Feasibility Study in Implementing Shop Floor Management

- A Case Study of A Learning Organization

A Full Dissertation submitted to the University of Cape Town in partial fulfillment of the requirement for the Degree of Masters of Science in Engineering Management

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Declaration

I, Yao Wei Tung, the underigned, hereby declare that the work contained is my own and original work submitted to the University of Cape Town for the Degree Masters of Science in Engineering Management, and has not previously, in its entirety or part, been submitted at any University for the purpose of a degree.

Signed by candidate

Yao Wei TUNG

30/07/2001
Signed

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Abstract

Most manufacturing companies in the world have solid benchmarking standards to compete against competitors all over the world. The number of tools that they possess to become World-Class Manufacturing companies is numerous. With the philosophies of Deming, Juran and Crosby on Quality and the invention of the different practical tools from the Japanese, the results should have been positive but the practical results have been poor. The next question that arises is *what is so difficult in emulating the successes of these companies*? The theories are the same but the implementation is different for each company. Therefore, the solution seems to be able to understand the philosophies so that modifications brought about are still within the limits of the company's core values. The case study that is being explored in this thesis will be a container tank manufacturing *Company E (CE)*, a subsidiary of a bigger company, in their attempt to implement these famous concepts.

Since *Company E* has been in this business for the past 65 years, their core business has always been the building of container tanks ranging from very small to very big ones. Their normal operations were based on a job shop level, which employed experienced artisans at critical stations. With the shift to a World-Class Manufacturing production company five years ago, the whole thinking had to change to be able to deal with the more complex interactions of the parts within the organisation.

The company has split the manufacturing department into three major departments namely, the gas tanks, standard tanks and the special tanks to not only meet the customers' specific requirements but their quantity also. The Supply department manufactures parts for the three production lines. Since *Spinning Shop's* products, one sub-unit of the Supply department, were found to be faulty, management decided to investigate the cause of those defects. Their initial decision was to implement Total Quality Control to correct these problems.

Abstract

As their main customers are foreign, the costs involved with rejected tanks are high, therefore prompting an investigation in improving the quality standard of the tanks.

To first understand the situation, the researcher was actively involved in the production schedule starting from the supply shop to the final assembly of the tanks on the standard production line. The period at which the research was conducted has produced unique insight in the way management reacted to problems in time of crisis. This was brought about when there was major restructuring of the company with several top management executives being retrenched. The top management of production has been changed at the eve of the financial year-end and pressure was on Production Department to meet the delivery deadlines. The transition of power has also been marked by the death of the previous production manager.

Since the company has redesigned its main production line to the standards of World-Class Manufacturing, the quality of products have been random in some instances, highly dangerous with pressure vessels. With attempts at Total Quality Control concepts, Just In Time systems, the organisation has not encountered major successes. Since Deming was considered as one of the founders of the Quality awareness in the world, his work and philosophy was chosen as the starting point for further exploration. The adaptation of his work by the Japanese people will also be analysed at a shop floor level, which is considered to be the main area where breakthroughs make businesses successful. Then, an in-depth understanding is needed for the different failures that have occurred not only at the shop floor level but also within the organisation's different management levels.

Problem Formulation

The first typical reaction of *CE* to the new vision of Total Quality Control (TQC) is to ideally reduce the reworks in their production to zero. Senior

management initially pushed this program but it "died out" after some time when more pressing problems occurred. Now, the desire is to once again implement this world-renowned concept in the Supply Department, as there was a number of rejected tanks by customers because of the dish ends.

The main complaints by the customers are the shape of the dish ends. Some of the liquids in the container tanks get trapped in the "pocket" left between the barrel and the dish end. This can be particularly costly for leasing companies if new products are mixed with cleaning agents and also the previous cargo. This has therefore prompted top management to try to find a way for the dish ends to be made according to standards.

But as the process is analysed in more details, the problem does not seem to be localised in the *Spinning Shop* only but also on the standard production line. With non-standard dimensions of barrels, the dish end problems seem to be less acute. Through further researches in other support departments, it was realised that the defective tanks are not the result of *Spinning Shop* only but from the ripple effects of other departments' lack of rigour in their work. The departments having direct impact on the production line were approached for more details on their normal operation as well as the importance of their contribution. Due to the sensitive nature of the business, some figures have been changed or omitted to preserve the company's business figures.

Theories used in this research

The topics covered in this thesis are Deming's work on Quality Management, Shop Floor Management, Learning from Failures and the Viable System Model of Stafford Beer. Using a Systems Approach, the focus will be on the learning process of the organisation as a whole, when faced with the complex interactions of the smaller subsystems and the possible solutions from the external environment.

Abstract

Deming's work on Quality is recognised internationally and his impact on the manufacturing world can be seen in the Japanese production companies. With high hopes of emulating this success formula, companies have tried to adapt his teachings to their business but with varying degrees of success. The main striking feature was the difference in culture. With the emphasis on the human factor, Deming has shown one specific factor that can be considered as the core competency of the Japanese success, ownership of their work. Now, some of Deming's philosophy has been adapted to suit the Western culture with the derivation of Total Quality Management (TQM) from Deming's work for example. But the success of TQM has also been below expectation in most cases. That has prompted Deming to advocate his new theory, which is Theory of Profound Knowledge, explained in more details in Chapter 3.

In his new theory, the slow emergence of Systems Thinking can be seen. With 4 major factors supporting it, the emphasis is on learning. But even learning has to be in a structured way with knowledge of the environment as well as its different factors. The impact of each branch can not be neglected as the whole complex integration makes the learning robust to disturbances. Therefore, companies attempting to implement any programs should have proper understanding of the theory of variation, theory of system, theory of knowledge and the psychology.

With better understanding of the theories, the next stage is to look at the implementation stage, which occurs mainly on the shop floor in this case. The new shop floor management that the company is looking at is being viewed as the solution to their most pressing problems. The whole chapter on Shop Floor Management is being drawn from the Japanese and some successful American companies. The aim of that section is not to implement those success "theories" in *Company E* but to understand the different other factors that has made them work for the companies as a whole and their learning process that has made these theories work for them.

Abstract

What Suzaki has advocated in his book, ***The New Shop Floor Management***, was the trust in the workers to help the company solve the problems. As for improvements on the shop floor, the recommendation by the workers should be carefully analysed since they are the ones using it in their daily life. This knowledge drawn from this type of discussion between management and workers provide not only a platform for trust building but also a learning group where the gap between theory and practice can be narrowed down. With clear ideas of what tools are being used to measure their performance, the workers will be aware of what is being expected from them.

With continuous changes in the business world and the academic world, the different theories or plans will sometimes be the wrong one to choose if the external or internal factors have changed. Failures that result from them must be properly understood to avoid repetition of errors. This has therefore created a need to learn from failures. Chapter 5 will be analysing the different types of failures that exist and also the traditional view of failures. Most of the time, the severity of failures is dependent on the number of factors and their impact that lead to it. Some factors are simple mistakes others are gradual build-ups of smaller failures that go unnoticed.

Understanding failures is therefore another important step in the learning process. Most companies document their problem solving processes so that the knowledge is not lost. With the new field of Knowledge Management, it will hopefully capture the essentials of problem solving and important data. These are often considered as the company's core competency especially in a fast changing field, like Information Technology for example. Some examples of failures and ways of identifying them are also described in chapter 5. To be able to categorise the failures will also help in finding the best solution for the problems.

From these theories, the Viable System Model (VSM) was found to be more suitable as it provides a context in which the theories can be implemented by management. The goal of VSM is to merge these theories together to sustain the model which can make the organisation viable. The model also demonstrates the Systems' perspectives that allow the organisation to function in the chaotic environment with the different functions advocated in the model.

There will also be a chapter on personal learning for the researcher. Being a purely academic researcher with no previous knowledge of work, this research has been an eye opener as to what the real world looks like. For example, some basic laws of management have been violated and yet, the company is still profitable to have sustained for more than half a century. It has also shown that without proper learning, the company will face more and more problems until it collapses. The organisational politics also plays an important role that most textbooks have not catered for since the assumption by most authors is the success of the company and not personal agendas. So, this research was very rich in the real world's complexity.

Evaluation of the research

What was really surprising in this research was the huge difference between theory and practice and also the politics within organisations. Especially with the South African past, the cultural differences was one extra hurdle in the path of "success" of the different programs. With the strong emphasis on trust from Deming and Suzaki, the problem still remains quite difficult to solve in this South African Company. Being a very old company in the manufacturing field, their approach is still very traditional.

With a very mechanised production line, the company relies on the skill of the operators to produce their high quality tanks. The quality of their final products can be highly competitive in the world market but the cost for creating such high quality products is too high to be sustainable. For example, this year's

costs outstripping the record profit of last year was very surprising for the workers as well as management. Their attempt of implementing Total Quality Control earlier failed because there is no quality culture within the company. Any quality programs forced upon the workers by management will be met with resistance.

Driving an organisation by numbers or targets was also strongly condemned by Deming as a recipe to a systems failure. The targets must be attainable if other factors of the system have been upgraded to sustain the pressure on the long run. With turnovers of workers, the company must also compensate for the brain drain by offering incentives for key staff and thus understand the differences in set goals. The normal response to problems should be communication instead of threats. The whole company's goal should be to learn from their mistakes, some more costly than others but the final aim is still to make money without the workforce suffering from it on the long run.

Senior management needs to look at the company's performance and decide if the current management style is the path for the future or if there is a need to change. Training across all levels of the company should be one of the key criteria for any company to improve and evolve. *Company E* does not seem to be learning from their "failures" on the shop floor, as the data are not properly captured as corrective actions work for short period of time only. For example, the indices for Quality, Safety, Delivery, Cost and Morale are not compiled as a set of interrelated data for managers to work on. To the workers, it is lack of trust of management on their performance. The advantages of these data can help the whole organisation to improve their work habits, thus increasing their potential bonuses from reducing expenditure.

As for implementing a new shop floor management as the solution to their problem on the production lines, the answer is no. The new shop floor management can alleviate the problem but not solve it. This new "fad" will fail after some time as it is treating only the symptom and not the root cause. This

narrow focus of "production" problems has to be expanded to deal with the other problems in other departments that are affecting the production. Therefore, SFM will provide with the basic tool to differentiate real problems with normal fluctuations in the system. Whether the company can benefit from it will depend on their learning ability.

Part 1: IDENTIFYING THE RIGHT PROBLEM

This thesis is involved with the identification of the possible true problems in the organisation and an awareness of the theories and basic philosophies that can be used to explain the problems occurring in the company currently. This ethnographic research was undertaken at *Company E* (CE), a container tank manufacturing company. Part 1 will be dealing with the problem situation perceived by the company in its normal environment and the gradual diversion from the initial problem identified. The area of concern here is being referred as the "problem situation" as most problems' real root causes are often hidden beneath their symptoms.

Chapter 1 will be dealing with the company's background and its normal operating schedules in their production. A very brief summary of how the container tanks are manufactured and the inputs of the different departments to their main production line are also looked at. This chapter will be analysing the problem seen by the Management of *Company E* as the starting point of this research and then at other possible areas of concern that might impact on the problem in focus, therefore looking at the problem holistically. This section will also demonstrate that the management of *Company E* has narrowed their focus too early and that their proposed intervention is not the real solution to their problems. A hypothesis is then formulated and tested with theories in an attempt to disprove their belief held, that is, solving problems in a mechanistic way will have a greater chance of failure when dealing with symptoms.

