that, company-wide, people are trained to use the seven basic Continuous Improvement Tools, described in Section 4.5.

The mistake made too often, especially when finances are tight, is to cut training programmes. The intention is to protect short-term profit margins, but the medium-term consequence is most likely to be a reversal of financial viability as the lack of competence in people takes its toll (Flood, 1995). Training therefore must be seen as an investment into the long-term effectiveness of the company.

Joffe et al. (1995) also see constant skill acquisition as part of what they term an 'Intelligent Production Strategy'. They see a need to link training and human resource management to company strategies to increase or maintain competitiveness in South Africa.

All manufacturing activities create 3 to 5 times as many secondary jobs as service activities do, and a World Class Manufacturing sector creates the most jobs of all (Moser, 1994). World class production depends on world class people, so the plastics conversion industry must attract and train the best and brightest managers and workers and keep all employees' skills current.

Industry's most important resource is people, without whom change, innovation, and implementation of improvements cannot be achieved. Manufacturers must be able to adjust rapidly to changing conditions while maintaining ongoing operations. This will require the creation of an environment in which learning and knowledge sharing are continuous processes, and in which managers are as good at managing human resources as they are at managing technological resources. A new breed of leaders needs to create this change in environment (Devanna, 1994).

6.6 Value Analysis

The purpose of Value Analysis (VA) is to simplify products and processes. Its objective is to achieve equivalent or better performance at a lower cost while maintaining all functional requirements defined by the customer. Value Analysis does this by identifying and eliminating unnecessary costs. Technically, Value Analysis deals with products already in production and is used to analyze product specifications and requirements as shown in production documents and purchase requests. Performed before the production stage, Value Analysis is often called Value Engineering, and is considered a cost avoidance method. In practice, there is a looping back and forth between the two for a given product. This occurs due to the fact that new materials, processes, and so forth, require the application of Value Analysis techniques to products that have previously undergone Value Engineering.

The Value Analysis approach involves brainstorming such questions as:

- Does the item have any design features that are not necessary?
- Can two or more parts be used as one?
- How can we cut down the weight?
- Are there non-standard parts that can be eliminated?

Answers to these questions are converted into ideas to be developed and then proposals for implementation. Giffi et al. (1990) note some very impressive savings from Value Analysis. They also point out that the Japanese think so highly of Value Analysis that they give the annual Miles Award to companies that have demonstrated the greatest benefit from its use.

6.7 Summary

The above sections describe some of the available practical techniques that a company can use to improve its performance. Case examples of some of these techniques from the plastics conversion industry are described in the following chapter.

7. EXAMPLES FROM THE PLASTICS CONVERSION INDUSTRY

The following sections describe examples of successful World Class Manufacturing implementations by companies in the plastics conversion industry. These examples show that Continuous Improvement and World Class Manufacturing can be of great benefit to the plastics conversion industry.

7.1 Change to Total Quality

The following example describes the results of implementing a Total Quality approach based on Deming's principles:

"After doing some research on W. Edwards Deming, Kirk Hyde, chief executive officer of a Los Angeles credit card manufacturer Kirk Plastic Co., and other company managers decided to relinquish their hold on periodic status reports and numbers and started to concentrate on the processes involved in manufacturing credit cards. The company threw out all its quotas, ignored a management-by-objective approach, and focused on producing quality. As Kirk Plastic began to implement the Deming philosophy, it discovered that quality improvements could be made by using statistical process control. All the process improvements combined to lower the company's scrap rate from 30% to 11%, boost sales by 15%, improve profits by 100% despite a 5% price decrease and direct the company's efforts toward improving its turnaround time." (Litsikas, 1995, p. 134)

Kirk Plastic Co. demonstrates a clear case of double loop learning where the way the management thought and acted was fundamentally changed. Without this shift in their management paradigm, the changes could not have been made.

7.2 Theory of Constraints Implementation

The following example shows how the Theory of Constraints thinking processes were systematically used to make significant improvements in a U.S. plastic products manufacturer with initial sales of $18 million (Goldratt Institute, 1993, p. 3). The company wished to expand its sales and market share without significant investment.

"Stage 1	Problem:	The capacity and scheduling system was a 'push' system.
	Action:	Installed a drum, buffer, rope scheduling system.
	Result:	Improved on-time delivery. Increased net profit.

Stage 2 Problem: Had too many temporary workers and had to retrain constantly.
Action: Hire permanent employees.
Result: Significant improvements in morale.
On-time delivery improved.
Reduced training costs.
Quality improved.
Operating expense was reduced.

Stage 3 Problem: Needed more sales to fill capacity revealed by Stages 1 and 2.
Action: Traded unneeded equipment to sister company.
Obtained orders that were being out-sourced from sister plant
Result: Increased throughput of plant.
Increased profitability for the entire company.
Operating expense was reduced.

Overall Results

1. Increased Sales by $5 million or 28%
2. Increased Net Profit to 112% over plan.
3. Increased inventory turns from 7 to 20.
4. Saved $1 million by not having to buy additional equipment
5. Avoided having to hire direct labour at a cost of $600 000.
6. Decreased overtime by $100 000.
7. There are now 300 secure jobs."

7.3 Cutting Setup Times Using SMED

Shingo (1987) gives a list of impressive improvements made in reducing setup times. These were achieved by new setup procedures, extensive mould preparations (including preheating) and boltless die mounting methods. The following table is taken from his book (p. 327):

Company Name	Before Improvement	After Improvement	Reduction
N	45 min.	1 min.	98%
B	60 min.	3 min.	95%
E	60 min.	5 min.	92%
T	90 min.	5 min.	94%

Note: (1) Times are given for machine stoppage (internal time).
(2) Colour changes are exclude from both before and after times.

Eylert (1995) shows that significant time and cost savings were achieved when "a defined mould change strategy" and "a standard procedure was developed for starting up moulds." Also, the number of machines required to expand the output capacity of the plastics moulding plant in his study was reduced from 61 to 49.

7.4 Just-in-Time Implementation

"Textron Automotive Interiors was forced to look inward for solutions when it needed to expand in 1993 because it had nowhere left to grow. The plan was to liberate 11,000 sq. ft. of warehouse space. As a Just-in-Time supplier to the automotive industry, Textron was accustomed to keeping minimal inventory. By early 1994, the company had almost doubled its inventory turns to 70 per year from 36. At 70 turns per year, no inventory, either raw material or finished parts, remains in the plant for more than 5 days. The faster turnaround reduced warehousing requirements and freed space for 3 new Husky injection molding machines." (Turriff, 1995, p. 15)

7.5 Benefits of Training

"In March 1993, Westplex enrolled in a productivity challenge co-sponsored by Paulson Training Programs and Plastics World magazine. Results in the first 4 months after 50 key employees participated in an interactive training program provided by Paulson included:

1. Cycle time savings for 8 jobs that could be compared showed a saving of 16%.
2. Internal reject rates decreased 48% during this period for a saving of about $15,000/month.
3. There was a significant reduction in credits issued to customers." (Smock, 1994, p.30)

7.6 Summary

This is only a small sample of the extensive literature that shows how implementation of World Class Manufacturing practices can lead to great improvements in performance in the plastics conversion industry. Smith (1995) shows how a South African company, has made great progress using the Total Quality Management methodology with Shewhart's PDCA learning cycle. Ebrahimapour and Schonberger (1984) describe the great potential advantage that can be achieved by implementing methodologies such as Total Quality Control and Just-in-Time in developing countries like South Africa.

8. PREPARATION OF THE QUESTIONNAIRE

The survey of South African plastics conversion companies described in this and the following chapter aimed to investigate whether Continuous Improvement and World Class Manufacturing are practiced by these companies. The World Class Manufacturing evaluation questionnaire is shown in Appendix K. This self evaluation questionnaire focuses on evidence of fundamental improvements in the way the organisation performs its day-to-day business. Changes to processes, quality, products, and the role of leadership are the characteristics that are assessed by this questionnaire. The questionnaire was designed to be simple to understand and answer according to the instructions and guidelines given in Fowler (1984) and Easterby-Smith et al. (1991). The number of questions was limited to forty to make the questionnaire quicker to answer. The questions asked are a synthesis of the 'new' Baldridge Award criteria (Brown, 1994) and the writings of Giffi et al. (1990), Hayes et al. (1988) and Shingo (1987).

The questionnaire evaluates two dimensions of an organisation. Part of the evaluation is based on the performance improvement trends achieved in:

- Financial results
- Customer satisfaction
- Product quality
- Supplier performance
- Productivity
- Human resources

The other part of the evaluation is based on how the organisation is managed. How it is led, planned, measured, trained and improved. Major parts of the business are assessed and the questionnaire looks for approaches that are systematic and continuously evaluated and improved. World Class Manufacturing appears to many to be simply the collective name given to Japanese manufacturing methods. Nevertheless, many fail to realise that these changes require a prior transformation to a different attitude and company 'culture'. Hence the emphasis on 'people' issues in the questionnaire.

The criteria are grouped into seven categories: categories 1 to 5 are about the approach in running the company, category 6 is business results and category 7 is the customer satisfaction results of the company. The seven categories and their point values are as follows:

1. Leadership (50 points)
2. Information management (30 points)
3. Strategic planning (30 points)
4. Human resource development (50 points)
5. Management and improvement of the process (140 points)
6. Quality and operational results (120 points)
7. Customer focus and satisfaction (80 points).

The questionnaire uses a Likert type rating scale and the scoring per question is also shown in Appendix K. The range of scores per question is from 0 to 10 and these are split as shown below.

Yes (completely)	10	Mostly	7	Somewhat	5	Slightly	3	No (not at all)	0

The last two categories were weighted at double the previous ones as these reflect actual measured improvements over a number of years. The overall score required for a company to be considered a probable World Class Manufacturer was set at 75% of the total, as in Brown (1994).

The survey was designed to give a reasonable estimate considering the resource and time constraints involved. One of the prime objectives was to achieve a high response rate and thus avoid bias due to non-response, which can be significant (Fowler, 1984). The target population was plastics conversion companies from all over South Africa with 100 or more employees. The population size is approximately 1000 (according to the Plastics Federation). The proportion of companies predicted to have implemented World Class Manufacturing principles was presumed to be 5% and the standard error deemed acceptable was 5%. When calculated, according to Moser and Kalton (1972), this gave a minimum sample size of 19. A sample size of fifty companies in the plastics conversion industry was therefore chosen for safety. The companies were chosen at random from the Plastics Federation database. The sample was distributed throughout South Africa and no significant geographic bias was expected.

9. EVALUATION OF THE SURVEY RESULTS

The overall score results for individual companies is shown in Figure 15. The categorisation of the companies' overall scores are shown in Figure 16 (the categories are described in Appendix K). The detailed results are shown in Appendix L.

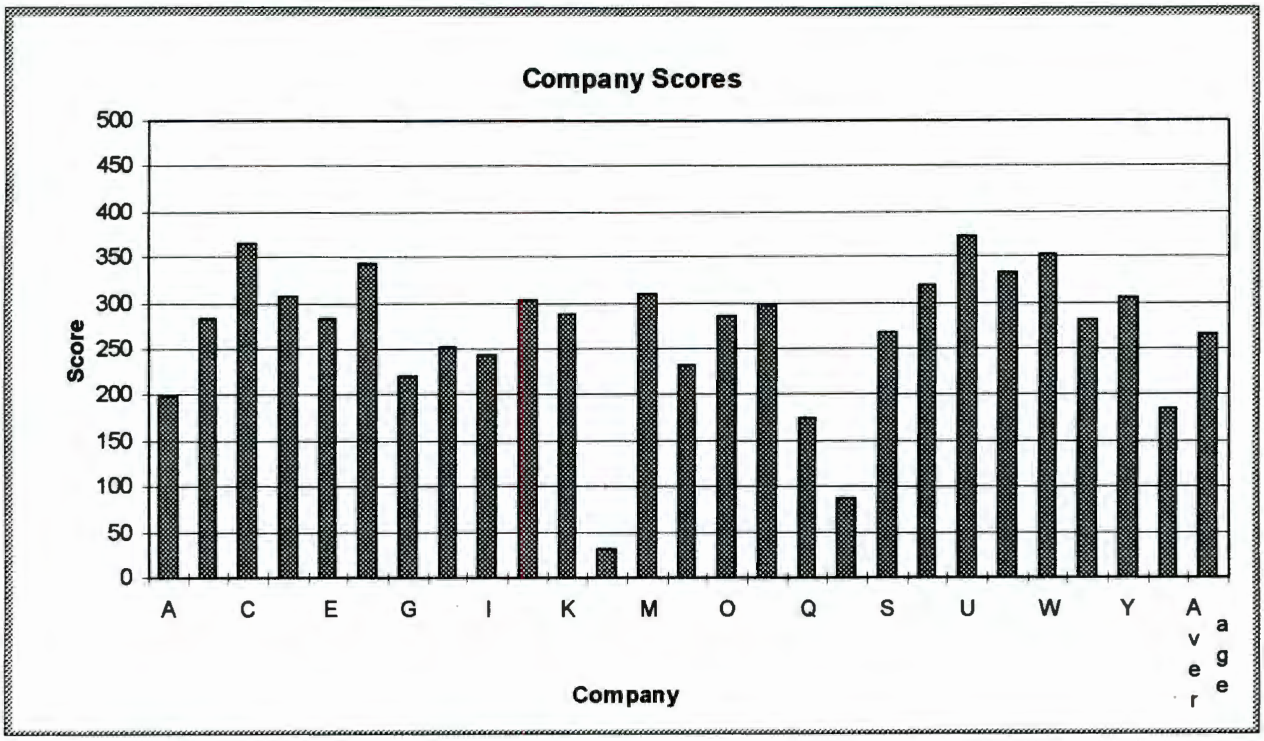


Figure 15: Overall Scores of the Companies

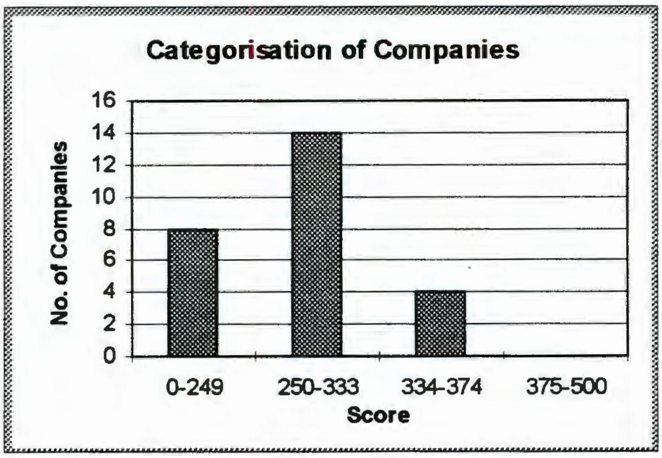


Figure 16: Categorisation of Companies' Overall Scores

9.1 Response Rate

The survey was conducted during the month of July 1996. Personal contact was made with all of the target companies both before and after the questionnaire was dispatched. This was done to improve the response rate. The response rate was 64% which is considered high for a survey of this type (Fowler, 1984). This was achieved by telephonic reminders and, where possible, meeting the respondents during visits to their plants. Two of the non-respondents informed me that they were in the process of declaring bankruptcy and two others refused to answer the questions due to reasons of 'confidentiality'. Six of the respondents were not included as their questionnaires were not fully completed, making their results invalid.