Chapter 2 will show the relevance of qualitative research in this case as the data gathered was based on mostly soft issues. Looking at the manufacturing plant, the tendency of analysis is to concentrate on "hard issues" as it is easier to quantify but the role of this research is to also look at "soft issues" that are often neglected. The need to understand the whole organisation is essential to have a holistic approach in the evaluation of the problems and the three ways of

obtaining data are based on deduction, induction and abduction. Each one of them provides unique aspect of problem solving based on the information gathered.

CHAPTER 1 – Problem Formulation

1.1 Background information on Company E

The system in focus in this case is *Company E*, which manufactures container tanks for storage of chemicals, food and gases with the possibility of customised tanks based on the needs of the customers as shown in Figure 1.1. With the production line as their core business, the interactions of the different departments also play an important role in the overall complexity of the company's problems. System thinking, in this case, will be very helpful in formulating a picture of the interaction of the different departments in the whole organisation. Johnson (1993) emphasised Ackoff's work that the strength of this concept is focussed on the understanding of all its parts and to also realise that a system is made up of the ***product of interactions of its parts*** and not their sum.

Figure 1.1: An example of the container tanks manufactured at CE

Bridging the gap between Systems Thinking and the real world, the system *(CE)* is analysed for its purpose, its definition, the constraints, the worldview of the system, the system dynamics and its self-organising tendencies. They are the basic components of Systems' Thinking concept that are needed to

be able to understand the whole picture. The first step is to therefore describe the environment in which the company is operating.

At the time of the research, *Company E Ltd* forms part of a bigger group whose core competency is in the construction business. They manage a large number of smaller business units that runs different businesses from theirs like *CE* for example. They control *CE's* financial statements when there are major investments needed. As for the daily operation, the company is independent of the bigger organisation's control. They operate as a smaller business unit.

Company E Ltd head office and manufacturing plant is located in Cape Town. They have smaller sub-business units, like marketing, sales and tank container maintenance division in Netherlands and in the US. They also offer a repair and erection service for the range of products manufactured abroad. They sometimes fly technical personnel to provide expert advice at the customers' premises if needed. The company also offers a wide range of products to the customers as well as custom made tanks depending on the needs.

CE has currently a control of approximately 28 % of the world market. They have recently implemented a world class manufacturing system for their production line of standard tanks in 1995. With the sale of other business units such as beer, the petro-chemical and the wine divisions, the company has now focused on building container tanks only. Since the company's customers are mainly foreign-based, their quality standards and punctuality of their deliveries are very high so as to be able to compete with foreign competitors closer to the market. Their core competency is to provide custom-made container tanks at high volume if needed. This reinforces the company's competitive advantage on the world market as part of its trademark.

1.2 The Purpose

In order to understand the company, the different departments' functions must first be understood since each one contributes its own complexity to the company. But the common goal is to be profitable at all levels of the company. The only difference in the perceptions is the short or long term goals depending on the problems and *CE*'s aim. But the actions taken are often short-term based, just to put out the "fire" and not really understanding why it had occurred.

The purpose of the different departments involved is also different, as each individual's perceptions of their immediate needs are different from the other. The mental models that each person has will also determine his actions in the organisation. With a relatively uneducated workforce, the focus of the workers will be more on short term as compared to the management's view, which will be on long term. With a continuous need for supervision, management has gradually changed to short term goals since long term strategic planning does not have the group's input and one of the most important reason in this case is the crisis time that the company is at this stage of the research.

The different departments involved in the manufacture of container tanks are listed below with particular emphasis on the production department and the management support. This was seen as essential as the research is an ethnographic one and some of the data will be based from opinions obtained in interviews in addition to the few quantitative data.

- *The Management*

The aim of the company is to maximise profits by cutting costs wherever possible. This drive for maximising profits has been forced upon *CE* by the main company in an attempt to reduce expenditure. The decision by the CEO of *Company E* to reduce costs by reducing the number of executives in the company has created a sense of insecurity among the employees. The

retrenchment of 3 out of 6 directors (one of them, the Director of Production) and some permanent employees have added to the general unease at the company. The replacement of the production manager who had passed away during this unfortunate time was unavoidable. This has therefore resulted in a completely new production management team with completely new policies at that stage of the research.

- *The production division*

Their goal is to maximise the profit by producing large number of tanks at the lowest costs possible without compromising their quality. Since the standard production line is the main income earner for the company, they have tremendous responsibility to produce quality goods on time in order not to erode the company's image of timely quality products. Their focus was the number of quality tanks produced on the standard line especially. Only the standard line has been upgraded to be a world class manufacturing production system to cater for the ranges of the different models of tanks designed by the company's own R&D department and also to be able to handle the huge work orders.

The line managers rely on the different types of tanks ordered to run the whole production line smoothly, with batches of "difficult" tanks on one line and simple ones on the other. The synchronisation of the supply shops is also essential to produce the tanks on time. Concentrating at the beginning of the production line, bottlenecks at the *Head to Shell* section and the *Spinning shop* are the most serious problems for the line since they produce the main components for the rest of the production lines.

- *The employees*

The perception that the employees have of management's view on them is "work till they drop" attitude. They do get paid slightly higher than average companies but their amount of work is worth more than their current salary since they have to manufacture different kinds of tanks under a fixed time cycle. In

general, the employees equate any additional responsibilities to their normal work as wage increase opportunities. For example, when asked to perform quality checks, they ask for more money, as it does not form part of their job description. Most of them who come from disadvantaged communities are struggling for survival daily.

In an attempt to understand the different perceptions and needs of the workers and the managers, Maslow's Hierarchy of Needs, shown in Figure 1.2 can be used to represent them. The more senior the manager is, the higher up he is on the pyramid of needs. The workers at the bottom of the pyramid do not share all those visions of long-term goals from management. They are interested only by the short-term goals that they can control. Due to the current economic and social differences, the majority of the contract workers do not know about their future since their livelihood depend on the market demands.

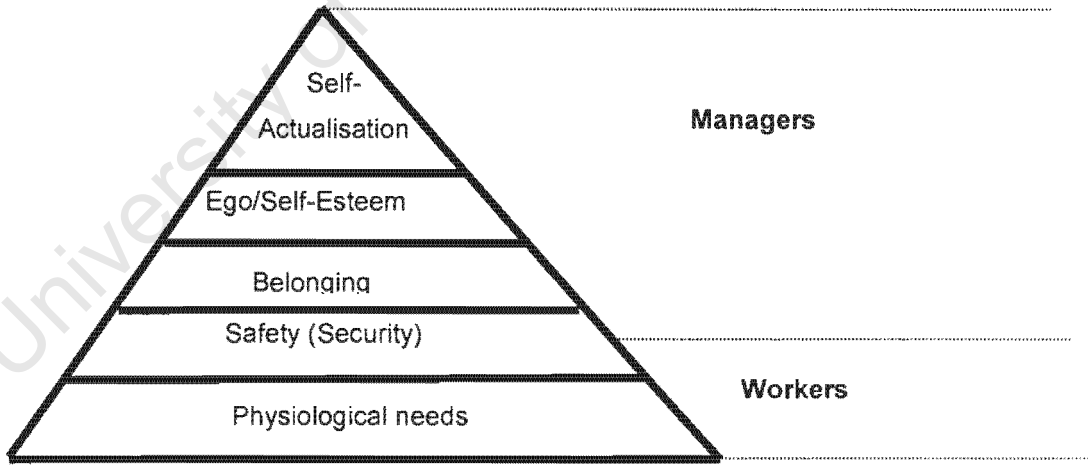


Figure 1.2: Maslow's Hierarchy Of Needs

With such a broad spectrum of needs from the employees in the company, the management's job has increased in complexity. Aligning the differences in the goals of the employees and the company has to be delicately balanced to have maximum efficiency and efficacy from the personnel. The workers are

always keen to climb up the pyramid of needs by earning more money while few management personnel sometimes want to earn a sense of purpose and self-fulfilment rather than money. The current level of education and training among the workers in South Africa is not helping the company's business plans, especially the long-term ones.

The goal of any policies or visions has to be clearly defined to the workers, explaining each steps clearly and logically for the whole company to move forward in the same direction with minimum resistance from the workforce.

1.3 Constraints of the Production Division

Whenever a problem area is considered, the constraints must be known so that effective solutions can be found. There are two types of constraints that exist for any organisations. The external factors are often not under the control of the system and the internal ones are often created by the system itself.

Normally, the external factors are considered to be unmoveable but the Systems Approach advocates knowing them first and see if the boundaries within which the organisation exist can be redrawn. Internal constraints on the other hand consist of mainly "hard" and "soft" issues. The hard issues are often tied with performance, which are easily measurable. But the "soft" issues are often neglected, as it is very difficult to be measured. In this thesis, the importance of both hard and soft issues will be shown and a balance must be achieved to be able to solve problems holistically.

1.3.1 External Constraints

In this case, the following external constraints are:

1. The economic situation in South Africa is going through a relatively rough period. With the Dollar-Rand exchange gap widening, the company is buying stainless steel plates from *Columbus Co.*, a milling factory in South Africa at

international prices. The products are no longer as competitive since the basic start up costs are the same as their international competitors. Only their production costs can be an asset for their overall cost for the tanks.

2. They have only one main supplier, *Columbus Co.* who dictates the price as well as the quality of their products supplied. External suppliers, foreign companies, are too costly to be used, especially with the exchange rates.
3. The distance of *CE* from major customers abroad is also very detrimental to the company. The shipping of tanks is highly dependent on the weather as well as the frequency of ships travelling on the route. And with increasing petrol prices, the transport costs are also cutting into the profit margin of the company.
4. The trend in the market is very volatile. The work order decreases by half in the period of July – September while it can sometimes increase to full order for the next three months.
5. The new policies by the main company that have decided for example to sell off some divisions to cut losses show the gradual decrease in interest.
6. The strength of the labour unions is also a problem for management. The government laws support the unions when negotiations between workers and management are taking place, rendering negotiations difficult.

1.3.2 Internal constraints

The main internal constraints identified here are:

1. The lack of quality products from the workers
2. The level of education and thinking of the workforce and management. Average level of education of workers is standard 8 and the thinking is still based on traditional organisations
3. Unhappy workforce
4. Distrust between management and workers
5. Relatively unclear organisational structure of the company
6. Lack of control from management

7. The off-limits of the Human Resource Department at the beginning of the research due to the complexity of the organisation's internal politics

1.4 The Worldview of the Production Department

The aim of the Production Department is the number of tanks produced, which is then equated with the amount of money made by company. The focus has remained on producing tanks within the allocated time. Whenever they are behind schedule, workers are asked to work overtime. There is always a difference between theory and practical targets as the organisation works on the assumption that all the tanks are standard ones. The target driven organisation is being managed, based on the traditional approach, which is to maximise profits at the expense of the workers. This type of management seems to be typical in traditional organisations.

The Production Department views the workforce as expendable as they employ more than 60% of them are contract. The company has shifted the dilemma of looking for qualified artisans and workers to labour brokers. This has been deemed necessary with the high volatility of the market and the need to cut overhead costs as much as possible in time of low demands. Therefore, the company has decided to hire contract workers who offer fewer problems with union laws and severance pays and also have labour brokers as a filter to the problems from the workforce.

With the high unemployment rate in the country, any job is being sought by dozens of applicants and that has prompted a "don't care" attitude from management in *CE*. There are even workers queuing at the company's main gate everyday, hoping to get a job even for one day. Also, since most of the work does not require specialised skills, management has no plans for education or regular training to increase the workers' skills level. The workers see the organisation as taking advantage of them to the maximum and firing them once

they are of no value to the company. They blame management to be resistant to change. Workers still think that management's way of thinking has not changed from their past.

1.5 The Dynamic interaction between the parts

The system under consideration in this thesis is the manufacturing process. This section will provide the back drop of the environment, structure, function, constraints, and the dynamics, as well as organisational and managerial issues that were identifiable of the company by the researcher. There are 4 departments in the production department. They are the supply department, standard line, special line and the newest of them all, the gas tank line as shown in Figure 1.3. The initial main focus will be on the Spinning shop of the Supply Department and the first part of the standard production line, the *Head to Shell* section. C*ompany E* sees the problem as emerging from Spinning Shop mainly.

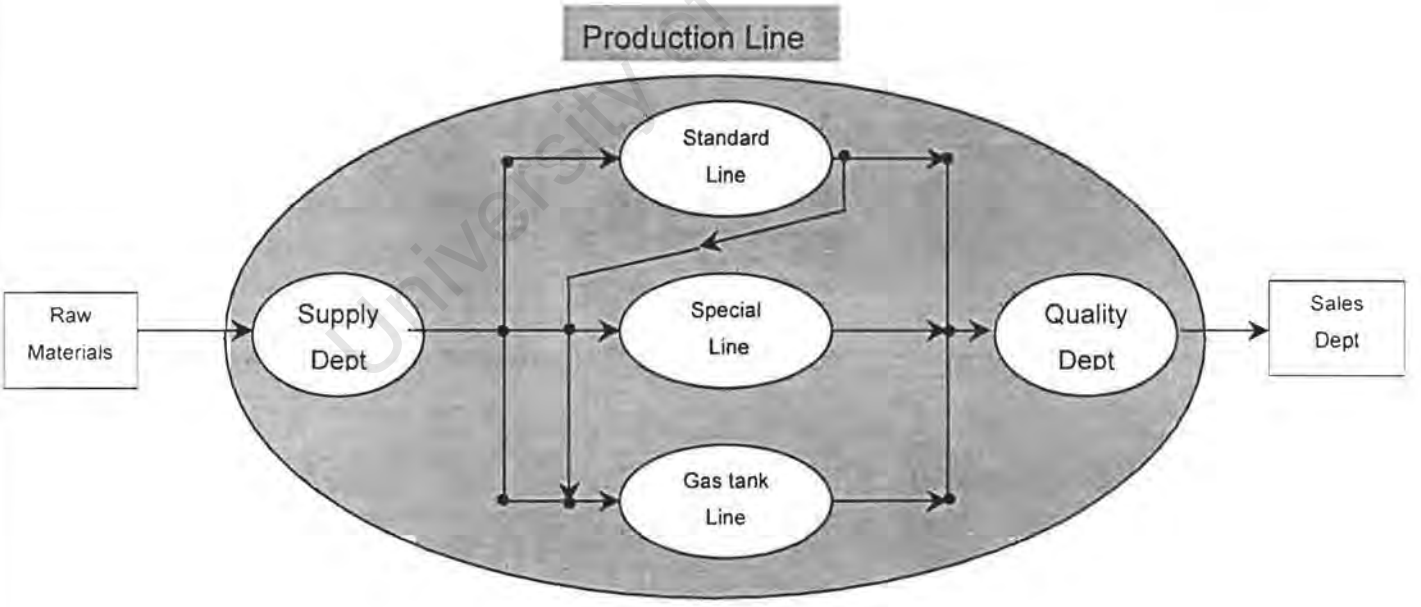


Figure 1.3: The interactions of the different departments

1.5.1 The Internal Supply Department -Spinning shop

The supply department is itself split into numerous smaller sections each one catering for the manufacture of specific parts of a tank. The 3 sub sections are located in different parts of the Co. and each one makes parts for the tanks ranging from small brackets to walk ways. Since the *Spinning Shop* is found in another building separate from the main production buildings, like the other supply shops, it was being included in the supply department. *CE's* supply shops manufacture most of the parts that are needed. They get their raw materials from mainly local cornpanies, where possible.

The starting point of the assembly of tanks is the Spinning shop, which makes dish ends for the tanks, whether standard, special or gas tanks. The flow diagram of the Spinning shop's production can be seen in Appendix A with more detailed explanation of the work process. The main input is the semicircular metal plates which are welded together to form a huge circular plate. The metal plate is then flow formed where the crown of the dish end is made. Knuckling of the dish end is the final physical shape changing process where the knuckle and the skirt are made as shown in Figure 1.4. Then the dish end's interior is polished. A quality inspector checks the dimensions and any other characteristics on the engineering drawings at the end of the production line. The data is recorded and sent to the Quality Control Department. The final product on a completed tank will be a dome shaped metal plate as shown in Figure 1.5.

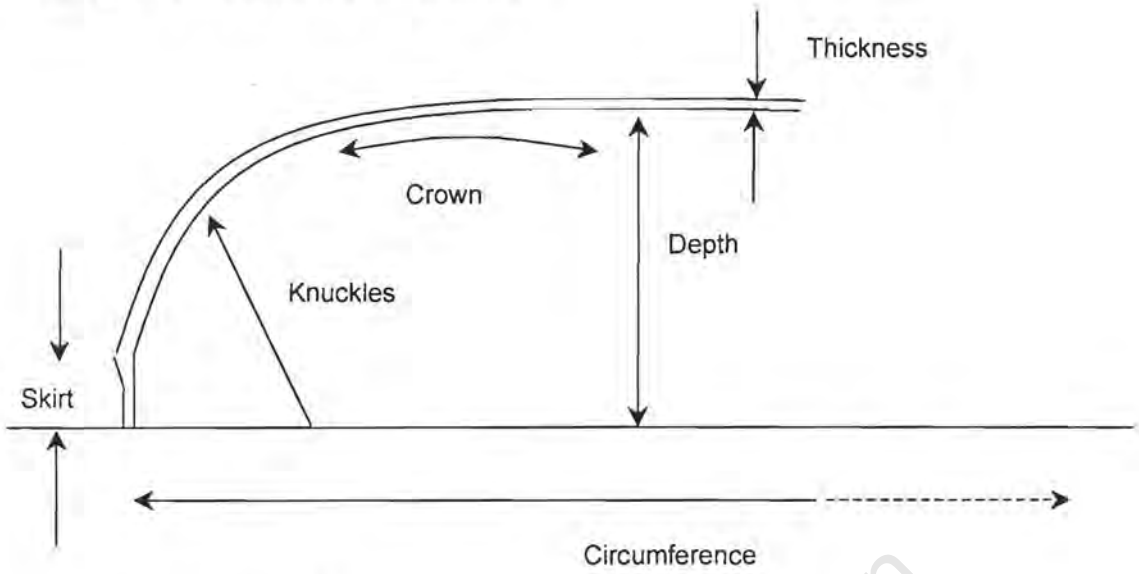


Figure 1.4: The dissected front view of half a dish end

Figure 1.5: The dish end on a completed tank

The workers' performances and outputs are monitored based on cycle times determined by time studies conducted by the Industrial Engineering Department. This is essential since the *Spinning Shop* supplies all three production lines of the company and any delays in that department can stop any production lines completely. The employees work in two teams, day and night

shifts for two weeks, before they change shifts. This was deemed necessary in order to be fair to other workers. The employees have a supervisor to co-ordinate the workflow within their section and a line manager controls the whole section.

Since the department has two machines for each station except for the flow forming station, some of the workers fill in gaps whenever there is absenteeism at certain critical stations. All the supervisors are skilled operators at those critical stations. Based on the current production rate, the *Spinning Shop* can supply the standard, the special line and the occasional gas tanks' dish ends just in time. The gas tanks dish ends are more difficult to make as the plates thickness" are three to five times thicker the normal ones. The production of gas tanks normally precedes the building of a large buffer of dish ends for the other production lines.

The layout of the Spinning shop was recently redesigned so that the flow of materials from station to station is faster. This study was warranted in an attempt to increase the productivity of the dish ends that were being supplied just in time to the production lines. The implementation of the new layout was done two months before the research started at the company.

1.5.2 Standard production line – Head to Shell section

Two line managers, one production manager and a Director of Production initially control the standard production line. But with the restructuring, the position of Director of Production has been made redundant and a new production manager was also appointed. The first section of the standard line is focussed on the assembly of the tanks while the second part is focussed mainly on aesthetics like painting, cladding, labelling of tanks, etc. Each line managers have on average six team leaders, controlling about 280 people for the day shift on two parallel lines. They are the main production line of the company with an average of 66 tanks per week. There is also a repair station, nicknamed "the

Hospital" where unfinished tanks are completed there. That station is mainly for "little reworks" like putting labels on tanks, fixing of fixtures that were unavailable at the time, etc but major works can also be done if the need arises.

The start of the standard line is the welding of metal sheets to make the barrels. The metal sheets are welded together with the last plate trimmed to fit the dimensions required. The plates are then rolled and welded to form a barrel. Depending on the type of tanks, some customers want the weld to be grinded off. This has resulted in the creation of a new workstation that has 3 grinders to do this particular job. Once the barrels are completed, they are then sent to the next part of the *Head to Shell* section where the dish ends are fitted. Using two kinds of clamping machines for different sizes' tanks, the complete shell of the container tank is assembled.

The container is transported to the next station where the barrels are completely welded by automated machines. Then, grinders smooth the interior of the barrels manually. The work at each station is done within one cycle time. Then the tanks are X-rayed for possible defects in the welds. The following stations are then fitting manholes, brackets, taps, etc., which are more of the assembly of container tanks.

The standard line's production is based on the cycle time. Different team leaders meet with their line managers respectively at the end of each cycle to give a feedback on the progress. Any problems found are discussed in the cycle room meeting among themselves where the best solutions are found. Any problems at earlier stations are also made known to others down the line so that they can prepare for the contingencies. The problems and comments are recorded in a sort of logbook and on a board for the other section of the production line to be aware of the progress of the tanks on the line.

1.5.3 Special Line

The special production line deals with custom-made tanks for specific customers. Their production is more on a unit-based system as compared to the standard line. Since their tanks are more complex and require more specialised work, the workers in that department do not operate on cycle times. They run on one single line at times with more or less the same amount of workers at each station. The machines used are the basic ones that the standard line has and some additional customised machines designed for specific jobs.

The production manager and the sales department make the selection criteria for those tanks. For example, if they contain too many extra features that can not be manufactured within the cycle time set on the standard line. This section runs independent of the others in terms of quotas and also on time. Additional tanks are also sent to them during crisis time from the standard line if their work order is very low but that has basically never happened since the "special" tanks are more often "pushed" on the standard production line. This is because of the bigger production capacity of the standard line.

The Special line's capacity is almost doubled the standard line during off peak season. Often, the workers from the Standard line are transferred to the Special line. This situation helps to balance the workload throughout the whole year. The prices for those special tanks are at least one and a half time more expensive than the standard tanks since the customers are charged on the basis of the amount of time spent on their customised tanks. The Special line sometimes compete with the Standard line for parts from *Head to Shell* and *the Spinning Shop*.

1.5.4 Gas Tanks production line

The latest addition to the production of *CE* is the gas tanks. This production line was bought from a specialised company of gas tanks. The

production line was being set up at the time of the research and the tasks were to design the layout of the machines and analysis of the workflow. Evaluating the design of existing machines and the time studies are being done to try to determine the optimum working conditions for the gas tank production line. The production line will be running on a job shop system until the work order increases and also until a work process is designed for that line. The production line was not fully operational at that time and also not within the scope of the research.