9.2 Evaluation of the Score Results

The results are higher than expected. The only bias that is apparent is a type of 'halo effect'. This occurs when the respondent classifies the matter in question according to their general impression, rather than according to the scale's meaning (Moser and Kalton, 1972). This is likely due to the large majority of the respondents being senior managers in their respective companies. Senior managers tend to view the results as a reflection of their personal ability and thus rate the answers higher. This bias is also described in Fowler (1984); where senior managers tend to rate their companies' performances higher than middle managers or other employees. There is evidence of this in survey's results as well. The companies with the lowest ratings were evaluated by shopfloor managers, while the companies with the highest ratings were evaluated by company directors.

Also of note, is that although the questions were written in a manner to remove ambiguity, each respondent can interpret the question in their own way relative to their situation, introducing some subjectivity (Moser and Kalton, 1972). The evidence for this is from my personal investigations during plant visits of respondents' companies. These were opportunities to see first hand the operations of a number of plants and informally interview the managers of these companies. The most conspicuous case is that of a company with a history of exporting excellence and growth (a global competitor), which was scored far lower than companies which could not have achieved such results due to the manner in which they are currently managed. This caused me to doubt the reliability of the data collected by the survey. Many of the respondents' comments (described in the next section) indicated that the managers were still grappling with basic management issues, yet many still marked the company quite highly on most of the questions. I have therefore not attempted to draw statistical inferences from the obviously deficient data.

I suggest that, in reality, most companies perform far worse than their scores indicate. Most companies then do not measure up to their world class counterparts. The high scores could be attributed to South African managers lack of exposure to global competition and to World Class Manufacturing practice. The only way of removing such a subjective interpretation is to have an external independent team of evaluators that visit each plant. Such evaluators look at the companies' practices and results with a less sympathetic eye than a manager who may see the result as a reflection of his own ability. This is the practice of the Baldridge Quality Award and other large organisations performing detailed evaluations, this was however out of the budget and scope of this thesis.

It is of interest to note the results of Question Number 28 which asks for the average setup time in minutes. This is a measure that leaves little room for interpretation. The world class standard time is less than 10 minutes, and numerous examples are described by Shingo (1987). A World Class Manufacturer would choose to reduce setup times to reduce down time and make smaller batch sizes feasible. Setup time reduction is crucial to enable Just-in-Time as explained in Section 6.2. I have chosen to plot this on the graph below. This clearly shows where the sampled South African plastics converters stand with relation to world class setup times. This further strengthened my impression that the company scores were not representative.

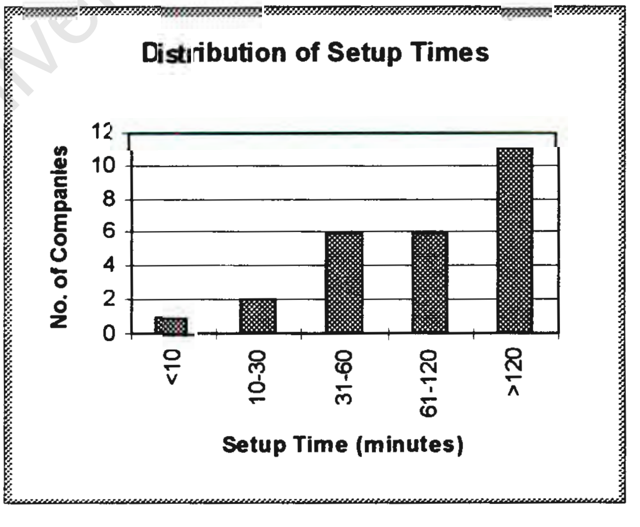


Figure 17: Distribution of the Setup Times

9.3 Evaluation of the Respondents' Comments

The comments written on the questionnaire by the respondents provide much insight into what they see as major areas of concern and how they were attempting to deal with these concerns. It appears from reading these comments that some companies are readily working on solving their problems, while others are still groping in the dark. Some companies do appear to be working towards a Continuous Improvement/World Class Manufacturing type work culture. However, in conversation with some respondents, they expressed difficulty in translating their World Class Manufacturing principles into practice. This is not uncommon; Motwani et al. (1994) also found this in their survey of North American manufacturers.

Most of the problems related to 'people' type issues. Many respondents identified productivity and trust as major problems needing attention. Many respondents commented on the lack of skills and the need for more shopfloor and managerial skills training. Some had gone so far as to implement basic literacy courses for their employees. One frequent 'solution' given to the people problem was simply to automate and replace the people with machines. International experience suggests that considerable investment in automation has failed to produce the expected productivity gains (Joffe et al., 1995). Automation has frequently failed to live up to expectations due to difficulties in implementation and the complexity associated with the design and management of automated systems (Chase and Aquilano, 1995). Relative to automation, Continuous Improvement is a low-cost strategy. Moreover, the investment made in training people in its methods pays back in improvement savings year after year.

A few companies still seem to be under the impression that the government must still protect them from foreign competition with lower interest rates and anti-import legislation. This is a clear indication of the old 'laager' mindset still in operation in some companies. This will not cause manufacturing performance improvement, but rather more of the same poor productivity performance. A comprehensive listing of comments from respondents is shown in Appendix M.

9.4 Summary

The scores for most companies, when assessed by an independent party, would probably be significantly lower, as described in Brown (1994). Taking my own observations and the subjectivity of a self evaluated questionnaire into account, the survey shows that most South Africa plastics converters have not achieved World Class Manufacturing performance. How each company achieves high performance levels, will be different, based on their existing situation.

I suggest that South African manufacturers implement the transformation process to World Class Manufacturing using learning cycles and the Continuous Improvement approach. A model for the transformation process is shown in the next chapter, followed by an example of implementation. Guidelines to assist companies in such a transformation process are given in Chapter 13.

10. A MODEL FOR THE TRANSFORMATION PROCESS

"Practice without theory is blind, theory without practice is sterile."

Immanuel Kant

Figure 18, below, shows a picture of a proposed model for the transformation from existing operating practices to World Class Manufacturing practices based on Learning, Continuous Improvement and the World Class Manufacturing methodologies.

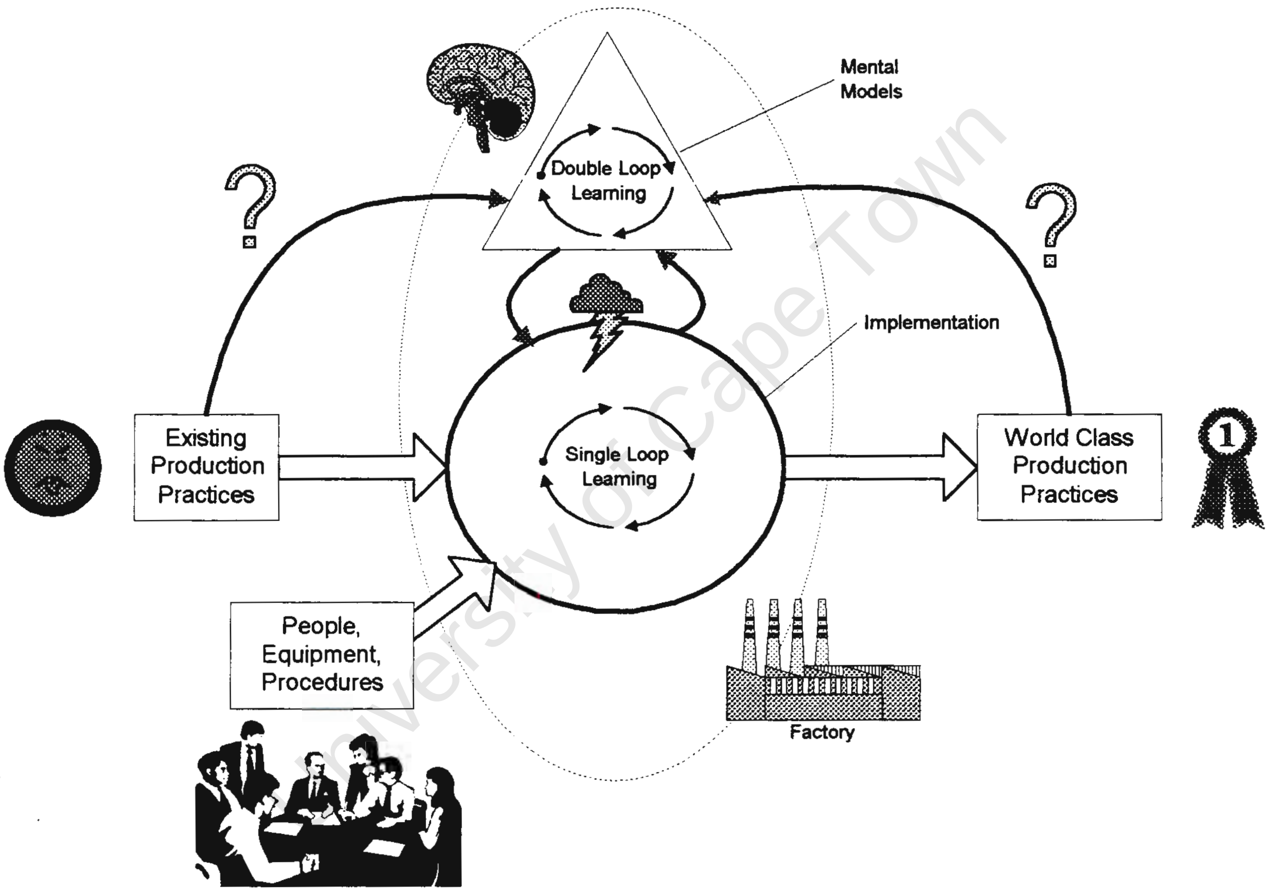


Figure 18: The Transformation Process Model

The purpose of this model is to represent the transformation from existing production practices (input) to world class production practices (output). The resources used by the transformation include people, equipment, procedures. The model for the transformation process shown above has two essential parts. The upper part represents the mental model of those involved in the transformation and the lower part represents the actual facility where changes are implemented. Note that the mental model is shared by those involved in the transformation process (the team), this provides for multiple perspectives on the problems and for a greater variety of interventions to deal with the problems.

The upper and lower parts need to be in a state of constant feedback, the mental model level providing knowledge and understanding for changes that need to be tested in reality, and the implementation level providing data on the progress and results of implementation. Their interaction is crucial as it provides for the synthesis of theory and practice. This interface allows the practice level to learn from the theory and also for the theory level to learn from the practice.

The mental model also seeks information from the existing state of affairs in the operation of the plant (internal), and also from the current state of the art and future trends in World Class Manufacturing (external). Internal information can be obtained by doing a thorough analysis reviewing the processes and the current performance of the plant. This includes investigating customer and employee satisfaction levels. External information can be obtained from literature, conferences and industry benchmarking. Foreign industry journals often contain articles on improvement.

Continuous learning and improvement are essential to drive this process, with single loop learning operating on the implementation level and double loop learning operating on the mental model level as explained in Section 3.7. This learning enhances effectiveness and results in an even stronger commitment to change (Beer et al., 1993). The mutually reinforcing cycles of improvement also create a growing sense of efficacy. Any learning cycle can be used, as long as it continues to revolve and increase knowledge. The use of continuous learning and improvement implies that the transformation is a never-ending process and not a programmatic change.

The changes in management practice, mentioned in the Chapter 4, are also of great significance in transforming from a Standards Maintaining System to a Continuous Improvement System. Such changes entail greater employee participation in the improvement process. The teamwork style approach typically improves bottom-up communication and creates a shared understanding of the issues involved. When properly managed, teamwork can create a sense of empowerment, great synergy and motivational drive.

The case study in the following chapter, shows how this model can be used to describe a transformation process in a South African plastics converter.

11. IMPLEMENTATION OF THE MODEL: XYZ PLASTICS

This chapter shows how the Transformation Model, described in the previous chapter, was used to assist a South African plastics converter to effectively improve its processes. This chapter reflects personal experiences in an improvement process.

11.1 Background and Situation

XYZ Plastics was formed in 1986 to produce plastic engineering components. The company has since grown rapidly and now employs 200 people. It now exports engineering components worldwide and makes a wide range of other plastic injection-moulded articles.

The Production Department changes approximately 75 moulds per month. Mould changes and setups were mostly limited to the day shift due the low skill levels. Setups are a major time consuming task. On some days, 6 or 7 moulds need to be changed, making the situation more acute and putting considerable pressure on the persons responsible for the setups. Most mould setups took more than two hours. Such long setup times caused mould changes to be the greatest source of downtime. They also caused large lot sizes (and their consequent long production runs) to be desirable according to the Economic Order Quantity formula.

11.2 Concerns and Questions

The long production runs caused high Work-in-Progress inventory levels in the departments following the Production Department in the value-adding chain. Small quantity orders were uneconomical to run as the labour-time cost for the setup is prohibitive. Also, certain moulds can only be run on specific machines and therefore some orders are delayed by a preceding long run on the same machine. On many products, customers wanted small runs at irregular intervals. Satisfying some customer demands was therefore uneconomical for the company.

The company had grown at a faster pace than it has been able to develop its management systems. This led to poor internal co-ordination and cross-functional planning as the organisation grew larger. Communication was poor and many issues fell between the functional responsibilities and were therefore not properly addressed by those concerned. The questions to be addressed were:

- How can the Production Department reduce setup times in order to reduce downtime meet the market demands placed on it?
- How can this be successfully implemented?

11.3 Development and Answers

11.3.1 Group Answer Development

To achieve group participation in arriving at an acceptable solution to the long setup times, an ad-hoc task group of stakeholders that would be key to implementing the required changes was assembled. This involved inviting the persons responsible for planning, mould changes, mould maintenance, materials preparation, quality control and the department manager to sit down together. Initially, this was to assess the causes and effects of the long setup times and later to suggest solutions to these causes.

The setters actually performing the mould changes were consulted for their opinions as to the causes of the long setup times, and for their suggestions on improvements in the situation. They are the employees performing the setup procedure and thus they needed be involved in the formulation of improvements from the beginning, for successful implementation.

Key to doing this successfully was to encourage an open, co-operative forum where the participants felt free to speak their minds. The 5W2H Method described in Section 4.4 was also used to generate new ideas. Alignment of goals and consensus on how to implement interventions to achieve the goals were reached fairly quickly. Each person then understood their role in achieving overall success for the programme.

The group's overall objective was to use new methods to transform existing poor performing practices into faster, more flexible practices. The initial agreed upon target was to reduce the setup time to a maximum of 30 minutes for the smaller moulds and 1 hour for the larger moulds. The desired transformation explicit in the objective is shown below.

Figure 19: The Desired Transformation

equipment. The Mould Store technician was placed in charge of performing the preparation procedure. He prepared a mould list, with all the moulds, their pipes, ejector bars and all auxiliary equipment they require. This list took a month to complete, as moulds that are running were removed so that all the necessary standard parts could be recorded. If necessary, the correct parts were purchased and the use of inadequate fittings and equipment was stopped.

All the fittings and equipment were then stored in the mould store. When a mould was to be changed, the fittings and equipment must be checked against the list for that mould and issued to the setter. When the mould comes back to the mould store, it was checked to see that all the fittings and equipment were returned with it.

11.3.4 Implementation of the Mould Change and Setup Procedure

Detailed procedures and a flowchart were produced and a new way of working was developed with all setters. The under-skilled setters were trained by the company's one 'expert' in setups to try develop the basic skills in mould changes and machine setting. The new procedure was practised by the setters and mould changes were timed. The Mould Change and Setup Procedure Flowchart is shown in Appendix D.

11.3.5 Mould Clamping

Each mould's clamping plate was modified so that the clamping gap was standard on all moulds, speeding up the fitting process. Each machine was fitted with a standard set of quick release clamps set to that gap. This was to save the setup time usually wasted searching for suitable clamps and adjusting the clamps. This was shown to be effective in Shingo (1987).

11.3.6 Improve Co-ordination

Improved co-ordination between the Production Planner, the Materials Manager, the Mould Storeman and the person changing the mould was also found to be necessary. This was done by improving the flow of information from the Production Planner to the other personnel and the feedback information back to the planner. A new Route Sheet was designed to contain the relevant information that the other personnel require. The Route Sheets were then produced as soon as the Production Planner received an order. This gave the other personnel time to prepare for the new production run. In this way, they were better able to plan their work and less reactive to the earlier unanticipated mould changes. The Work and Information Flowchart is shown in Appendix D and a sample Route Sheet document is shown in Appendix N.

11.4 Reality Test

Three months after beginning the improvement process, a number of pilot test runs of the mould change procedures were performed with some of the smaller moulds. The results were very encouraging. After a few tries, it took less than 30 minutes from the time the machine was stopped until the time the machine was running a different quality approved product. After a few repetitions and some learning, the results became progressively better. The next goal is to achieve mould changes of less than half an hour for all the moulds and then progressively reduce to single digit times. This still requires some time and work, yet the principles and methods have been firmly put in place for this to continue.

11.5 Reflection

Improving setup times reduces downtime and can make the work-in-progress inventory levels lower throughout the company by reducing the batch sizes. Improving setup times also makes the company more flexible to meet customer demands for variations in product and small batch quantities (Goldratt and Fox, 1986). This in turn, becomes progressively more economical as the setup times continue to improve.

This implementation required a number of interventions to achieve the desired transformation. People who had a key role in implementing improvements needed to be brought together in an open forum where they were able to speak freely. Shared understanding and co-operation were critical for success and these were fortunately achieved from the beginning. Considerable enthusiasm was thus generated towards the success of the improvement process and participants spent many spare moments working towards this.

Much of the success depended on the setters actually working to the procedures and thus they needed be involved in their formulation. This was achieved by asking each one what problems delayed the setups and what suggestions they could provide for improvement. These were then introduced in the group meetings. Each problem encountered was seen and understood as a new opportunity for improvement and learning.

The additional benefits that resulted from the mould setup improvement process were as follows:

- Training needs for the under-skilled setters were identified.
- Practical in-house training according to the needs.
- Equipment stored in one place will make preparation and control easier.

- Fittings, bolts and hoses that are damaged will be repaired or replaced.
- Less down time will occur due to worn pipes bursting.
- More available productive capacity.
- New flexibility is the first step on the road to implementation of a Just-in-Time production system.

11.6 Learning

The learning involved in this process was shared by all involved, and as such, it represented organisational learning. The single loop learning process was the explicit PDCA cycle used by the task group. Each step taken was planned, implemented, tested and then made part of the new standard procedure. Each time a problem was encountered, a preventative countermeasure was planned.

Handy's learning cycle is also mirrored on the mental model level: A question is generated by the situation, a theoretical answer developed, this answer tested in practice and the results are evaluated (reflection). Handy's 'lubricants of learning and change' (see Section 3.5) were also used by the team. Both learning loops are represented in the model as well as the internal and external information needs.

The double loop learning generated by this transformation was that the management's mental model, which was initially: "Try to get larger orders and batch sizes for economy", is now: "We can handle more small orders economically." This is a profound change and also implies that constraints that seem fixed, like setup times, can be broken. Assumptions are constraints in themselves and should be challenged and changed. The success of this improvement process now makes further improvement initiatives more credible to those involved and to top management. New questions are now asked which can lead to proactive improvements. These are, for example: How can we better co-ordinate marketing with production? How can we improve throughput? How can we prevent quality problems? How can we recycle sprues (the part of the moulding not sold as a product) more efficiently? How can we reduce downtime?

11.7 Summary

This case study shows that the Transformation Process Model of Chapter 10 is useful to aid in the understanding of an improvement process. The case study also emphasised the need for teamworking and human skills and not only for the function-specific skills of the participants. It required new learning abilities for technical employees who had only been active in developing their technical skills and faced new responsibilities without the appropriate skills and understanding.

Team problem solving was highly effective, especially in the implementation phase. Great enthusiasm, ideas and discussion were generated by the 'shared purpose' atmosphere of the meetings. The stages in problem identification and solution also reasonably corresponded with the guidelines given by Beer et al. (1993), shown in Section 5.4. The team did not simply attempt to copy what others have achieved, but rather developed its own solution and worked through the implementation. This prevented a decline in enthusiasm by the participants and is recommended by Wilkins (1989) (see Section 5.2).

Most problems encountered in a production environment have probably been addressed successfully elsewhere before. The key is to know that these successes exist, to understand why they were successful and to learn from them how to improve one's own situation. For me, this is especially true of the work of Shigeo Shingo. However, one should not try to force these ideas onto others, as they may resist them, but rather to gently make people aware that they exist.

12. CONCLUSIONS

The essentials of Learning, Continuous Improvement and World Class Manufacturing have been described. The implicit continuity between Learning, Continuous Improvement and World Class Manufacturing has been shown. Problems relating to implementation of World Class Manufacturing have been described and a solution proposed. Some of the techniques and practices that support a move towards World Class Manufacturing have also been described, and contextual examples have been given.

The small sample of literature relating to the plastics conversion industry, shown in Chapter 7, shows that Continuous Improvement and World Class Manufacturing, when implemented properly, will greatly improve the performance of such a manufacturing business.

The evaluation of the survey, described in Chapter 9, shows that the majority of companies in the South African plastics conversion industry do not practice Continuous Improvement and World Class Manufacturing. This may also be a reason for the poor productivity performance of the industry described in Section 2.3. Many South African managers are ignorant of World Class Manufacturing practices; some have also not changed their mindset to deal with the new situation.

The case study of Chapter 11 shows how use of the transformation model, of Chapter 10, can aid understanding and effectiveness in achieving improvement. This is not a once-off improvement, but leads to organisational learning, which allows the company to continually adapt to changing environmental conditions and also to proactively improve its processes. The case study also shows that improvements can be made in South Africa. Such improvements will require involvement and commitment to change.

The following additional points came out of this research:

- South African plastics converters probably need a radical overhaul in their management philosophy and practice. This should be away from the traditional cost reduction mindset and towards a more holistic approach. This awareness amongst managers is key to starting the change process.
- Management must accept the fact that current methods of management are just not good enough and need to be updated to World Class Manufacturing practices in light of increased competition. Total commitment and dedication are required of management to succeed in improvement.

- Manufacturing improvement, like any organisational change, needs to be seen and understood as a continuous process and not as a once-off programme.

- Technology is lucrative, but not always the answer, more improvement can often be made by developing people and processes, but this often requires more time and managerial effort.

- Human factors play a large role in productivity, competitiveness and hence profitability. This needs to be recognised by top management. Training of managers and shopfloor employees should be given higher priority when making investment decisions.

- Training is needed both for managers and shopfloor employees in South African industry. This should provide technical skills as well as improvement and people orientated skills (i.e., the Continuous Improvement tools, effective team work, etc.).

- There is a need to link training and human resource development to company strategy to increase competitiveness. Training should be designed around the long-term needs of both the company and the individual.

- Participative management and employee empowerment can be beneficial but managers need to learn to lose 'control' gracefully. Managers should move away from being commanders and controllers towards becoming leaders and mentors to their subordinates.

- Everybody within an organisation can participate in problem solving and indeed this should be encouraged. This implies that management must support all acceptable suggestions and implement such suggestions truthfully and honestly.

- Management must provide the means and opportunity for improvement and problem solving. Support and guidance in the application of new techniques must be provided and subordinate employees must be under no misunderstanding that the whole exercise is to improve quality and competitiveness, not to retrench people.

The next question one needs to ask is: "What can companies do to transform themselves towards world class performance and international competitiveness?" In an attempt to answer this question, I have proposed recommendations as guidelines for implementation in Chapter 13.

13. RECOMMENDATIONS FOR IMPROVEMENTS

"A problem cannot be solved on the same level of consciousness that created it."
Albert Einstein

The Continuous Improvement and World Class Manufacturing practices have been shown to be effective in the plastics conversion industry (See Chapters 7 and 11), yet most companies in the South African plastic conversion have not implemented this. World Class Manufacturing methodologies can only be beneficial to an organisation if properly understood and implemented. South African manufacturers should implement a transformation process to World Class Manufacturing using learning cycles and the Continuous Improvement approach. Effective implementation will require a number of interventions to transform South African plastics converters from their current state into better managed and more competitive companies.

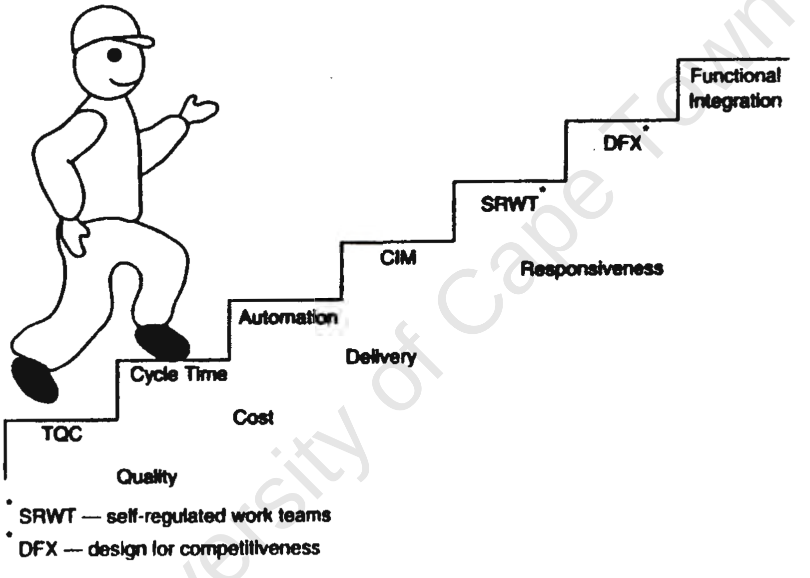
13.1 Guidelines to Companies

There are three main elements that management of a company should investigate when making a transition to World Class Manufacturing (Vasilach, 1994):

1. An understanding of what world-class benchmarks are and where one's company is in relation to those levels.
2. A comprehensive company assessment performed by a cross-functional internal team.
3. A means to determine where improvements can (and should) be made within one's company, depending on specific characteristics of the company.