1.5.5 Sales Department

The Sales Department is in charge of translating the customers needs' to technical dimensions. They work closely with the design department to evaluate the possibilities of certain customers' requirements and also the delivery time needed by the customers. After consulting with the design team, the pre-empt team then takes over by checking the list of parts that are needed from the supply shops to the production line. Once they are satisfied with the list, the sales department discusses the delivery period of the tanks with the manufacturing division. Once that has been agreed, the tanks are paid in advance and the planning of the production can begin.

The pre-empt team draws out the lists for all the parts needed for the tanks and they are then sent to the relevant departments. The supply shops are given approximately a ten-day lead to prepare the parts for the standard line and a fifteen-day lead for the special line. With one pre-empt engineer for the whole company, the tasks are planned very meticulously to be able to produce the different models of tanks (about four standard models of tanks but with a wide range of dimensions) on time and of highest quality standards. The Quality Department helps them in their goal.

1.5.6 Quality Department

Quality department works with all the other departments to set up the achievable standards by the operators. They continuously re-assess the quality standards in an attempt to improve them. This is in essence easier as *Company E* has its own design team and based on their experience in tank manufacturing of about sixty five years, the standards can be immediately known to be achievable or not. This relationship reduces the testing time for quality standards for new models.

As for the reporting system of defects, it is through the normal meeting channels as well as group reports. They are often made when the daily data is collected from the production line. Meetings are held whenever there is a crisis on the production line on the quality of certain parts or craftsmen ship involved. With real time data essential for the production line managers to make their decisions, the Quality Department has introduced a new fault reporting system called *Lotus Notes*, which is accessible to all qualified personnel in *CE*. The feedback of the defects can be done through the software, designed by their IT department, in an attempt to increase the response time to decisions on the lines.

The format of the electronic form is very simple and probes the root cause of the problem. It even displays the identity of the person for finding the fault and for solving the problem. The problems can also be categorised as CAR (like engineering design fault, also named as Corrective Action Report) or simply a mistake (workmanship mainly). These steps ensure that the Quality Department follows the ISO 9000 series on the whole company's production lines and that the products made from *CE* is of the highest standards.

1.5.7 Maintenance Department

Maintenance Department is concerned mainly in keeping the machines in good working conditions. They have grown from maintaining a small fleet of

machines from the job shop to the World-Class Manufacturing era now. They have also the job description of building equipment and machines based on own designs from production and industrial engineers. They are still doing both jobs with a staff of 32 workers including four engineers.

Their normal maintenance period is during the period of December where the company's production is low enough to do maintenance. Normally, periodic maintenance is done only when there is a decrease in orders. But with the plant running twenty-four hours a day, almost seven days a week, the repairs of breakdowns then become the standard procedure and not really preventative maintenance. This was observed during the period spent at *CE* but a reminder must be made that at the time, the company was focussed on reducing the backlog of orders and also meeting the end of the company's financial year targets.

1.6 Developing the concern

The concern developed by anyone often starts with the conflict of personal ideas or paradigms to the one discovered in certain situations. This will then go through the normal reasoning process, which are the question, theory, action and evaluation cycle (Kolb's Learning Cycle). It is through these stages that a certain hypothesis is developed to test the validity of the concern. The formulation of the problem will also depend on the understanding of the situation and the dynamics of the parts involved.

The concern is then analysed with different theories that might give a close diagnostic of the problem and therefore a possible cure. But the fallacy with these theories is that they were based on certain tacit assumptions and situations. They can not be directly applied to the problem. Modifications need to be made to certain theories once they have been properly understood to be able to modify them to fit the situation. But some managers apply these famous

concepts to their organisations and expect them to work but the results are often surprising.

The problem area viewed by Management is first analysed to see its validity as the true problem or if it is a cause of some other problems hidden in a web of seemingly trivial matters. This preconceived notion of a specific problem may also be apparent only to Management and not to the workers. The in-depth probing will then give the reader the logical build-up of the problem identification and also of the recommendations to solve the problems. In this thesis, some of these issues seen by the company do not coincide with the evaluation of the researcher on the problems identified.

1.7 An Overview of the Problem Situation

With the huge fluctuation of the container tank market, Management has to ensure that the quality of their tanks produced is up to international standards. Also, top management is facing a dilemma of making more money for the Mother Company to keep their shareholders' support. This has resulted in the redesigning of the standard production line into a world class manufacturing plant to be able to produce tanks more efficiently and a streamlining of the company's core business.

Top management has also looked at an external consultant company to help implement the process of Quality Control. This program is a slow and methodological process with focus on some key measurements of the performance of the production line. Revolving around the 5 main concerns of management (namely Quality, Cost, Safety, Delivery and Morale), the company has started to use these data to have a general idea of the situation on the shop floor and ways to control them.

The company is using these key indicators since last year when lectures were given by the consultants, not only to managers but also to workers, advocating their importance. The trend is to develop an awareness of the situation on these different areas of concern at all levels of the organisation. There is one person in charge of this program and he has allocated times to monitor the use of the two taught concepts (Business Idea and the Visual workplace from the consultants' syllabus) in the different departments. Audits are conducted regularly every two months. But there seems to be a lot of problems in co-ordinating these activities. Workers do not seem to be supportive of the program, as the results are not obvious to them. What they see is management's lack of trust in them and their continuous attempt to use them as machines in their work and now, new ways to monitor them more closely.

One company's action has reinforced that belief of distrust is the continuous firing of about 40 % of the workforce, mostly contract workers, annually to cut their overhead expenditure. This has been a repetitive move from the company for the past 5 years with a particularly hard cut this year with about 40 permanent staff in addition to the 40% workforce retrenched. But in September, as the work order increases, the retrenched workers are expected to be re-employed again. This trend is badly viewed by workers as they see that as some sort of conspiracy from management to control the workers by threat of retrenchment.

Some of the new recruits from the new intake in September have to undergo a steep learning curve since the standard line deals with more than 6 different types of tanks normally on one day. Also, the environment is different from what they are used to. For example, the new welders are not used to weld either standing or lying in a tank. The new employees are pushed into full production since the customers have already ordered the tanks. There is no formal training within the company since these workers are expected to be qualified for their job as part of the company's labour broker's selection.

Therefore, the experienced artisans are often teaching their new helpers of the quality expected from them on the production line. This informal training do not form part of the company's regular training program.

Company E has managed to keep a relatively large international market share because of their flexibility in the types of tanks produced. The design team of the company can accommodate almost any type of tanks on the standard production line based on the modifications from the customers' specification. If the modifications are too complex, they are then sent to the Special Line. In business terms, the company is very good at satisfying the customers needs but for the manufacturing department, this diverse number of tanks is a nightmare in terms of logistics, planning and workmanship.

1.8 The Emerging Concerns

The management of *CE* perceived the problem as dish ends problems in their attempt to reduce their defect rates on the Standard production line. This was prompted by the recent rejection of certain tanks by customers on the shape of the dish ends. The main complaints by the customers are the "pockets" that retain liquids. This "pocket" not only retains products from previous usage but also the chemical agents used to clean the tanks. Even a little amount can cause major losses to these leasing companies as well as their customers on the quality of their products. Management of *CE* has been forced to look into ways of avoiding a repetition of this problem. They have decided to start implementing quality control measures at the beginning of the tank assembly and therefore the focus was on the *Spinning Shop*.

The starting point of this case study was in the *Spinning Shop* of the Supply Department. The problem that the operators of the *Spinning Shop* have is the knuckle radius (Refer Figure 1.4). The control that the operators have on the knuckling relies on the end point of the flow forming which creates the crown

radius. Overknuckling and underknuckling are the main causes of defects that the operators make (as shown in Figure 1.6). The quality of the Spinning Shop is dependent on the operators' experience and skills.

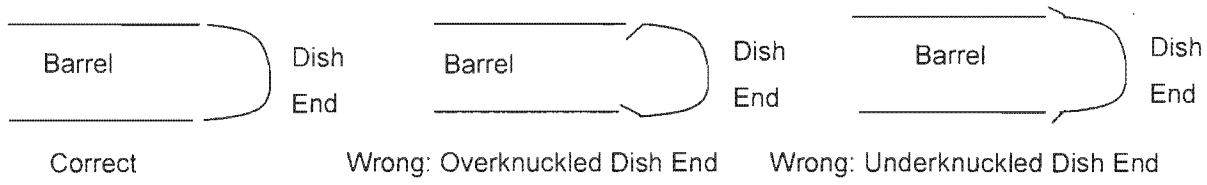


Figure 1.6: Overknuckling and underknuckling of dish end

The practical methods used on the shop floor to measure that the skirt is "straight" (perpendicular and not skewed to either side) is almost impossible. Even though the defects of the dish ends may seem to be easily noticeable, the skirt of the order of 1mm is difficult to judge if it Is straight or not. Templates, made of wood, are being used to measure the correct dimensions. The current method employed is to compare the dimensions with a template to measure the crown radius and knuckle radius (as shown in Figure 1.7) at the workstation. As for the skirt of the dish end, there is no control mechanism in place to verify the dimensions. The Quality Department had worked out a measurement solution, namely that the gap between the template and the dish end should be based on a percentage (6%) of the diameter of the dish end for it to be acceptable.

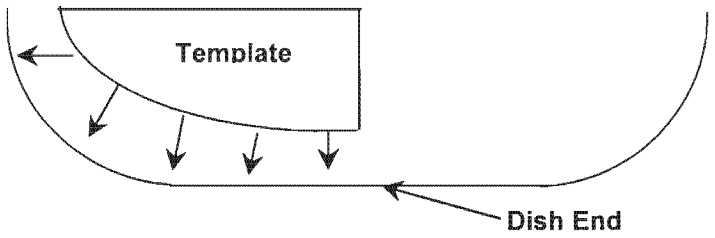


Figure 1.7: Method of Measurement of Dish End

As for other dimensions, the whole dish ends' tolerance for its circumference must lie within the range of +0mm and –4mm but workers can work with a range of +3mm by "squeezing" the dish end to fit the barrel. This practice is often done and that sometimes cause problems to the next stations when the dish end "pop" out. Even though it does not happen often, this practice is very costly to the company. In the instances where the dish ends are too big, they are returned to the *Spinning Shop* for rework but these little problems are not recorded in any documents. Verbal agreements are the common method of solving the problem.

The first attempt to track down when this "problem" surfaced was unsuccessful, as there was simply no records of it. Another interesting thing about that is the awareness of everyone on the shop floor of the problem but nothing has been done to solve it permanently. As for the regularity of the problem, it can not be traced to any specific day or shift. Within the three months spent at the company on the shop floor, these problems seem to have vanished completely with the exception of a few cases which was "accounted" for.

Another possible reason of the mismatch was the different sizes of the barrels after being rolled. That in itself was due to the different dimensions of metal plates bought. The supplier of the metal plates seems to be at fault with their distorted product. The inspections carried out at the *Head to Shell* Section of the Standard Line on each metal plate are to look for defective shapes (as shown in Figure 1.8) or wrong dimension plates. Measuring about hundred plates each day and cutting them to fit the required dimensions is boring and that has sometimes resulted in defects slipping through the control points to the production line.