I suggest that each company assess its current situation in terms of a number of factors to obtain a more holistic picture. These could be the dimensions described by Giffi et al. (1990) (See Section 5.1). They are as follows: customer requirements, management approach, performance measurement, manufacturing strategy, manufacturing capabilities, technology, human assets and organisation. The views of as many stakeholders as possible should be swept in to generate a fuller picture. Questions such as "What are our objectives?" should be answered before tackling questions such as "How can we achieve our objectives?" are attempted. When the company's desired objectives are defined, then the gap between desired and actual can be identified. This gap can be bridged using the Transformation Process Model of Chapter 10 and its associated learning cycles. The literature can then be consulted in search of World Class Manufacturing methodologies and techniques that address the company's needs. These methodologies and techniques should be carefully evaluated and adapted to the company; they should not be adopted indiscriminately. Note that the transformation to the desired objectives should be implemented using a holistic approach and may require a significant 'paradigm shift' in management thinking (See Section 7.1).

Measurable improvements should be seen within six months of beginning implementation and the savings made from the initial interventions can possibly fund the subsequent interventions (Shores, 1993). Continuous questioning, learning and improvement should become part of the company's culture for the improvement process to be sustainable in the long-term (Giffi et al., 1990). Appendix H also provides the operating principles for World Class Manufacturers that can provide ideas for the transformation's goals. The following diagram represents one company's path to World Class Manufacturing.



(Source: Shores, 1993)

Figure 20: A Path to World Class Manufacturing

Management should specifically focus efforts on the areas that will have the greatest impacts on business results, challenging assumptions and breaking constraints. According to Schlesinger (1994), a manager should concentrate on managing for long-term effectiveness. The Continuous Improvement management practices mentioned in Chapter 4 can provide stimulus for a paradigm shift and a change in management behaviour.

In addition, I suggest that any improvement process should be founded on the following principles:

1. Have management make a clear commitment to improvement.
2. Actively encourage suggestions for improvement opportunities.
3. Set objectives and goals participatively with affected stakeholders.

4. Create cross-functional work teams that can effectively break down the barriers between departments.
5. Organise teams to reach goals by identifying and solving problems.
6. Train with vigorous programmes on technical education and improvement techniques.
7. Report results of measured improvements to all.
8. Do it again to emphasise that the improvement process never ends.

13.2 Guidelines to the Plastics Industry Training Board

"Training is of paramount importance. One executive's company spends $120 million annually on employee training, including $2 million on literacy" (Maira, 1994, p. 22). World class companies invest heavily in training. Yet, the Plastics Industry Training Board reports disappointment at the unwillingness of South Africa plastics companies to participate in the training programmes offered. This is shown by the extent that they are experiencing difficulty in apportioning the grant money that they allot to training. This is probably due to South Africa's long history of management-worker mistrust and the view by management that workers are a factor of production rather than an asset to be developed (Joffe et al., 1995). To change this will require a substantial shift in management paradigm, that will, necessarily, have to originate from within management. The Plastics Industry Training Board can only attempt to alleviate this by demonstrating to companies successes due to training that have paid for themselves and have allowed companies to improve. Employee training should be measured by the Plastics Industry Training Board and companies rated on their employee skill levels. This type of industry benchmarking, has been successful in the United States (McCune, 1994). Correlation between company training and long-term profitability should be studied and widely published.

The key to efficiency is to understand manufacturing processes. Once processes are understood, problems that constrain throughput, lower quality, raise costs, and reduce profits can be eliminated. These benefits of training need to be driven home to companies until continuous training becomes part of their improvement strategy. This should emphasise that the benefits of training far outweigh the costs involved and that training is vital to their improvement and long-term well being.

Senge (1990) believes that everybody in an organisation should develop their own 'personal mastery' which is a process whereby one learns to generate and sustain 'creative tension' in one's life. Creative tension lies between vision (what one wants) and current reality (where one is relative to what one wants). Personal mastery can also be seen as the commitment of an individual to their own personal learning and to their own self-development. Senge (1990) states that people with high levels of personal mastery are more committed, they learn faster, they take more initiative and they have a greater sense of responsibility in their work. Hence, "many companies espouse a commitment to fostering personal growth among their employees because they believe it will make the organisation stronger." (Senge, 1990, p 143). Personal growth or 'mastery' can be assisted by self study programmes related to the type of work that the person performs and also to enable employees to become skilled in other related tasks.

Schemes that involve employees in the assessment of their own skills, and training needs, are essential to any attempt to further employee ownership of their own training and development. Maintaining World Class Manufacturing performance depends on employees being ready to learn and adapt quickly to changing roles and tasks. An effective developmental guidance service that accurately identifies personal needs, and empowers employees to take responsibility for their own self-development, is needed. This is the way many international companies and industries are attempting to achieve world class training (Flood, 1995).

The training strategy I recommend to the Plastics Industry Training Board, is one that allows employees to take charge of their own learning and development. This could focus on development of the Training Board's current 'Bootstrap' and 'Learner Directed Training' programmes into recognised qualification courses. These programmes aim to assist the employee study outside of formal training courses, however, they need to encourage employee pride by giving formal recognition for progress made. Qualified workers would then merit improved pay.

The lack of training taking place could also be due to smaller companies not having a person responsible for employee training. Consultants from the Training Board should be assigned to visit companies at regular intervals. These consultants could help companies identify training needs and develop training programmes tailored to particular company needs. Self study programmes could then be instituted where the consultant visits the company at regular intervals to assist the trainees and to ensure that progress is being made. The consultants should also aim to train supervisors or qualified staff to become trainers of others on the shopfloor. This would reinforce the course theory with practical shopfloor skills. Workshops to introduce Continuous Improvement and World Class Manufacturing practices, such as those mentioned in previous chapters, could also be promoted to the industry by the Training Board. The Training Board should also consider developing management training courses as such skills appear to be lacking in the industry.

13.3 Summary

The guidelines recommended for implementation in the preceding sections are all in accordance with current management theory and practice. They have been proven in a number of diverse organisations and the results have generally allowed these organisations to bridge the gap into the Information Age. Organisations that have successfully implemented Learning, Continuous Improvement and World Class Manufacturing have experienced great sustainable improvements in quality and productivity, allowing them to remain viable, learn and flourish in today's turbulent, competitive business environment (Senge et al., 1994).

These recommendations, however, will not benefit South African plastics converters and the manufacturing industry unless actually implemented and managed. If the suggested practices are implemented and managed correctly, I have no doubt that the rewards will be great and will sustain the South African manufacturers far into the future. The test is best performed in reality where the true results can be seen. The industry's future survival and growth are very much in the hands of the leaders and workers of the South Africa companies. The challenge will be to leverage the human side of the business to create rapid learning and continuous improvement and an environment for world competitiveness.

13.4 Recommended Areas of Further Investigation

I recommend that further studies be undertaken in South African manufacturing companies, where the Continuous Improvement and World Class Manufacturing practices are implemented. Such studies should aim to address the problems in a participative change process as described in Section 5.2. This is the 'reality test' of the recommendations made and could yield great learning on the future of transforming South African industry.

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15. APPENDIX A: GENERAL NATURE OF A PLASTICS CONVERTER

A plastics conversion plant can be seen as a socio-organisational system (Ackoff, 1994). All employees contribute to the success of the enterprise. For a plastics conversion plant to produce high quality products, the individual departments must co-operate. The organisational structure (which shows the hierarchy of authority) of a plastics conversion plant may vary greatly, however, the general process flow will be similar for most plants (Michaeli et al. 1992). This indicates the sequence of order processing within the plant, from the customer order all the way to delivery of the products to the customer. This is shown in Figure 21 in the next page.

Two main areas receive special emphasis here: mould making and plastics products manufacturing. Mould making is a metal fabricating activity, while plastic product manufacturing represents a plastics conversion processing activity. The employees involved in mould making are mostly skilled toolmakers, while those employed in plastics products manufacturing are mostly unskilled and semi-skilled workers.

Figure 21 also shows how different functions are involved, depending on whether a new order, repeat order or an order with assembly operations is processed. New orders require more time as the part and mould must first be designed and the mould must be constructed. For a repeat order, it is only necessary to refit the processing machine with the appropriate mould, which is held in the mould storage area. Note that most plastics converters are process focused with a make to stock inventory policy (Michaeli et al. 1992).

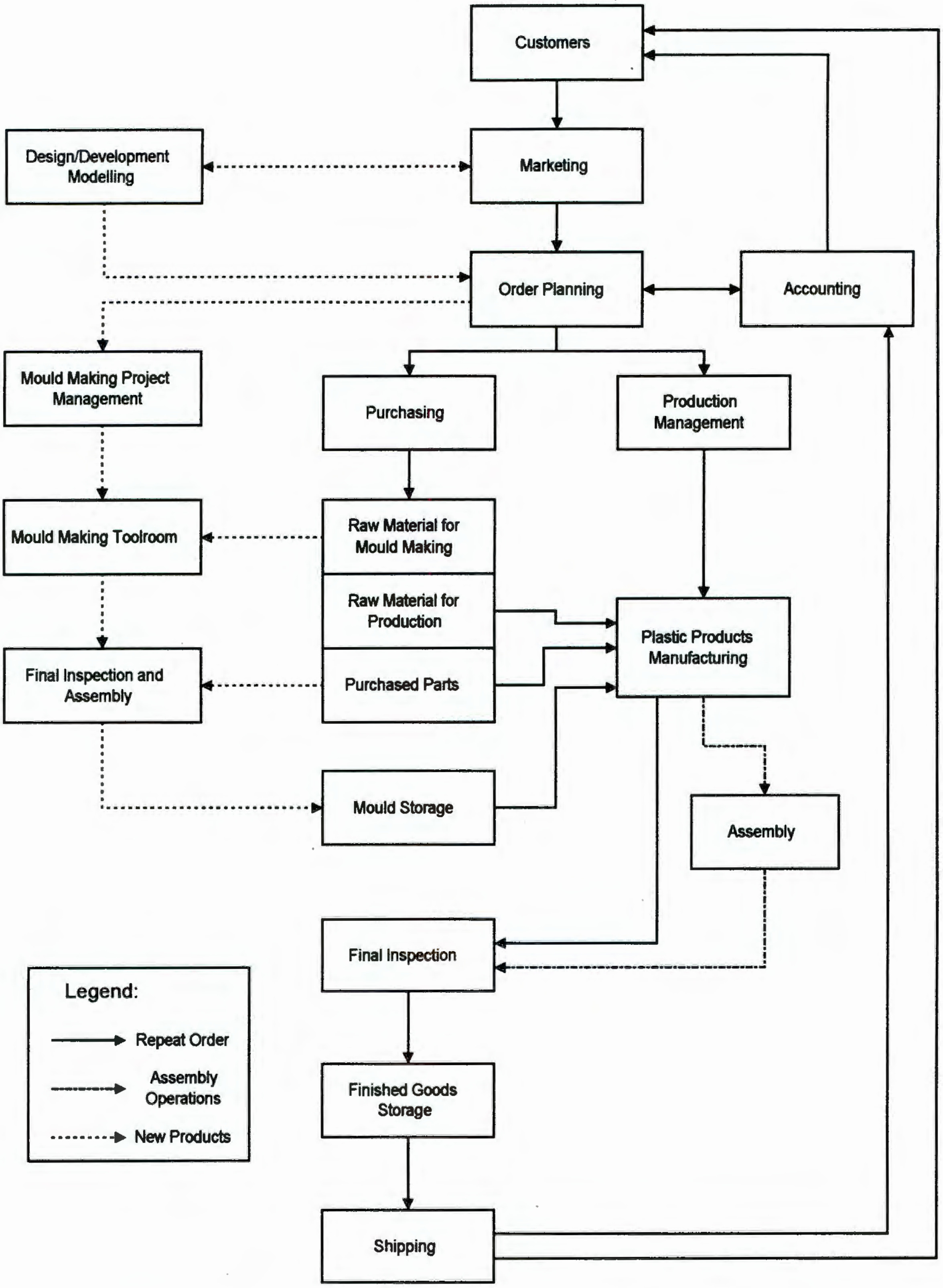


Figure 21: Process Diagram of a Typical Plastics Converter

16. APPENDIX B: SMS VERSUS CIS PROCESSES

Operational Processes	Standard-Maintaining Systems	Continuous Improvement Systems
Method for discovering problems	Breakdown from natural stressors such as: • variations in demand • defective raw materials • tool wear	Planned intervention in addition to natural stressors: • waste reduction • work-in-progress reduction
Scope of analysis	Localized: Problems are segmented and solved where they occur	Holistic: Problem classifications move from the subsystem toward the whole system
Time frame of solutions	Short term: Treat the symptoms of the problem	Long term: Address the root causes of problems
Types of solutions	• add resource buffers (inventory or labor) • punish to motivate • establish tighter control	System improvement: • change layout • change product design • modify machines • train and educate employees
Generality of solutions	Solutions considered unique to problem area	Solutions evaluated for deployment in other areas
Direction of information flow	Mostly downward: • communicate standards and the means to achieving them • how to handle deviation	Upward and horizontal: • suggestions flow upward for evaluation • solutions are communicated horizontally for deployment
Frequency of information flow	Low, exceptional: • when deviations from the standard occur • when changes are implemented	High, regular: • the suggestion system and its evaluations
Role of operational level management	Close supervision: • monitors the workers • provides instruction to individuals	Arm's-length supervision: • acts as a consultant to workers individually • directs instructions generally to groups of workers engaged in problem solving
Role of middle management	Monitors and solves problems: • monitors performance • intervenes if performance is substandard	Supports and trains: • trains workers to solve problems • evaluates and helps implement suggestions
Role of top management	Traditional: • short-term control • watches the bottom line • presses for immediate relief to present crises	Futuristic: • long-term vision • watches the environment • provides the leadership for interactive planning
Environmental scanning and benchmarking	Minimal: • No such function is formally acknowledged	Extensive: • Either through a formal function or by means of shared responsibility

Source: Melcher et al. (1990)

17. APPENDIX C: PDCA AND THE QUALITY IMPROVEMENT PROCESS

PDCA	Improvement Step	Function	Tools
Plan	1. Select theme	• Decide theme for improvement • Make clear why the theme is selected	"Next processes are our customers" • Standardisation • Education • Immediate remedy versus recurrence prevention
	2. Grasp the current situation	• Collect data • Find the key characteristics of the theme • Narrow down the problem area • Establish priorities: serious problems first	• Check sheet • Histogram • Pareto
	3. Analysis	• List all the possible causes of the most serious problem • Study the relations between possible causes and between causes and problem • Select some causes and establish hypotheses about possible relations • Collect data and study cause-effect relations	• Fishbone • Check sheet • Scatter diagram • Stratification
	4. Countermeasures	• Devise countermeasures to eliminate the cause(s) of a problem	• Intrinsic technology • Experience
Do		• Implement countermeasures (experiment)	
Check	5. Confirm the effect of countermeasure	• Collect data on the effects of the countermeasure • Before-after comparison	• All seven tools
Act	6. Standardise the countermeasure	• Amend the existing standards according to the countermeasures whose effects are confirmed	
	7. Identify the remaining problems and evaluate the whole procedure		

Source: Lillrank and Kano (1989)

18. APPENDIX D: PROCESS FLOW CHARTS

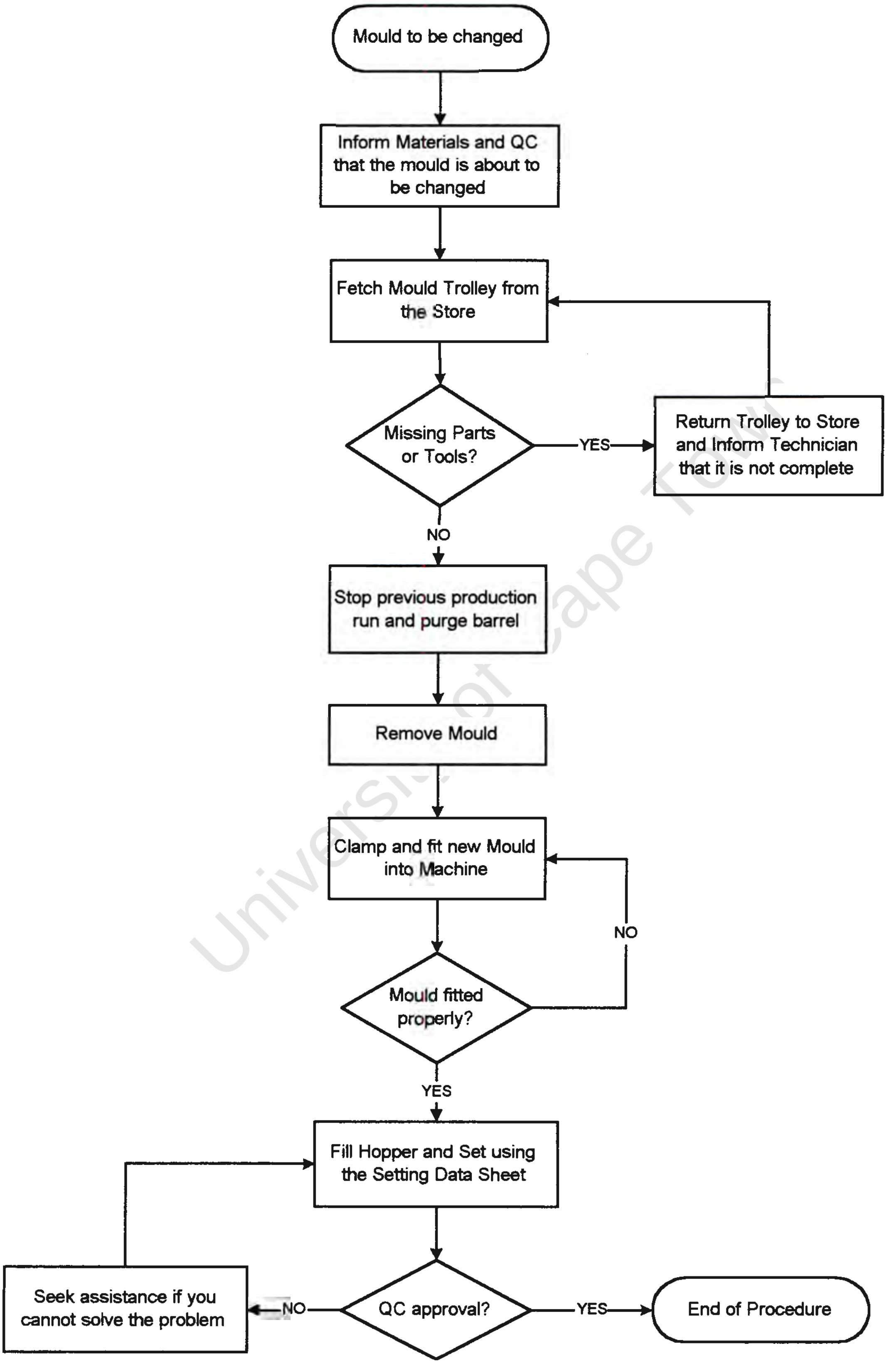


Figure 22: Flowchart Diagram for Mould Change and Setup Procedure

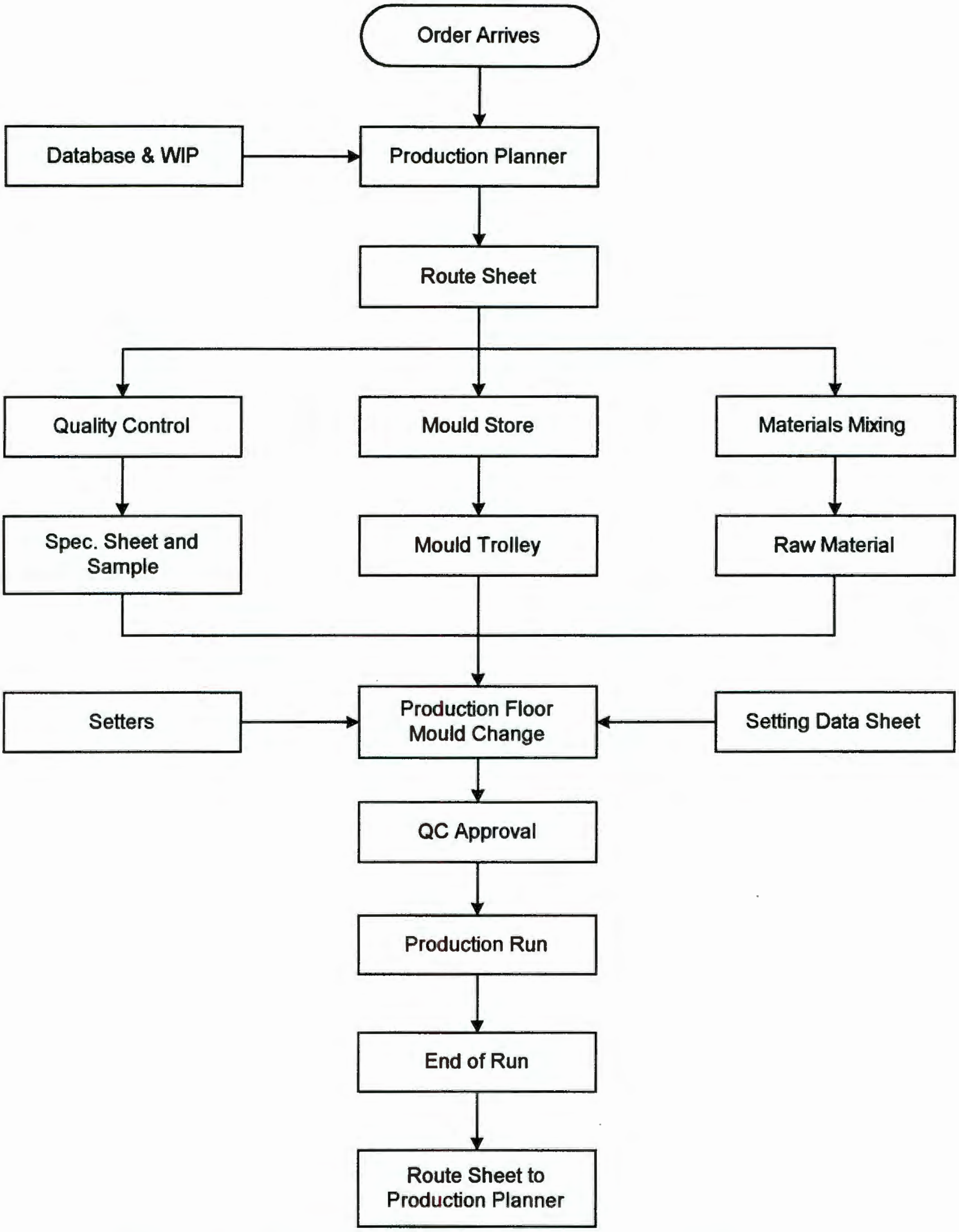


Figure 23: Flowchart Diagram for Work and Information Flow

19. APPENDIX E: MULTIPLE CAUSE DIAGRAM

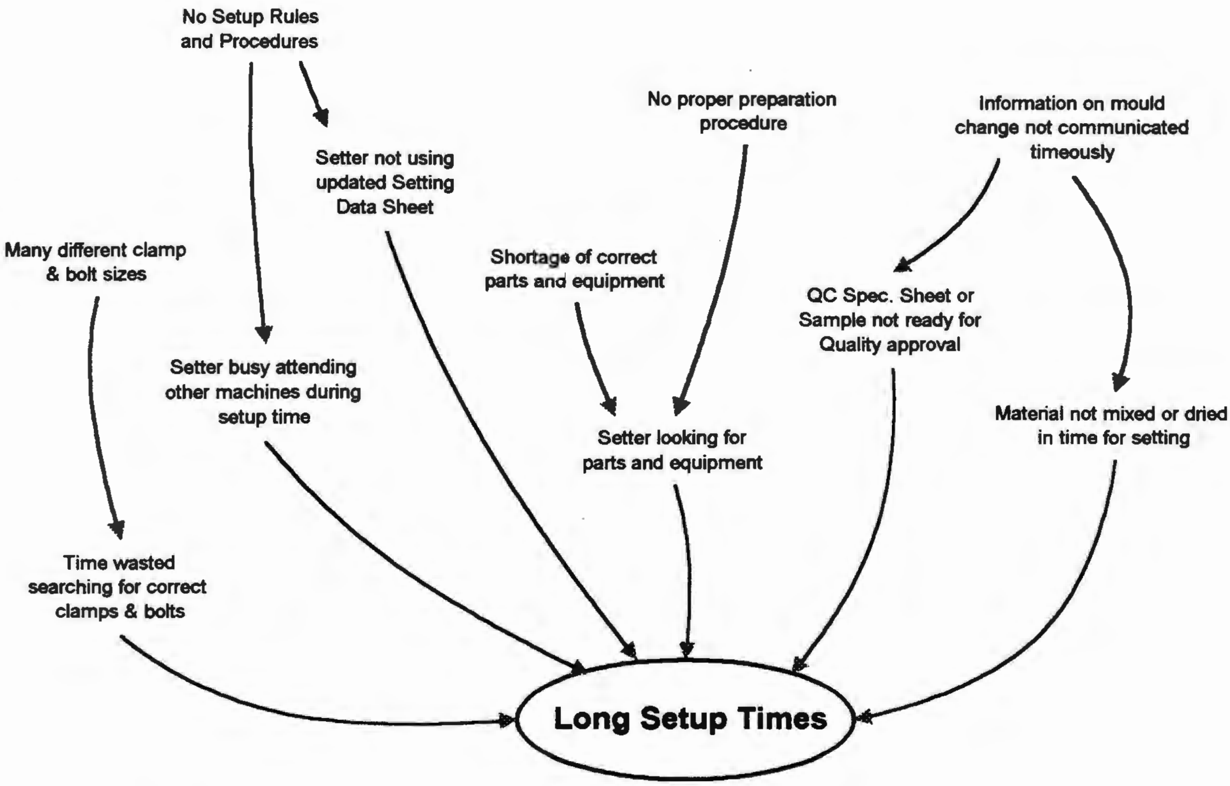


Figure 24: Multiple Cause Diagram for Long Setup Times

20. APPENDIX F: JUST-IN-TIME PRODUCTION

20.1 What is Just-in-Time (JIT)?

It is a manufacturing philosophy which targets inventory as waste. Just-in-Time aims to reduce stock levels to the minimum level possible (ideally batch sizes) by aiming to produce only when something is required or Just-in-Time. Other words used for Just-in-Time are lean manufacture or stockless production.