Figure 1.8: "Banana" shaped metal plate

Even with standards set by Quality Department, some workers are using their judgement to pass certain products without knowing the problems faced by others down the production line. The functioning of the whole company as a complex system with interrelated parts does not seem to be understood by some of the employees. The quality of work of every workstation is all equally important for the production line to run smoothly. Pushing a below standard product down the line builds up more pressure for the other workers to perform their duties and the reworks within the cycle time. Mis-aligning the plates when rolling the barrels is an example of lack of accountability. It is a cheaper option to rework the dish ends rather than "rework" the barrel. The workmanship as well as understanding of the whole system is underestimated among the operators.

Looking at this type of problem raises another concern. The control of management team on these issues seems to be very weak. What type of management structure exists at the company that is filtering seemingly trivial information happening on the production line? What kind of organisational structure does *Company E* has to develop a learning organisation throughout the whole company to aim for an effective and efficient method of production and also to learn from failures? These futuristic new management and production concepts will only be successful if the support and the qualified personnel make them work for *CE.* Therefore, an attempt to implement a new Shop Floor Management will only be successful if the management is supportive and keen to explore the existing situation on a qualitative level in addition to quantitative research.

Chapter 2– Framework of Research

Ethnography was chosen because of the situation in context which is mainly an exploratory research based on seemingly structured data initially. Since the hard data are not accurate, the main source of information is based on *"the observation of human actions, namely verbal descriptions and explanations"* (Denzin & Lincoln, 1994) while the hard data is being used as a support role in the overall analysis. Ethnography can also be used to possible compare the image that hard data and soft issues project to the researcher.

This case therefore needs a research method based more on the soft rather than the hard issues. Qualitative research is therefore preferred to Quantitative research as the data are mostly based on interviews and observations. As the research was performed in a very labour intensive environment, this adds to the value of Qualitative research as the main investigating tool used.

2.1 Definition of Qualitative Research

Qualitative Research is *a multimethod in focus, involving an interpretive, naturalistic approach to its subject matters* (Denzin & Lincoln, 1994). It is often exploratory and inductive as problems emerge from patterns in most of the cases. The theories are often generated from the gathered data, as each problem is unique in its own environment. The use of a variety of interconnected methods to narrow the area of concern is also another strong point of qualitative researches.

Since the situation under study involves a new environment in which the researcher has to analyse not only trends but also the different perceptions perceived by the actors in the environment, qualitative research is required in

addition to quantitative research. Quantitative research only can not provide all the answers needed as the problems will be treated mechanistically and the solutions will not be viable for the long term. The emphasis on qualitative research is to draw out the human aspect of the problems in addition to the scientific facts used.

Qualitative research uses multiple methods to capture a rich picture of the situation so that the both hard and soft issues are taken into consideration. Levi-Strauss (Denzin & Lincoln, 1994) referred to the researcher as a *bricoleur* (a "Jack of All Trades") as he is continuously modifying his mental models based on any new information. This continuous reassessment of mental models creates an *emerging pattern* of the way of thinking of the researcher according to Weinstein & Weinstein (Denzin & Lincoln, 1994). This is a powerful tool as it can be easily adapted to any research where the problem is not clearly defined and in which some new methods have to be devised by the researcher to get the wanted information.

This rest of this chapter will be mainly on the characteristics of Qualitative Research and its advantages over Quantitative Research. Some of the tools used to promote qualitative research will also be highlighted in this chapter. For example, SSM is used to collect data while the VSM is being used to understand the behaviour of organisations. Both of them will form the learning organisation framework in which the research is undertaken. The focus on quantitative research will be minimised, as it is a well-known method as compared to qualitative Research.

2.2 Advantages of Qualitative Research

The flexibility of Qualitative Research has created a sense of unease among quantitative researchers based on their lack of unscientific methods used. This is due to the fact that the method is based on the perception of the

observers who might not have covered all the areas of the problem. Referring to Figure 2.1, the difference in perception is being compared to the refraction of white light through a prism. Depending on the researcher's paradigms, the complexity of the situation can increase dramatically especially when the problems are hidden through layers of interactions of different sub-systems.

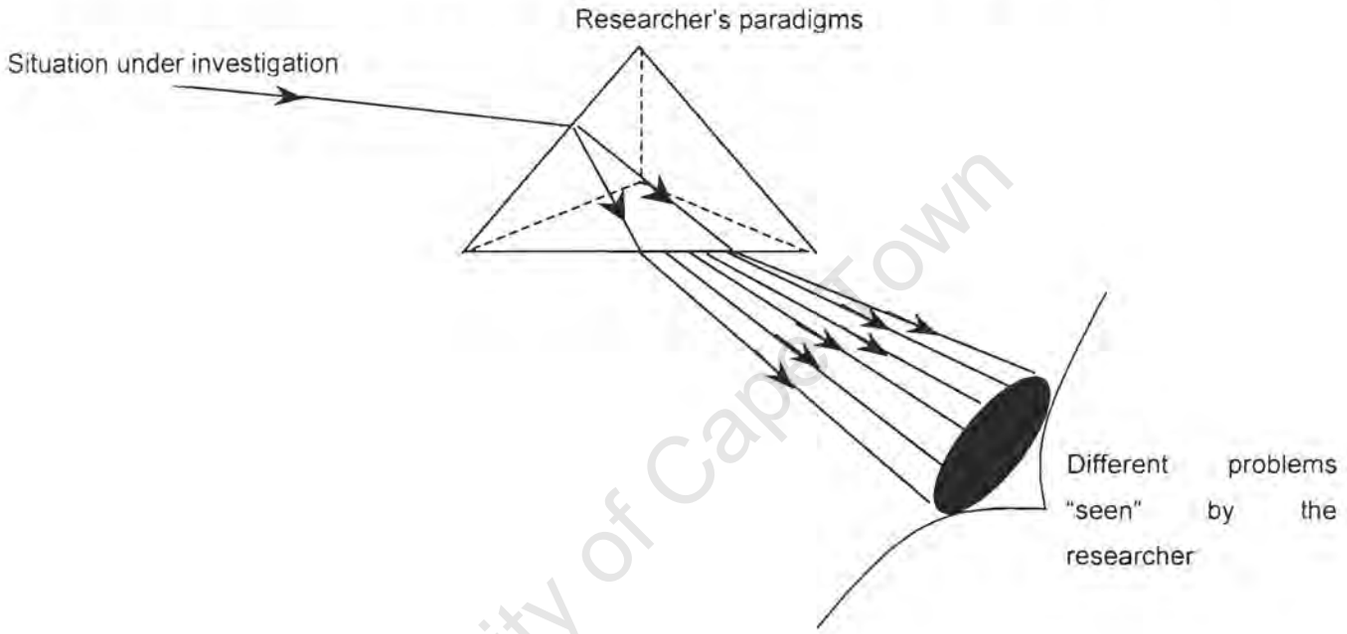


Figure 2.1: The effect of researcher's paradigms on analysing problems

Qualitative researchers are normally better equipped to capture individual views because of their open mind. They rely on their observations not only of the situation but also the behaviour of the actors in the situation in context. The "soft" issues are often neglected as part of the problems and that has caused system failures in some cases. Morale and work conditions are some of the aspects of real life that qualitative researchers look for when analysing problems while quantitative researchers are more reliant on scientific methods and mathematical models concerning outputs for example. The decisions based on "hard" issues are well known and are rarely refuted but their results have been less and less positive with time, showing that the conclusions drawn are not complete.

Scientific models are essential for any benchmarking exercise but sometimes, the variables used are very difficult to measure if not impossible. An example is the morale of the workforce in a company, which still can not be measured accurately, and yet, some of the measurement used is being accepted as THE correct measurement like the attendance of the workforce as a measurement of morale. The effect of morale on productivity is not immediately associated with quality but quality with productivity. Quantifying every single variable has created the tendency to omit the relationships that caused the problem and not their individual presence.

The tendency of quantitative researchers to use averages to set up standards for all situations has caused confusion when the results are unexpected. Statistical Process Control is one of the scientific methods that calculate those averages but as for their applicability in some situations, it remains uncertain. These averages are normally valid within a certain set of conditions which quantitative researchers neglect in their reports. When these averages are generalised for other situations, problems appear. Qualitative research provides the relevant environment in which the averages were calculated so that viable modifications are performed or even in some cases, change the way the problem is being viewed.

These targets are sometimes revised based on external sources especially when a new theory or method is successful at their competitors' organisations. Its applicability within the current organisation is often neglected in their attempt to achieve success. And the main reason is the unknown paradigm that their competitors operate in. Each organisation's strategies are different as they are based on their specific paradigms. Normally, their operational procedures are derived from their paradigms and on their core competencies. If their field is more related to a service industry, then their focus will be more on the social aspects of problems for example.

In this study, the focus will be on a learning organisation paradigm in which the existing organisational and social structures are analysed. The methods used to investigate these specific functions are *Soft Systems Methodology* (SSM) for the social and *Viable System Model* (VSM) of Stafford Beer for the characteristics of organisations. Both methodologies will be relying on "soft" data mainly in this case. The paradigm in which this research will be conducted is shown in Figure 2.2. The "learning" paradigm will be shown to be essential from the data gathered from both the VSM and the SSM with the same information gathering techniques but just different analysis method.

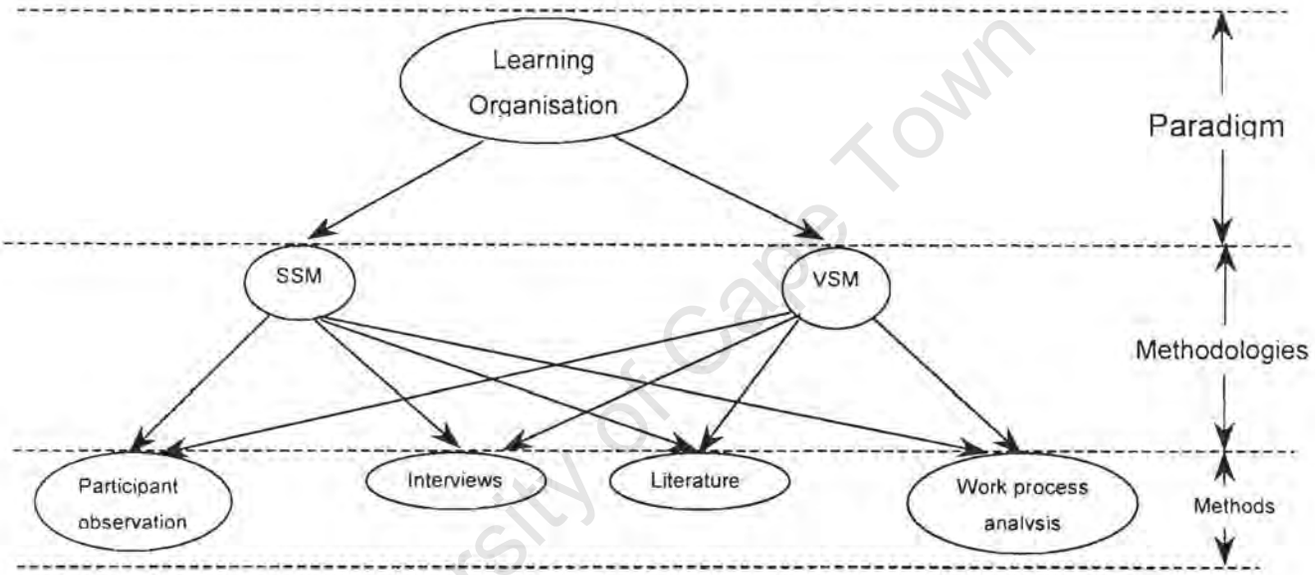


Figure 2.2: The paradigm of a research

2.3 Cybernetics

Cybernetics is also known as *the science of effective organisation (Beer, 1979)*. It was created to deal with systems that possess these following characteristics (Clemson, 1984):

Complex – More details than what the observer can record

Dynamic – Constantly changing behaviour or structure

Probabilistic – Some of the behaviour of the elements are partly random

Integral – The combined action of the elements have a huge impact

Open – The effect on their environment and the environment's effect on them

All these characteristics form part of systems thinking' definition and these definitions can also be applied to most organisations. With complex interactions continuously varying with time, the prediction of systems is further compounded by some random nature of elements in the system. The two-way relationship between each system and the environment also increases the complexity. But among this seemingly chaotic environment, most systems obey the three laws of Systems Thinking, namely: *Self-Organising Systems, Feedback and Law of Requisite Variety.*

Most of the systems possess to some degree part of these laws but they all lack a solid structure for them to deal with disturbances when the organisation undergoes changes. They are often not complex enough to deal with the information assimilated from both the internal and external environment. This research will be built from the definition of these three laws and their input on the different models used to have a better understanding of the situation.

2.3.1 Self-Organising Systems

Since any system is made up of numerous sub-systems, complexity exists at different levels of recursion within the organisation. Each level has its own methods of self-organising to be able to function within the bigger system. The interactions between the parts form the core of problems most of the time as the survival of one system normally means consumption of resources intended for others.

These systems have coped with the instability at some level but often, the frequency of these disturbances exceeds the system's ability to deal with it. Also, the time for systems to return to their stable state takes too long (according to the managers for example) and the interventions are added to the disturbances. The interference caused increases the complexity of the problem, resulting in an uncontrollable problem. But this interference is often based on flawed data that can be irrelevant at the time of analysis but valid at time of capture. Therefore, timely feedback is crucial for constructive solutions to be found.

2.3.2 Feedback

The output of any system must be continuously reassessed with the initial goals set by means of a feedback mechanism. But the problem is the real time data that the system needs to be able to provide corrective actions. Often, the data is outdated by the time it reaches the problem solvers. As the problem is left untreated for a period of time, it escalates to another level of complexity. The feedback is then considered as not performing or non-existent in some cases. In some cases, the outputs can be measured accurately but in other cases, they are only indicators of something more complex and often hidden.

Some outputs' feedback do not give hard data but possible causes of problems. For example grades in school do not reflect the personal learning of the student but what the system considers to be essential. The amount of dropouts can give a better example of how the school is performing based on their students' eagerness to learn. In this case, the system does not cater for the needs of the individuals and therefore, no data is fed back to raise awareness for corrective actions to be taken. Any characteristics classified by the system as important will have feedback.

The law of feedback is therefore to look at the general situation and implement checkpoints at different parts of the system to deal with possible

errors. Its' goals are to have a faster response to problems and a better monitoring process for any new changes implemented. These check points then need to possess variety, which is reflected in the third law, which is the Law of Requisite Variety.

2.3.3 Law Of Requisite Variety

The law of Requisite Variety states that to be able to solve complex problems within a system, the regulators must possess the same level of complexity as the system. The numerous checkpoints in a system filter out the problems at each stage so that only the relevant ones reach the intended regulators. An example is the ability to solve problems is based on one person's knowledge. Once that the complexity of the problem exceeds the problem solver, a more qualified person (better regulator) is brought in. This often happens with consultants that propose their huge human resource services to their customers.

But problem solving also relies on the understanding of the interactions of the sub-systems. This is because some parts regulate others and this can help to design better systems that can self-regulate each other. The variety of the system and regulators therefore depend on the creators of the system to be able to have an efficient self-organising system that requires minimum intervention. The capability of the control mechanisms is closely monitored to prevent any problems from filtering through and if needed, the regulators can be upgraded where possible. Therefore, Stafford Beer created a practical model, namely the Viable System Model that takes into consideration these three laws (explored in greater depth in Chapter 6) since SSM is only good at theorising not really at implementation. The need for another tool to assess the feasibility of implementation is to focus on the organisation's structure to deal with the changes. But SSM is first used to define the system and its different characteristics for future analysis.

2.4 Soft System Methodology (SSM)

SSM was initially designed by Checkland and his colleagues (Checkland, 1981) to capture the social aspects of problems and learn how to solve them in a holistic way in the Systems world first, then to the real world. This method ensures that the problem is well thought in the "systemic world" in which different tools are used to explore their limits. SSM is used mainly to identify the main sub-systems that are functioning as a whole in a specific environment. It ranges from the main actors within the system to the environment, with the understanding of the transformation processes.

This method triggers the mind to identify the problems and select the appropriate systems' tools to learn from the process of problem solving. The process also involves defining the different sub-systems that exist. One particular "tool" that SSM advocates in identifying the main systems is the CATWOE mnemonic in which complete root definitions[1] are used to help define the system. Once the root definitions of the system are known, the problem can be analysed with better understanding and of greater value. The whole process forms part of a learning cycle where the appropriate questions are formulated to the relevant areas.

SSM's main data gathering method is through interviews, participant observation, literature and work process analysis. Most of the methods mentioned are dependent on the researcher's ability to develop an inquisitive mind to draw information from different sources so that the results are cross-referenced. The literature then provides the direction that the researcher should be looking at whether the problem is relevant to a more social or technical context for example. The need for hard data is also essential for some basic scientific knowledge to understand the concerns raised.

2.4.1 *Interviews*

Interviews are normally the formal inquiry process with senior personnel within an organisation. Depending on the availability of the "actors", the frequency and type of interviews are adjusted accordingly. Formal and informal interviews are both important data gathering tools based on the environment in which the investigation is being carried out. Sometimes, informal interviews are more of a trust building exercise between the researcher and his information source as a stepping stone for future "co-operation". Formal interviews are often conducted with a very precise goal in which information is gathered to either prove or disprove a mental model formed.

A well-prepared interview can also be modified depending on the reaction of the interviewee. This will then depend on the experience of the interviewer to be able to notice possible areas of discomfort or lies that are being told. Notes can be made to cross-reference them with other sources of information. The depth at which a situation can be probed whether formal or informal will be determined by the ability of the interviewer to notice any changes. Therefore, interviews are not only conducted based on a fixed plan but also on the psychological aspect, thus bringing its shares of complexities in the problem identification.

But one very important aspect of interviews is not to reveal the sources of information to others to prove one's reliability. This also shows the information providers that their anonymity will be preserved at all costs to ensure that no punishments can be taken against them. To be able to receive continuous information from all sources, the researcher must not take sides by making biased remarks but rather leaving open-ended questions where the interviewee will give his opinion on the matter. This is why the interviews are normally

[1] C = customers (beneficiaries of the T process), A = actors (who can make things happen), T= transformation (changing inputs to outputs), W= worldview, O= Owners (those that can stop T) and E = environmental constraints (external known elements)

conducted with a background information given by the interviewee so that any gaps can be filled in based on their inputs. This is to complement the bigger picture that is often hidden among layers of semi-truths.

Interviews can not provide them with all the necessary information and this is why participant observation is also needed to bring its share of input in problem solving. This method adds a new dimension to the social aspect of the problem under investigation.

2.4.2 Participant Observation (P.O)

This method of research is often needed as the situation has its own specific characteristics that make it a unique situation. To be able to properly analyse it, the researcher has to be part of the problem and draw his own conclusions from it. But one must also be aware of the changes that will be brought along with the presence of the researcher whether he is just an observer or a participant observer. That is why his function must be clearly explained to the people in the different sub-systems to reduce the chances of false data supplied by employees.

The level of acceptance of the participant observer will depend on the trust between management and employees. Normally, any research conducted by an outsider is considered as a warning to the employees as an imminent change within the organisation. Therefore, "blending in" the internal environment can be harder if the relevant data is hidden. Queries raised during observations must also be thoroughly examined for possible negative effect to the workers in the future. The goal is to understand the work process at that stage with any other information considered as bonuses. P.O is a time consuming process that can generate a lot o information if properly implemented.

The other possible problem that the researcher faces is "to become one of them" as the time frame of the research is lengthened. Small breaks can be included as the researcher moves to another sub-system to increase his knowledge of the broader picture and be more objective when analysing the first situation. The small break also allows the researcher to reformulate his mental model of the situation and thus improve his participant observation techniques for the next stage of the learning process of data gathering and self-learning also.

2.4.3 Literature

The knowledge of these theories and models is obtained from other researches. The aim is to look for practical and successful applications, which can be applied to the current case. Understanding the reasoning process allows modification of certain parts of the model to become a better tool. As more and more information is obtained of the possible limitations of the models and theories, the search for a model, which is more adaptable to the current situation, is undertaken. The aim of the literature for this case is to understand the tacit assumptions on its impact on the model used.

Literatures also shorten the trial phase of the models or theories as some of the practical work has been already tested. These sources of data also provide alternatives on other researches that can have a greater chance of success depending on the environment. The published researches can also narrow down the areas of concern where specific tools are used. For example, a diagnostic tool can be used to pinpoint the major areas of concern and appropriate models can be used to investigate them. This reference to other articles also strengthens the learning curve of the researcher in finding the relevant articles based on the right problem formulation.

Therefore, literatures give an insight not only on the content of the research but also on the key indicators when problem formulating and data

recording. Once these two methods are reached, the quality of the research has a foundation on which it can be built and improved.

2.4.4 Work Flow Analysis

Workflow analysis allows the researcher to play a more active role in understanding the situation under investigation. With some basic calculations to form the starting point of the research, the researcher is made aware of the way the whole process is being measured. Ratios and other statistical tools also provide standards on which the situation can be benchmarked. Often, these numbers has changed the way the organisation is managed. One of the most common mistakes is to eliminate defects through costly quality plans when the basic structure is non-existent for a quality conscious workforce.

Apart from the workforce, the system is then analysed for possible changes in its operation. For example, if there are numerous bottlenecks on the production lines, then JIT system can not be implemented without major changes in the organisation. The responsibility is not solely on the workers to produce defect free products but on the organisation for not providing the constructive environment. This is because the needs of the organisation clash with the way it was designed. The workflow analysis can provide some indication on how the organisation is being managed and if their current vision is aligned with the organisation's vision.

2.5 The Reasoning Process

With the methodologies mentioned above, there are mainly three types of reasoning when analysing problems. Each one can be used at certain stage of the research depending on the information that is being collected. The advantage of Qualitative research is its flexibility in changing sometimes the inquiry process as problems might change from an inductive to an abductive reasoning process.

Once the concern is formulated, the next stage is the inquiry process by which the research is going to be built on. There are basically 3 types of reasoning processes that are being used in the inquiry framework namely – *Induction*, *abduction* and *deduction*. For the three cases, the researcher starts with an inference, which leads from an initial premise to a derived conclusion. Pierce (Minto, 1982) mentioned that in any situation, a case, a rule and a conclusion will always be part of the reasoning process.

A Case – an observed fact that exists in the world
A Rule – a belief about the way the world is structured
A Result – an expected occurrence, given the application of the rule and the case.

Depending on the situation involved, the problem can be analysed by any of the three methods mentioned earlier. But in problem solving, there is always the use of all three types of "thinking" at some stage in the research. A brief explanation is given on each of them.

2.5.1 Induction – Inferring a rule

In this process, the analysis starts with a case, which is often started by some action. The results are observed and recorded. They will then be tested against existing rules, whether satisfying them or not, are corrected if necessary as shown in Figure 2.4. The researcher then assimilates the "new" theories.