Just-in-Time can be categorised as "Big JIT" or "Little JIT"; the former refers to the philosophy which encompasses all aspects of operations, including human resources and supplier relationships. "Little JIT" refers to production-control methods only and it is argued that it is limited in scope, as in order to harness JIT to its full potential, the system as a whole needs to be geared to its principles.

20.2 The JIT Principles

1. Eliminate waste through the reduction of inventory. Waste is defined comprehensively by Fujio Cho of Toyota in his "Seven Sins of Waste" (from Suzaki, 1987):
   - Waste from overproduction
   - Waste of waiting time
   - Transportation waste
   - Inventory waste
   - Processing waste
   - Waste of motion
   - Waste from product defects
2. Stock, raw materials or products are only ordered or made when required.
3. Delivery or manufacture is triggered by a visual or audible signal (Kanban).
4. Reducing stock levels reveals inefficiencies in the system, this forces continuous improvement of the system as problems are not hidden.
5. It is a pull system driven by the user, be it the external customer or next operation.
6. JIT works to a master schedule, which is dictated by demand.

20.3 What Factors Need to be Implemented for JIT to be Successful?

- Reduce buffers to a minimum.
- Cut throughput time.
- Cut set-up times.
- Develop and train employees to enable them to be involved
- Ensure the capacity of the plant, both machine and operator, is under-utilised to allow for Total Preventative Maintenance and Continuous Improvement.
- Create strategic alliances with suppliers.
- Ensure the quality of the product that is utilised in the system.
- Make quality the responsibility of the maker or provider of the good or service.
- Empower operators to stop a process or alert management, if a quality problem is experienced.

20.4. Advantages of JIT

- It dramatically reduces costs, i.e., inventory, waste, inefficiencies.
- Less space is required, with decreased work-in-progress.
- Flexible to change in customer demands.
- Quality problems are picked up early in the process and rejects are therefore minimised.
- Problems are exposed which were previously hidden by high inventory levels.
- Employees are more involved (motivational benefits).

20.5 Disadvantages of JIT

- Requires a high level of commitment from staff.
- Can be problematic if this culture is not present in a company.
- Stresses the system and if employees and managers are not trained can create serious motivational problems.
- Suppliers must be reliable and accredited to supply raw materials with minimal defects.
- In South Africa, proximity to foreign suppliers can be problematic.
- Increased vulnerability to any sort of delay, e.g., natural disaster, strikes.

- Requires a change of culture in terms of the way things are traditionally done.
- Managers and employees need to be developed to accept a different philosophy.

20.6 Elements that support JIT

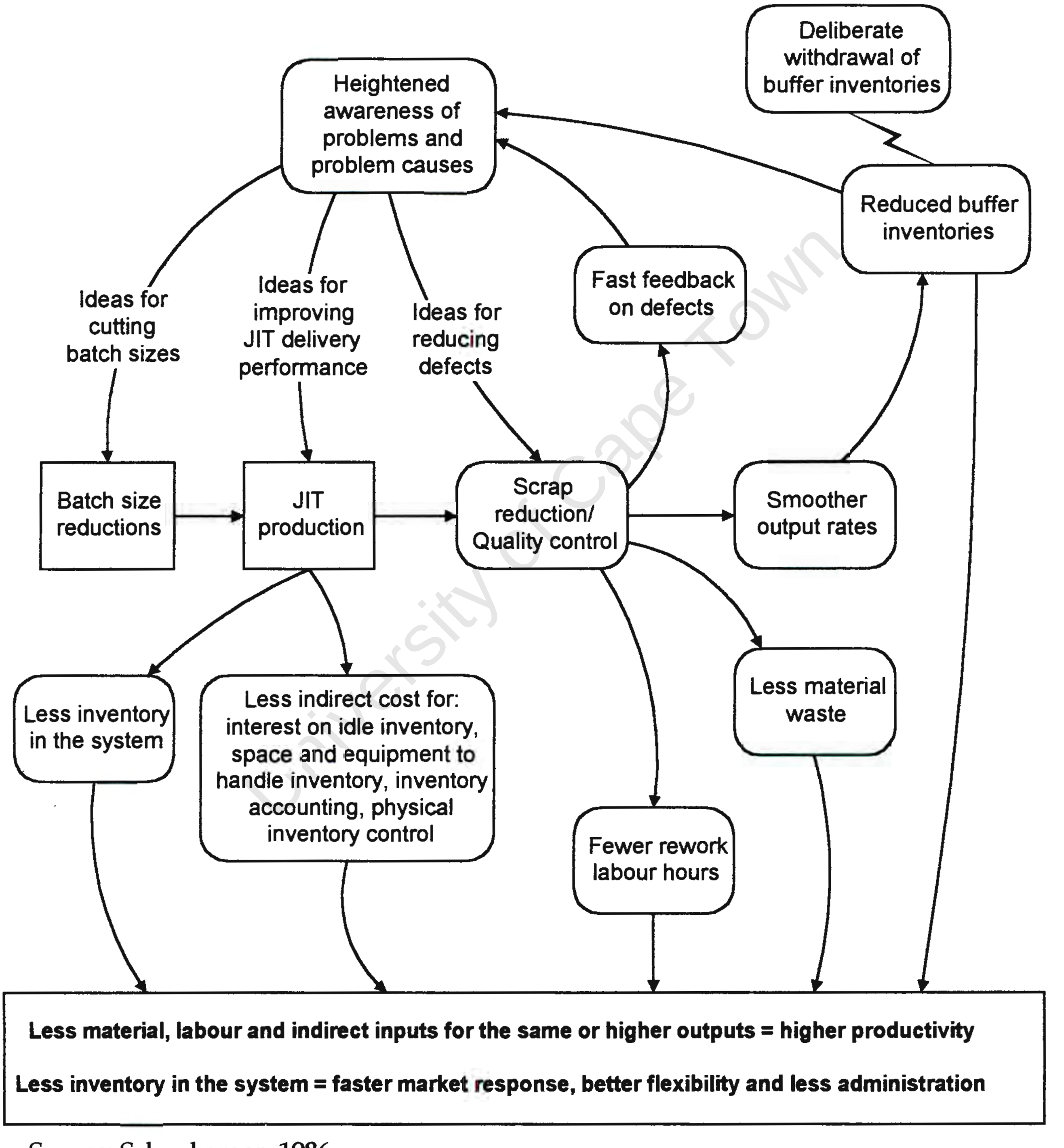
1. *Focused factory networks.* Build smaller focused operations that work together.
2. *Group Technology.* Group all operations together that are similar to reduce movement and queue times.
3. *Quality at the source.* Control quality at the source. Reduce or eliminate inspection after the event. Make process owners responsible for quality.
4. *Uniform plant loading*. Strive to reduce variability that will affect the loading of the plant. Many smaller specialised plants or units are preferable to one large operation that handles a lot of different products or units.
5. *Kanban production control system.* This is a Kanban pull system where the authority to produce or supply comes from downstream operation, who utilize some sort of signalling system.
6. *Minimized set-up times.* This means fixing small lot sizes and then working to reduce set-up times. (See section 6.2 on SMED).
7. *Culture of worker involvement*, support and development, including for example quality circles, small group activities.
8. *Use of outside suppliers.* Extensive use of reliable and accredited sub-contractors and suppliers.

20.7. Summary

Caution should be applied in trying to use JIT as a panacea to *all* manufacturing or service problems. Many United States companies fell into this trap in the 1970's when they copied Japanese techniques. What they failed to note was the infrastructure and systems supporting JIT manufacturing in Japan. JIT requires a holistic view of the manufacturing or service process as its success depends on managing the *whole* process from supplier to delivery of product.

Drucker (1990) states: "...the plant must be designed from end backwards and managed as an integrated flow." He also maintains that this holistic view is critical to any successful organisation competing in the global economy.

The strength of JIT is the very fact that it highlights problems in the system by reducing inventory that 'hide' waste and problems. JIT in essence will only work if management takes a holistic view of the organisation and ensures that the parts support each other in attaining improved throughput, quality and reduced cost for the greater system.



Source: Schonberger, 1986

Figure 25: Multiple Cause Diagram of the Benefits of Just-in-Time

21. APPENDIX G: TOTAL QUALITY MANAGEMENT

Total Quality Management (TQM) is an important element for World Class Manufacturing. Total Quality Management realises that quality must have higher priority in the business than cost reduction to assure long-term success (Sisell, 1995).

A definition of Total Quality Management might be (Conway, 1993, p. 1): "The unyielding and continually improving effort by everyone in an organisation to understand, meet and exceed the expectations of the customer." The six core principles according to Conway (1993, p. 2) are:

1. "Understanding and fulfilling the needs of customers is the best and only lasting means to business success.
2. Leadership of Total Quality is the responsibility of top management of any organisation or enterprise.
3. Data based statistical reasoning is the basis for problem solving, continual improvement, and decision making.
4. Focus by all functions at all levels is on the continual improvement of business processes to achieve overall corporate goals, from the top-down.
5. Problem solving and process improvement are realized principally through empowered multifunctional teams and natural work groups.
6. Continual learning, training and application of Total Quality principles and techniques is the never-ending responsibility of everyone in an organisation."

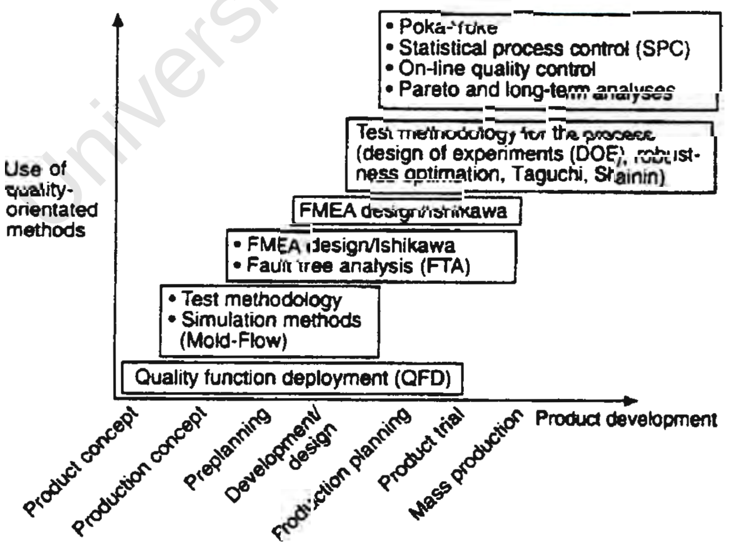
The PDCA learning cycle described in Section 4.3 is the driving engine of Total Quality Management. Implementation must be firmly rooted in the turning of the PDCA cycle.

Total Quality Management seeks higher quality work from all functions within a company, not only from the manufacturing functions. Marketing and support units are also measured on the quality of their performance. Total Quality Management involves the use of the Continuous Improvement Tools like: control charts, statistical analysis and Pareto charts. These have been described in Section 4.5.

Areas of concentration for learning and training that support Total Quality Management are as follows (Conway, 1993):

- *Policy Deployment (Strategy Deployment)* - a management system to develop and deploy strategic objectives and plans throughout an organisation.
- *Quality Function Deployment (QFD)* - a methodology to design quality into a product or process (or improve existing designs) via multifunctional teamwork.
- *Seven Management Tools* - a series of non-numerical techniques to assist managers in both problem-solving and process improvements.
- *Just-In-Time (JIT) Inventory Control*- a system to ensure only the optimum levels of production and inventory needed for customer supply.
- *Quick Changeover* - a system to realize the most rapid and efficient changeover of production processes during manufacturing cycles. (See Section 6.2 on SMED).
- *Total Productive Maintenance* - the application of Quality principles to machinery and equipment in order to enhance their productivity and capacity.

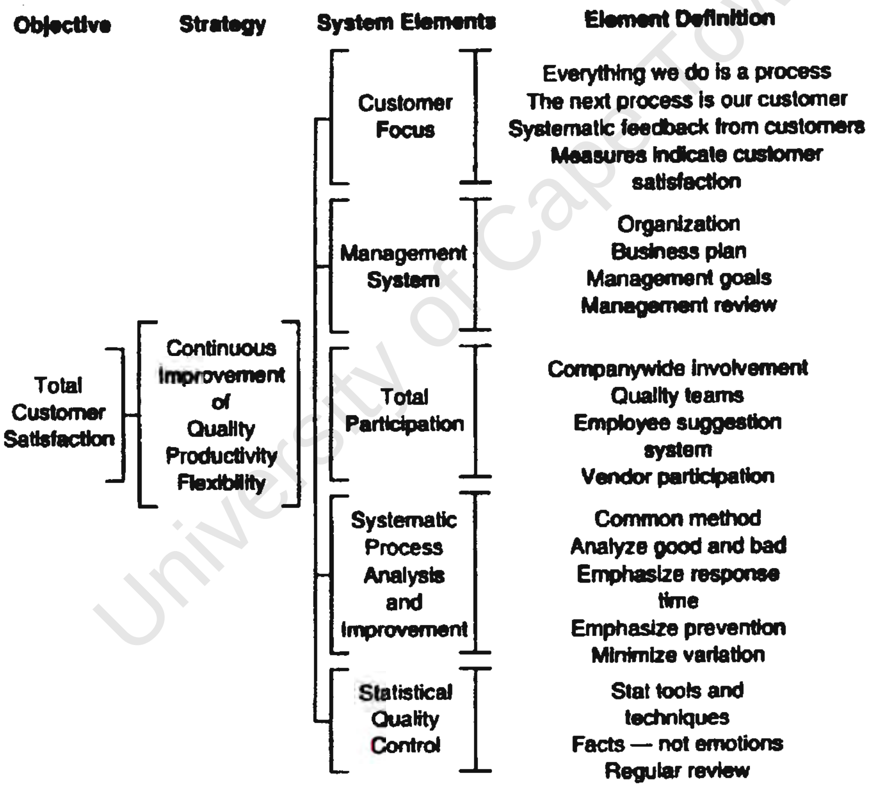
Figure 26 below shows how some of these areas (and others like poka-yoke) can be used in plastics product development.



(Source: Bourdon, 1996)

Figure 26: Methods of TQM Quality Engineering in Product Development

Total Quality Management also recognises the need for a strong feedback loop (reward/punishment) for quality performance. In practice, each team (or individual worker) inspects, analyses and implements their own quality improvements. Quality circles can be implemented within existing teams and also for cross-functional process improvements. Priority is placed on the need to satisfy internal (and external) customer requirements and therefore cross-team communication is stressed. Company wide commitment and training are prerequisites for implementation. A great deal of continual learning and training is essential for successful implementation of this management concept (Wortberg and Häußler, 1995). Successful Total Quality Management implementation usually results in great improvements in quality and cost. A framework for Total Quality Management is shown below.



(Source: Shores, 1993)

Figure 27: A Framework for Total Quality Management

22. APPENDIX H: OPERATING PRINCIPLES TOWARDS WORLD CLASS

This list of recommendations is adapted from Giffi et al. (1990) and is a result of their research on the common operating principles of World Class Manufacturers. Figure 9 in Chapter 5 shows a diagram of their framework relating the principles described below.

Quality and Customer

1. Define quality in terms of the customers' needs.
2. Integrate the concept of customer closeness into the organisation so that everyone in the organisation has a customer, and everyone's goal is to provide quality products and services to their customer.
3. View quality from a global perspective - products, processes and services.

Management Approach

1. Develop firm yet open management direction, strategic in thought and effective in the implementation of innovation.
2. Constantly 'stretch goals' for the organisation.
3. Foster an environment where sensible risk taking toward innovation is rewarded.
4. Develop a thorough understanding of the products which are being produced and the critical manufacturing process capabilities required.
5. Develop a systems perspective which treats manufacturing as an extension of a process from establishing customer requirements to the preparation of products fit for use and their satisfactory delivery.
6. Manage the organisation across functional boundaries.

Manufacturing Strategy

1. Establish clearly defined strategic intent; define success in terms of winning orders over the long run.
2. Establish a strategy consistent with the potential for developing needed manufacturing capabilities.
3. Develop a global perspective to competition.
4. Make the strategy a blueprint for action, a pattern of decisions to be executed over time.
5. Develop the strategy through a participative approach and share it freely with all employees in the organisation.

6. Review the strategy on a periodic basis to ensure congruence with current and future goals and capabilities.
7. Allow your strategic intentions to drive the size of your steps.

Organisation

1. Focus factories into organisationally flatter structures built around strategic business units.
2. Dissolve the boundaries between management and worker and between functionally segregated staff units; create dynamic cross-functional teams charged with resolving both strategic and operational issues.
3. Embrace the advantages of developing relationships with suppliers, customers and even competitors.

Manufacturing Capabilities

1. Make dependability and consistency in quality, delivery and service to your customers the goals of all operations.
2. Develop manufacturing operations that are flexible and able to respond rapidly to changes in products and markets.
3. Restructure the production operations to reduce waste and inefficiency, and to improve quality.

Performance Measurement

1. Focus on competitive variables that the customer sees.
2. Develop measurement systems that encourage continual learning.
3. Increase the vitality of the entire business by focusing attention on integrated business management.
4. Tailor the performance measurement system to the company's strategic action programmes.

Human Assets

1. Invest in people.
2. Empower teams of workers to carry out the mission of the company.
3. Eliminate the terms 'supervisors' and 'supervision'.
4. Evaluate the success of your people by their ability to achieve competitive capabilities, to learn and to adapt to change.

5. Develop accelerated and integrative learning programmes.

Technology

1. Develop an investment strategy for continual enhancement of technology throughout the company, based on a clearly defined vision of future competitive requirements.
2. Identify the competitive advantage of the knowledge base that advanced technology can create; simultaneously implement new technology and develop the new knowledge base.
3. Carefully plan technological upgrades to be consistent with infrastructural upgrades.

23. APPENDIX I: OPTIMISED PRODUCTION TECHNOLOGY

Optimised Production Technology (OPT) is a method of scheduling work through bottlenecks. It is an approach for planning, scheduling and inventory management.

It creates a product network that identifies the shopfloor situation. It includes definitions of how the product is made, the time required to manufacture the product, the capacity available at each resource and the order quantities and due dates of work on the shopfloor. This methodology aims to maximise throughput, minimise inventory and minimise operating cost in that order.

23.1 Objectives of OPT

- Output capacity is controlled at bottlenecks or the operation with the least capacity.
- Inventory levels in the system must be controlled to ensure that the bottlenecks are never idle.
- Maximise efficiency of bottlenecks and control non-bottlenecks to reduce inventory flow to the bottleneck operation.

23.2 Goldratt's Rules

The following are the rules used by Goldratt to achieve the results that he has in manufacturing companies around the world. (Goldratt and Fox, 1986)

1. Do not balance capacity, balance the flow.
2. The level of utilisation of a non-bottleneck resource is not determined by its own potential but by some other constraint in the system.
3. Utilisation and activation of a resource are not the same.
4. An hour lost at a bottleneck is an hour lost for the entire system.
5. An hour saved at a non-bottleneck is a mirage.
6. Bottlenecks govern both throughput and inventory in the system.
7. Transfer batch may not and many times should not be equal to the process batch.
8. A process batch should be variable both along its route and in time.
9. Priorities can be set only by examining all the system's constraints simultaneously. Lead time is a derivative of the schedule.

24. APPENDIX J: WORK STRUCTURING

24.1 What is Work Structuring?

Work Structuring provides for the understanding and design of organisational structures which enable people and technology to combine to produce work outputs most effectively. The Work Structuring philosophy is based on seven principles which are used as guidelines to fit together all the structures within an organisation and maximise the effectiveness of the whole (Shumacher, 1993).

24.2 Principle I: The Whole Task

Work should be organised around the Basic Transformations in the process to form 'whole tasks'.

The most fundamental structure is the work process itself. This is a series of steps by which raw materials are transformed into finished products. Work processes can be better understood by using a technique called Transformation Analysis. This rates the degree of change that occurs in each step and helps differentiate between key (value adding) activities and non-critical (cost adding) activities. It is a powerful tool for process re-engineering and is used to identify 'whole tasks', which are clusters of activities surrounding the Basic Transformations in the process. When 'whole tasks' have been identified, all equipment associated with it is moved to the same area.

24.3 Principle II: The Work Group

The basic organisational unit should be the primary work group (4 - 20 people).

The work group is the group of people required to operate the 'whole tasks'. The primary work group should be effectively matched to 'whole tasks'. Small group tend to be mutually supportive and have better interpersonal communication. Transfer of responsibility from one work group to another should occur at that stage when the work is most stable, i.e., storage.

24.4 Principle III: Leadership

Each work group should include a designated leader.

Each work group must have one designated leader. The leadership role includes being the decision co-ordinator, responsibility for personal development of group members. The leader is accountable for the efficient operation of the work processes which the work group is responsible for administering and improving.

24.5 Principle IV: Planning

Each work group and their leader should, as far as possible, plan and organise their own work.

24.6 Principle V: Evaluating

Each work group should be fully able to evaluate its performance against agreed standards of excellence.

It is crucial that the elements of planning, doing and evaluating be within the responsibilities delegated to the work groups. If any of these elements is detached, the whole task becomes incomplete and unsatisfying. When work groups can plan, do and evaluate their own work, they can become more motivated, efficient and learn more quickly.

24.7 Principle VI: Job Design

Jobs should be structured so that work group members can personally plan, do and evaluate at least one transformation in the process.

The design of 'whole jobs' within a work group and the development of people to carry out these jobs more effectively are important in the promotion of motivation and job satisfaction. This also creates individual empowerment and therefore ownership and responsibility for something that they can control. The design process used is based on Principle VI.

24.8 Principle VII: The Work Group as a Team

All work group members should have the opportunity to participate formally in the group's and the organisation's common tasks.

'Whole jobs' need to be integrated so that the work group members can operate as a team. The main structural conditions needed for teamworking are:

- flexible working arrangements
- common conditions of employment
- regular work group meetings
- a reward system compatible with teamworking

Beyond these structural conditions, group members must relate to each other co-operatively if they are to function as a team. Six individual behaviour traits have been identified as essential for successful teamworking.

25. APPENDIX K: SURVEY QUESTIONNAIRE

HEADER: UCT SCHOOL OF ENGINEERING MANAGEMENT (not shown)

Dear Mr. X

This survey is part of a study of the world competitiveness of the South Africa plastics conversion industry. The study is part of a postgraduate thesis in Industrial Administration being undertaken at the University of Cape Town. It is also sponsored by the Plastics Industry Training Board. Results will be sent to all respondents, with comparisons of the respondent's company to the industry best and the average. The results will also be compared to a World Class Manufacturing standard. At best, a survey like this will give you a rough idea of where you stand. Company names will be kept confidential and no others parties will view the completed questionnaires or the detailed results

To respond to this survey, simply read each question and check the most appropriate answer. The survey should not take more than 15 minutes. The scale for responding to the survey is as follows:

- **Yes (completely):** The statement is 100% true for your company and is being implemented in every function/location.
- **Mostly:** Practice is mostly true for your company and is being implemented in most major functions/locations.
- **Somewhat:** Most of this statement is true for portions of the company but not for others.
- **Slightly:** Practice is only being applied in a few limited areas of the company.
- **No (not at all):** Your company has not even begun to use the approach or practice defined in the survey item.

If you do not know what the answer is, please mark the No (not at all) box.

Please fax your completed questionnaire to Alon Saban at (021) 551-3972 before the 26th July.

If you wish to post the questionnaire, send it "Attention: Alon Saban" to the postal address above.

If you have any questions regarding the questionnaire, contact me at (021) 439-3280.

Your co-operation is appreciated.

Thank you

Alon Saban

World Class Manufacturing Company Evaluation Questionnaire

Company Name: ______________________________

Evaluator: ________________________________

What type of plastic conversion does you company perform? (Please tick)

Injection Moulding	
Extrusion	
Blow Moulding	
Roto-Moulding	
Film Blowing	
Other: ______________	

How many people are employed by your company?

Less than 50		50-100		101-250		251-500		More than 500	

PART I: LEADERSHIP

1. Does the company's leadership promote a focus on quality, efficiency, high performance, and delighting customers?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

2. Does the company effectively communicate its vision and values to all levels and types of employees?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

3. In your opinion, is there an excellent relationship and a high level of mutual trust between management and employees?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

4. Are employees and team members always included in the decision making process? (i.e. a participative management style)

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

5. In your opinion, do management, supervisors and employees work well together as a team?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

PART II: INFORMATION MANAGEMENT

6. Has the company identified planning and decision making needs and then designed information systems around the needs of the users?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

7. Does the performance data you receive tell you clearly how well the company is doing in all the key manufacturing performance areas (e.g. throughput, inventory levels, operating expense, etc.)?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

8. Does the company thoroughly understand the correlation between different types of measures, such as the relationship between customer satisfaction and quality, with financial performance?

Yes (completely)		Mostly		Somewhat	·	Slightly		No (not at all)	

PART III: STRATEGIC PLANNING

9. Does the company do a thorough analysis of customer needs, competition, and potential risks when developing annual and longer-range strategic plans?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

10. Is thorough research done to anticipate problems associated with the company's products and processes to correct problems before they occur?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

11. Is there excellent cross-functional communication in the company? (i.e. between teams or departments)

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

PART IV: HUMAN RESOURCE DEVELOPMENT

12. Does the company have specific quality goals and improvement strategies for human resource processes such as hiring, career development, evaluation, as well as training and education?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

13. Are training needs derived from an analysis of competencies needed to meet key business goals?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

14. Do all employees receive thorough training to enable them to do their job effectively?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

15. Are there goals and strategies in place for improving employee satisfaction, safety, health, and ergonomics?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

16. Is the company genuinely trying to create a fair and equal workplace?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

PART V: MANAGEMENT AND IMPROVEMENT OF THE PROCESS

17. Does the company systematically evaluate its design process and implement continuous improvements to improve quality and shorten the product design-to-market time?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

18. Does the company develop new products and simultaneously design the necessary manufacturing equipment (jigs, ergonomic workbenches, etc.)?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

19. Are all employees well trained in problem solving and improvement techniques?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

20. Does ample opportunity exist for people to make suggestions for improving working conditions and performance?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

21. Does the company attempt to identify bottlenecks and non-value-adding activities with the view to reducing them.

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

22. Does the company continuously experiment with new improvement opportunities?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

23. Are all effected employees thoroughly briefed on and involved in intended changes?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

24. Are all implementations followed through and evaluated against their initial goals?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

25. Have many of the company's key production processes been improved in dramatic ways over the last few years?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

26. Have all forms of waste been significantly reduced (e.g. scrap, time waste, movement, etc.)?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

27. Has the company significantly lowered inventory levels and batch sizes over the last few years?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

28. How many minutes does it take, on average, to perform a set-up (from stopping of previous run to starting of new run)?