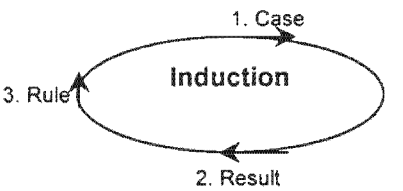


Figure 2.4: The Inductive cycle

2.5.2 *The Deductive Cycle – Inferring a Result*

In this cycle, the starting point is hypotheses that are used to try to explain the problem. Then, the outcome of the thinking process is deduced as shown in Figure 2.5. The "result" in this case will hopefully be addressing the concern. But with this cycle, the result might also be influenced not only by the process but also by the experience of the researcher in the field.

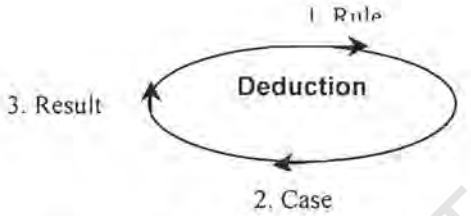


Figure 2.5: The Deductive cycle

2.5.3 *Abduction – The Explanatory Hypothesis*

Abduction is the process of developing a hypothesis. This normally occurs when the problem faced is unexpected. The researcher then uses his knowledge to try to understand the situation and develop a hypothesis for it as shown in Figure 2.6. This learning process's starting point will depend on how the problem is being visualised as subtle changes modify the way the problem is analysed.

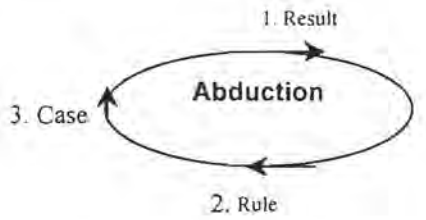


Figure 2.6: Abductive cycle

In this research, the problem faced by the inquirer is being analysed using all three types of reasoning at different stage of the study. The formulated hypothesis will be more focussed on understanding the whole reasoning process rather than **a solution.**

2.6 Developing the Hypothesis

Starting with the problem seen by the Management of *CE* as a quality problem in the *Spinning Shop* of the Supply Department, the analysis seems to be coming from an inductive point of view. The defective dish end is seen to be the problem and the result is to implement some kind of quality control to filter out the defects before reaching the customers. Therefore, Management wants to set a new rule (Total Quality Control) based on the case (defective dish ends) and results (defect free products) obtained.

To solve the *Spinning Shop's* problem, an overview of the whole manufacturing process must first be understood. The next stage is to try to isolate the incident to find out where and when did the problem arose. It was through the findings of these simple start-up questions that the problem area seems to have shifted to something bigger involving the different interactions of the departments, the understanding of the bigger system and most importantly, the "soft" issues involved. The focus has then changed midway as the inductive thinking of management does not seem to be the best fit to solve the existing problem. The abductive approach was then chosen by the researcher in an attempt to find the true causes and develop an own framework if possible, as most of the theoretical theories have been violated. It is through this first learning cycle that the following assumptions were found to exist at the company:

- The system is treated mechanistically, focussing on one department and not on the different interactions that might have resulted in this situation
- The quality standard seems to be different at different parts of the company
- The "soft" issues of the company are not addressed
- The communication channels between departments seems to be disorganised
- There seems to be problems in the organisational structures

Judging from the above problems identified, the following hypothesis are formulated:

- The strategic planning of the organisation seems to uncertain about their vision as the control mechanisms are still very poor in terms of regular and self-organising.
- There is no quality and learning culture among most of the company's employees. The problems seem to be repetitive and the employees are unable to solve them.
- The support from other departments' are also very low as they are faced with their own internal problems on quality issues.

The first step in solving the problem will be to narrow down the root causes of the problem and not the symptoms. Then, classification of the "hard" and "soft" issues is needed, as there are different methods for solving each one of them. Normally, "hard" issues are more easily solved because there are robust scientific methods for achieving the goals in relatively short term. But "soft" issues are different as the changes are focussed more on the long term and the tools used must be customised to the situation. Synthesis of both methods is essential for the solutions to work.

If the problem is solved in terms of "hard" or "soft" issues only, then a failure is expected sometime in the future, depending on the amount of tampering that will occur during that period of time. Applying the abductive rule of reasoning to the present situation, the *result* is the current situation at the world class manufacturing company (Chapter 4). The *rule* is the normal way a company is being managed (chapter 3, 5 & 6), in the case of *CE,* the Production Department. The *case* is the failure of the organisation to learn from its failures even though they are among the leaders in the international market. The problem emerging from *Company E* can be better represented by Figure 2.7

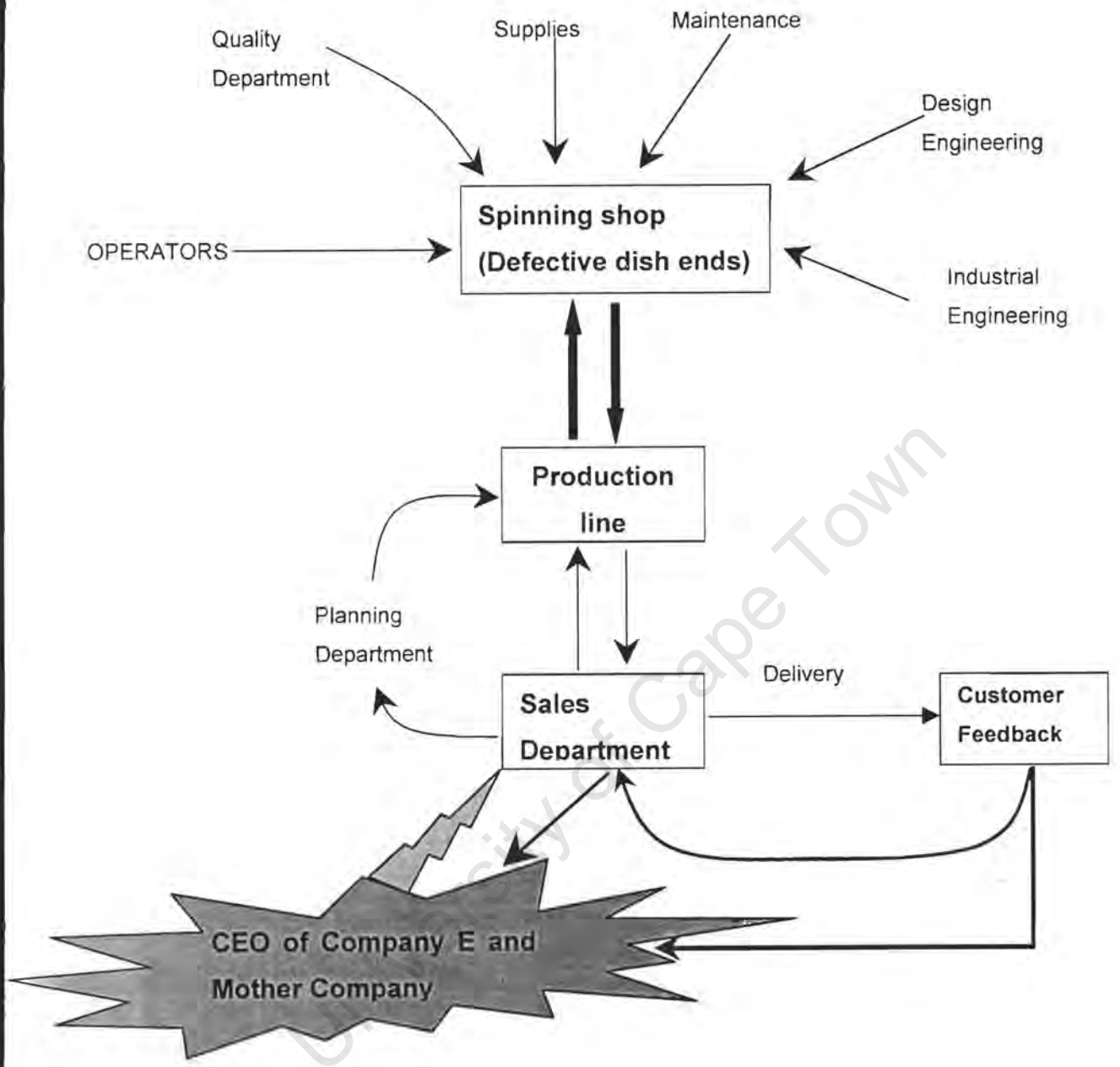


Figure 2.7: Problem Identification at CE

PART II: Theory in Context

Part II will be discussing the practical concepts used in world class manufacturing and also the characteristics of learning organisations. The theory can be used at three levels of recursion, namely operational, methodological and philosophical.

"Hard" issues are normally located in the operational level. They are found in the normal day to day running of a company. Most of the thinking process is based mostly on the quantitative data and some qualitative data for problem solving. As soon as the problem exceeds this level of expertise, the problem is then dealt at the methodological level, which is where "soft" issues are. One of the most common methods used at this level is the *Soft Systems Methodology* that deals mainly with qualitative data. The recommendations from this method are often long-term plans. If the problems are even too complex to solve at this level, then a *philosophical* framework is needed to understand the core thinking of people and the business.

The methodological level will look at possible reasons of why the learning and thinking process are essential for the acceptance of the new shop floor management process. The way the people in the company perceive problems as THE PROBLEM often results in solving the wrong one. This level of thinking will deal more with double loop learning in trying to formulate a robust process of problem solving by having identified the right problem in the first stage.

Part II will also be concentrating on Deming's philosophy of "Theory of Profound Knowledge", the Theory of Failures and also on the Japanese Management on the Shop Floor. This logical step of the theory that every company wants to emulate is "*Quality at all levels of the company is essential for the company to remain competitive*". But the harsh reality for most companies is the failure to learn from their past mistakes and stop their continuous and

unnecessary tampering of a misunderstood system. The Japanese has showed their understanding of their environment and has shaped their company to fit into it. This has made them a leader in the manufacturing businesses in the world.

Chapter 3 will be dealing with Deming's work to explain the way his theories are used with strong emphasis on knowledge of the basic concepts of quality, the importance of individual learning and the management of strategic plans for the future. Deming's latest work emphasises on learning to be able to adapt to the continuously changing environment. The emphasis is therefore on thorough testing of the plans before implementation since the company will only see its benefits in the long run. The goal is therefore to stop tampering of the system if not properly understood.

Chapter 4 will be a more pragmatic approach to these concepts used by the Japanese on Deming's work in their normal day to day operation. The differences in the management style as compared to the Western culture show a strong cause of the success of the Japanese manufacturing companies. This chapter will also be highlighting the importance of the learning process within the company to avoid failures.

The resistance to learn from past failures will also be explored in more details. Treating disasters or failures as isolated incidents, companies have learnt it the hard way with massive investment being lost. Chapter 5 will explore some famous failures that have occurred in history with explanations of the causes. It is often the result of a slow build up of problems that seem unimportant at that time but with time and seriousness, the problem has then exploded into unmanageable situation for the time allocated to solve the problem.

Chapter 6 will be looking at the context in which an organisation operates and the management style appropriate for it. This chapter will also explain the Viable System Model of Stafford Beer as the model to use for a viable

organisation with detailed explanation of its characteristics and its relevance to the theories from the previous chapters.

The scope of this thesis will deal primarily with the operational and methodological levels. The operational level will be looking at possible ways to improve the current shop floor management. Often, these problems are higher up the level of management who exerts unintended resistance to change. Hopefully, these theories will shed some light on the current practice of the company.