Less than 10		10-30		31-60		61-120		More than 120	

29. Are the improvement efforts of different departments and teams well co-ordinated and effective?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

30. Does the company have preventive and corrective processes in place to ensure that suppliers meet its requirements?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

PART VI: QUALITY AND OPERATIONAL RESULTS

31. Has the company shown steady improvements in the quality of its products over the last three or more years?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

32. Do sales, cash flow, operating expenses and other financial results show excellent improvement trends over three or more years?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

33. Do the trends in the company's responsiveness indicate excellent gains in reducing product design-to-market time?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

34. Do profits or retained earnings show clear improvement trends over three or more years?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

35. Do measures of employee morale show excellent improvement trends?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

36. Does the company have data to demonstrate a trend of three or more years worth of improvements in quality and delivery performance by all of the company's major suppliers?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

PART VII: CUSTOMER FOCUS AND SATISFACTION

37. Does the company continuously evaluate its methods for identifying customer requirements, and has it made a number of improvements over the last few years in their approaches to identify customer requirements?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

38. Does the company have many ways to make it easy for customers to seek information, comment, or complain about the company's products? Does a formal system exist for tracking formal and informal complaints, and an efficient process exist for resolving them in a timely manner?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

39. Have significant improvements been made in the levels of customer satisfaction over the last three years?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

40. Do measures of all major adverse indicators (e.g., complaints, returns) show decreasing trends over at least the last three years?

Yes (completely)		Mostly		Somewhat		Slightly		No (not at all)	

OPTIONAL QUESTION: What are the three major problems in the company? (Please list these in point form)

1. ______________________________
2. ______________________________
3. ______________________________

OPTIONAL QUESTION: What do you think your company needs to make significant improvements?

____

____

____

____

Do you have any other comments?

____

____

____

The following was not given to the surveyed companies:

How to score:

For questions 1-30 score as follows:
- Score 10 points for each 'yes' answer
- Score 7 points for each 'mostly' answer
- Score 5 points for each 'somewhat' answer
- Score 3 points for each 'slightly' answer

For questions 31-40 score as follows:
- Score 20 points for each 'yes' answer
- Score 14 points for each 'mostly' answer
- Score 10 points for each 'somewhat' answer
- Score 6 points for each 'slightly' answer

Add up all of the scores to come up with a total. A perfect score would be 500 points.

Interpreting the score:
Use the table below to interpret the score and give feedback to the respondents.

Points	Interpretation
375-500	Probably a World Class Manufacturer
334-374	You should be able to work on the areas needing improvement so that your company can attain World Class Manufacturing status in one to two years
250-333	With a great deal of work over the next two to three years you should be able to improve your company enough to become a World Class Manufacturer
249 or less	You have a great deal of work to do to make high performance a characteristic of your company.

26. APPENDIX L: DETAILED RESULTS

Questionnaire Evaluation Spreadsheet

quest	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Average	St. Dev.	Mode
1	10	5	10	10	10	7	5	5	7	10	7	5	10	5	7	10	5	7	5	7	10	10	10	10	7	7	7.7	2.1	10
2	5	7	7	10	7	7	5	5	7	5	5	0	7	7	5	7	3	0	5	7	7	7	7	10	7	5	5.9	2.3	7
3	0	5	5	5	5	5	7	3	5	7	5	0	5	3	7	5	7	0	3	7	7	10	7	10	5	3	5.0	2.6	5
4	5	5	5	7	5	10	5	3	7	7	5	0	5	7	7	3	3	0	3	3	5	7	7	7	7	0	4.9	2.5	7
5	3	5	7	3	7	5	7	3	7	7	7	0	5	7	7	5	7	0	5	7	7	7	5	7	7	3	5.4	2.2	7
6	5	7	7	10	7	10	3	5	5	5	7	0	7	7	5	5	7	0	7	7	3	5	10	7	7	7	6.0	2.5	7
7	7	7	5	10	7	10	3	7	7	5	5	0	10	3	10	7	5	3	7	5	7	7	10	5	7	5	6.3	2.5	7
8	10	5	10	7	7	10	7	7	5	7	7	0	10	7	7	7	7	3	7	10	10	10	7	7	10	7	7.3	2.4	7
9	7	5	10	10	10	7	3	5	5	7	7	0	7	0	0	5	5	0	7	10	10	10	10	7	7	7	6.2	3.3	7
10	5	5	7	5	7	5	3	5	7	5	7	0	7	5	7	5	3	0	7	3	7	7	7	7	7	3	5.2	2.1	7
11	5	5	7	3	7	7	3	5	7	5	5	3	7	3	7	5	5	3	5	7	7	10	7	10	5	5	5.7	1.9	5
12	5	5	7	3	7	5	3	5	7	7	7	3	10	3	0	5	3	0	7	5	10	7	7	10	5	7	5.5	2.6	7
13	3	5	5	5	7	5	3	5	7	7	7	0	5	3	3	5	0	0	5	3	7	5	7	7	7	7	4.7	2.3	5
14	7	7	5	7	7	7	5	7	5	7	3	3	5	3	3	5	3	0	7	5	7	7	5	7	5	5	5.3	1.9	7
15	5	7	10	5	7	10	3	5	7	10	5	0	7	5	5	5	3	0	5	5	7	10	10	10	7	5	6.1	2.8	5
16	10	10	10	7	0	7	7	7	7	7	7	5	7	7	7	7	5	3	5	7	10	10	10	10	7	5	7.1	2.4	7
17	3	7	10	5	7	5	5	3	7	5	7	0	7	5	3	7	5	0	3	10	10	7	7	7	7	5	5.7	2.6	7
18	10	5	10	3	7	5	7	5	7	7	5	0	10	7	10	10	3	0	7	7	7	5	0	7	7	7	6.1	3.0	7
19	3	5	5	0	5	5	3	3	5	5	5	0	3	3	7	5	0	0	5	10	3	5	0	5	7	3	3.8	2.5	5
20	3	7	5	7	10	10	7	5	7	7	5	3	7	3	10	5	7	3	5	3	10	7	7	10	7	7	6.4	2.3	7
21	5	7	7	5	10	10	7	5	7	5	7	0	7	5	10	7	5	0	5	10	7	10	7	10	7	7	6.6	2.7	7
22	7	10	7	5	7	10	5	5	7	5	7	0	7	3	5	7	3	0	5	7	10	7	5	7	5	5	5.8	2.5	7
23	7	7	10	7	7	7	7	5	7	5	5	0	7	5	3	5	5	0	5	5	10	7	7	10	7	3	5.9	2.5	7
24	3	7	7	3	10	5	3	5	5	5	5	0	5	7	3	5	3	0	5	5	7	7	10	7	5	5	5.1	2.4	5
25	10	7	7	10	7	3	7	3	3	7	7	0	7	5	7	7	3	5	3	5	10	5	5	10	7	3	5.9	2.6	7
26	5	7	7	7	5	3	3	3	5	7	7	0	7	5	7	7	3	0	3	10	5	5	7	7	7	0	5.1	2.6	7
27	7	5	7	7	7	10	5	7	5	5	5	0	7	7	10	5	5	3	3	3	5	0	7	10	7	0	5.5	2.8	7
28	0	5	5	0	5	0	0	3	3	0	5	3	7	3	10	0	0	0	5	3	7	0	0	5	0	3	2.8	2.8	0
29	5	7	7	7	7	5	3	5	5	7	3	0	7	5	5	5	3	0	5	5	7	5	7	7	5	3	5.0	2.0	5
30	3	5	10	7	10	10	5	5	7	5	7	0	10	7	7	5	3	0	7	5	10	7	7	7	5	0	5.9	3.0	7
31	14	14	20	10	0	20	10	10	10	14	10	0	14	10	20	6	10	10	10	10	20	14	14	14	14	6	11.7	5.2	10
32	0	10	14	20	0	14	14	10	0	10	14	6	0	10	0	14	10	14	14	20	14	20	10	14	10	6	10.3	6.2	14
33	0	14	14	0	0	6	10	10	6	10	14	0	6	10	10	14	6	6	10	10	14	14	14	14	10	0	8.5	5.1	14
34	0	10	14	20	0	0	14	10	6	10	14	0	6	6	0	20	6	10	14	20	14	20	10	0	14	0	9.2	7.0	0
35	6	10	14	6	0	10	10	10	10	14	10	0	0	6	0	10	6	0	6	10	10	14	14	0	10	10	7.5	4.8	10
36	0	0	10	14	10	14	0	10	10	14	6	0	14	10	6	10	0	0	14	20	10	0	14	0	14	0	7.7	6.3	0
37	10	10	14	14	20	20	6	14	10	10	14	0	14	6	20	14	6	6	10	14	14	14	20	0	14	10	11.7	5.5	14
38	6	14	10	20	14	20	6	14	10	14	10	0	20	14	20	10	0	0	14	10	20	6	20	0	10	10	11.2	6.6	10
39	0	10	14	14	14	20	6	10	0	14	10	0	10	10	20	14	6	6	14	14	14	14	20	0	10	6	10.4	6.0	14
40	0	6	20	10	14	14	6	10	0	10	10	0	14	6	6	14	6	6	6	6	14	10	14	0	10	6	8.4	5.2	6
	199	284	365	308	283	343	221	252	244	303	288	31	310	233	286	297	175	88	268	320	373	332	352	282	306	186	266.5	80.3	

27. APPENDIX M: COMMENTS FROM RESPONDENTS

This section gives a comprehensive review of the comments of the respondents to the questionnaire.

Major problems listed included:

- "Recent tendency to order smaller runs by customer."
- "No consideration for customer care."
- "Threat from imports."
- "Imports affecting order book."
- "Lack of 'basic' education."
- "Lack of trust between workforce and management."
- "Lack of understanding about how a business operates."
- "Shortage of trained employees."
- "First line management/supervisors lack of experience and learning potential."
- "Very low productivity."
- "Workers attitude is a problem."
- "Low Morale."
- "Labour problems."
- "Problems with night shift."
- "High Absenteeism."
- "Lack of communication, top to bottom and bottom to top."
- "Lack of recognition and reward for effort and improvement."
- "Poor direction."
- "Lacking leadership."
- "Poor management."
- "Lack of management's knowledge of quality."
- "Inefficient quality control/assurance."
- "Responsibility and accountability unclear."
- "Lack of planning by all departments."
- "Engineering designs not suited for production use."

- "Poor quality tooling."
- "Machinery not kept up to date."
- "Too little R&D taking place."

Solutions listed included:

- "Continuous education of staff including basic education."
- "'Business wise' type training for the workforce."
- "Training in all areas."
- "Promote quality awareness among all levels of staff."
- "Commitment to quality systems."
- "Proper and qualified leadership."
- "Management teamwork."
- "Rethinking how we do our work."
- "Re-evaluate systems and implement improved systems across the board."
- "We have identified a need to implement a SMED programme."
- "Embark on World Class Manufacturing and a level of understanding and trust must exist for all stakeholders, i.e., management and unions who do not support the initiatives and cannot see the benefits of embarking on this practice."
- "I feel that if we can all work as a team from bottom to top then this company will be a first world company."
- "Increased international competition requires improved productivity with fewer mistakes in production."
- "Far quicker and improved communication."
- "More motivational rewards."
- "A complete updated definition of company standards for all persons thus avoiding inconsistencies and confusion."
- "A broader base of core products."
- "Planned maintenance programme."
- "More Automation."
- "More modern machinery in moulding department."
- "More capital."

- "Better import legislation."
- "Lower interest rates."
- "Substantial continuous order/work status."

Other comments listed included:

- "The lack of trust between workforce and management effectively blocks any improvement initiatives which are proposed."
- "We success fully implemented a fully integrated information system based on MRP II principles."
- "Currently we are implementing a workplace democratisation (participative management) - corporate governance initiative."
- "We continually evaluate new products in an attempt to attract business with higher margins."
- "We are ISO 9002 accredited, so major systems are practically in place, but poor performance contradicts this in certain areas."
- "We are currently giving the workers the right to make their own decisions, instead of being told. This is a culture shock and will take time for adjustment, i.e.: 'Should we employ this person?' Is this product the required standard? Etc."
- "We have the capacity to improve. Direction and communication are, as I see it, our major stumbling blocks."

28. APPENDIX N: SAMPLE ROUTE SHEET

XYZ Plastics (Pty) Ltd.

Product Route Sheet

Date:	06/08/96	Material Name:	Durathane B30S
Order No.:	3731	Total Quantity:	60 kg
Customer:	ABC	Cycle Time:	10.4 sec
Article Name	120 mm Holder	Run Time:	1 day
Total Qty.:	30 000	Machine No.:	8

Mould No.:	A19	Mould Setting Time:	0.5 hr
Insert No.:	N/A	Prod. Start Date:	07/08/96
No. Cavities:	4	Prod. Finish Date:	08/08/96
Shot Weight:	7.8 g	QC Approval Sign:	

	Stock Code	Quantity	Colour	Pigment/Masterbatch	g/kg	Q.C.
1	02048	30 000	White	F50	15	
2						
3						
4						
5						
6						

Remarks

Q.C. TO APPROVE COLOUR