Chapter 3 – Deming's Concepts of Quality

This chapter will be dealing with the works of Edward Deming, the founder of the concept "Quality". It was through his work that most Quality Management concepts have been derived from. Total Quality Management (TQM) concept is one example of Deming's work from which his philosophies has been adapted to. References must be made to the founder's work to understand the fundamental concepts and if changes are brought about, they must be well justified by researchers in their creation of theories.

The section will be focussed on the understanding of the external and the internal environment of the organisation as well as the "soft" issues that are related to most problems. The impact of "soft" issues is shown in the different sections, especially on strategic management as well as learning organisation. Their omission in plans normally produces unexpected results and management's control mechanisms often do not have the ability to measure them. The first step in implementing a Quality Control system is an attempt to reduce the margin of error at all levels of the company to sometimes level that the system was not designed for.

3.1 The core of Quality Management

In order to understand the concepts of Quality Management, Edward Deming's work must first be understood. His famous philosophy "14 points on Quality Management" (refer Appendix B) is a good starting point for any company wanting to implement Quality programs. There are numerous quality concepts derived from Deming's work and often, the diluted version of his work produce failures. The most common one is Total Quality Management (TQM). TQM is defined by GOAL/QPC as " *a structured system to create organisation-wide planning and implementation of breakthrough and continuous improvement*

processes to meet and exceed customers needs". Although Total Quality Management (TQM) seems very similar to Deming's philosophy, there are some major differences, namely [Petersen, 1999]:

1. TQM is a general philosophy that can be adapted to suit certain companies whereas Deming's work is based on one philosophy only.
2. The aim is a long-term plan that requires total commitment even when some customers may suffer during the transformation process. This "journey" to that achievement is often not widely accepted by TQM practitioners when customers suffer.
3. TQM is often changed based on the environment that the organisation is operating in while Deming's approach is based only on its constancy of purpose.

The strongest difference is the lack of purpose that most companies experience when they abandon concepts for newer, more attractive management ones. This is due to the strong drive of TQM for complete transformation rather than small "tweaking" of the current system. The common mistake that companies make when implementing TQM is the selection of sub-units that they want to change, thus creating an imbalance in the whole organisation. These are some of the problems that organisations experience when implementing derived theories from Deming's work. To avoid repeating the same mistakes, Deming's philosophy must be well understood before any modifications can be brought to the strategic plans or the operational aspects of the organisation.

The most crucial part of Deming's philosophy is the moral tone, which concentrates on creating more jobs in a better environment for the workers for example. Most traditional companies view the workers as machines, which they can extract the maximum from and then retrench. Their goals, whether short term or long term, is to make more profits. That is the only way that they can justify their positions to their immediate boss and the shareholders. Therefore, their

ultimate goal is to fix the system so that it can self-organise and self-regulate to reduce the number of problems being transferred to management. This can only be achieved through training the workforce as Deming considered *quality as the outcome of a method and not quality as the method.*

Looking at his teachings, the focus is on reducing costs and not on increasing the price of products to increase profits. From the 14 points mentioned in Appendix B, the main concern is the flexibility of management to provide the environment for the people to learn and develop. This is critical in the drive for continuous improvement of the company not only in terms of their products but also with the employees. A more educated workforce will be able to improve the organisation by small incremental steps of solving the daily problems while providing time to the managers and engineers mainly for the big breakthroughs.

Therefore, his whole philosophy on "staying in the business and creating more jobs" is a long-term plan that most businesses can not afford to do if they are in a volatile environment and with a slow learning team. The normal short-term plans in companies often fail when the support from top management changes direction. These programs are then declared failures (Petersen, 1999). Total Quality Management (TQM) is being slowly viewed as a failure as the results are below the expected outcomes. When this occurs, the company's tampering only worsens the situation since the fundamentals are not well understood. Deming then proposed his Theory of Profound Knowledge to help people better understand the different factors that are affecting the system.

3.2 Deming's Theory of Profound Knowledge

In order to be able to implement the 14 points in an organisation, there is a need to understand the environment and internal interactions that exist in the company. The newer theory of Deming on Profound Knowledge (Deming, 1994)

has been focussed on the fundamentals of any organisation to possess to be able to survive. This theory consists of 4 main branches (shown in Figure 3.1):

- Theory of Knowledge
- Knowledge of Variation
- Appreciation of the System
- Psychology

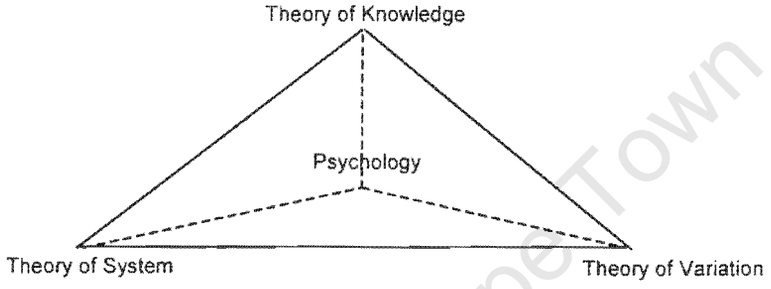


Figure 3.1: Theory of Profound Knowledge

All four of them must work together to be able to function properly in any organisation. Often, at least one of these 4 factors are neglected or forgotten and the results are often disastrous. The gradual strengthening of these sub-units are essential to growth but the time frame that is allocated by management is too short. The learning and evolution of the company's employees can become a core competency if these four concepts are well understood and used. In the next sections, a brief explanation of those main branches will be given except psychology, which is too complex to be covered in this research.

3.2.1 Theory of Knowledge

One interesting and yet simple statement made by Lawrence Leach, author of the article "TQM, Re-engineering, and the Edge of Chaos", is *the edge of chaos is a constantly shifting battle between stagnation and anarchy. For most purposes, this is where you want your organisation to be…because systems that are too stable will die as the environment evolves, while systems that are too*

chaotic will tend to self-destruct. One set of forces (the need for control and order) pulls every business toward stagnation, while another set of forces (the need for growth and creativity) drives it toward disintegration." From this point of view, the need to learn is essential for the company to continuously reassess its goals and try to reach that balance. And for the whole company to be there, the learning must be permeated at all levels of the organisation for it to be moving forward. The typical reaction of some companies is staying stagnant while thinking that they are moving forward by not challenging their basic assumptions while their competitors are forging ahead.

Handy (1984) developed the concept of the learning cycle, which is a continuous reassessment of a situation. This process starts whenever there is a disagreement with the observed fact and the knowledge of what it should be. This difference in opinion will result in the questioning stage, acting and reflection stages, which all form part of the learning process. This can be applied to an individual or to the whole organisation where the shared learning will make the decision making and problem solving a more robust process. Stafford Beer's (Clemson, 1984) law of requisite variety stresses this point, where the capability to solve a complex problem often depends on the level of "variety" the problem solvers have.

One example of misuse of Deming's work is the focus on one particular field of thinking. Re-engineering is an example of what companies are keen to do. This exercise is based mainly on breakthroughs where whole new ideas are being introduced to the company, starting from top to bottom. The details of the plans are not clearly established to the workers and the difference in vision results in a clash of interests of the workers and management. The re-engineering process, often in pursuit of quality, is often viewed as an intervention when the workers are at fault while the managers are right. Authoritarian control of the company is only successful for short term. An interesting analogy given by Sydney Pollack, is the *movement forward but with a lot of drag.* This kind of

"drag" which is the resentment of the workers, can cripple the organisation while striving to make progress in the short term.

Kaizen, the concept of continuous small improvements, is the better approach as it is a slow learning process for everyone within the company in the beginning. Breakthroughs are also important as this big "jump" forces people to undergo a huge paradigm shift in thinking and practice. The difficult task is not to favour anyone but to pursue both of them. This type of learning relies on the creativity of the workers to come up with ideas to not only improve the production but also to improve their working conditions. Gradual empowerment of the workers is also needed for them to test their new theory. Care must be taken though to ensure that the empowerment policy is not done on an *ad hoc* basis. Proper guidance must still be provided to ensure that the transition is without incident.

3.2.2 *Theory of Variation*

One humoristic sentence that Deming used to demonstrate his opposition to tampering is the typical order from line supervisors: "*Don't just sit there; do something!*" converted to: "*Don't just do something; sit there*". Often, the quality of products is the result of two main causes of variation, common cause (created by the system) and special cause (created by an individual worker). Variations are often treated as special causes as it seems to be the most obvious and the "solutions" are easily found. Common causes, often created by the system, are hidden under other layers of problems until one specific incident triggers it.

Deming demonstrated this narrow view of management of treating all problems as special cause by using his red beads experiment. In this exercise, a mixture of 800 red beads and 3,200 white beads were used. Volunteers are then asked to remove only 50 white beads with a paddle having 50 depressions in it. As can be expected, it was never the wanted result. From this example, the

system is to be found at fault and not what is really required from it. In the first instance, the red beads should have never been included. It is from this simple experiment that Deming drew out the following conclusions:

- The system (mistakes and all) is stable
- All the variations are inherent in the process.
- The result can not be linked with the worker's performance. Nobody would have done better.
- It is wrong to rank workers on their performance, which they have no control of.
- Pay for performance is useless.
- This is a typical case of bad management practice. Procedures were fixed, not allowing the workers to use their creativity to solve the problem.

Variation must not be seen as a dangerous characteristic of a system but mainly as an interesting window opportunity for more learning and discovery. Variation is often defined as something that does not fit with what is expected but that is often the beginning of an inquiry process. This variation must be understood before intervention occurs since everything varies within a range. The use of statistical tools are being used to understand the variations in systems and the concept of standard deviations as the range within which a system's performance is assessed to be acceptable or not. But the period in which the system varies must also be taken into consideration. This is why variation has been analysed on two levels, ***long term*** or ***short-term plans***.

In the **short term**, by comparing an organisation with an organism, its main aim is to survive in the competitive environment. At this stage, survival is the goal and the organism adapts to the new environment by changing a lot of its parts tremendously. The changes are therefore dependent on all other metamorphosis of the smaller units within the system. Flexibility, adaptability, and survivability are the main characteristics that the whole system must possess. But often, the organisations in the real world tend to strengthen only part of the

system, e.g. the return on investment of the company while neglecting the upgrades or maintenance. This type of highly illogical goal is a certain path towards failure of the whole business.

In the **long term**, the goal is more based on evolution. This concept is sustainable through continuous learning that has to occur at all levels. In addition to the different internal changes, the organisation has to look at the changes in the environment also. The trend is to evolve together with the others in the system. The survival of companies for example is through co-operation as compared to competitive "knockouts". This concept can also be referred to the organisms in the world where each species rely on each other to have a harmonious balance. Even the trend in the current business world is through mergers and acquisitions! All these ideas are thought to be inapplicable in the practical world that academics theorise in but Deming said that most of the problems are the result of the different interpretation of how one perceives the world and how the world really works. Deming often refers to the business world as a living system.

Looking at the mental models of some managers, they still work in a paradigm based on a traditional organisation, which is driven by financial targets. This type of management is starting to experience problems, as the workers are not fully utilised for their creativity but their basic skills only. This impacts on the performance of the company. The inter-departmental relationships suffer as a consequence of under-utilised creativity of the people in the complex environment. This relationship building, if done properly, can help the business to self-regulate to some extent, increasing the time for the managers and other staffs to deal with more long-term planning. Senior management often considers the current variations in the company as major problems, hence interventions from their part. The results are often disastrous in the system as it tries to correct an in-built variation.

The aim of management is therefore proper intervention in a system when the main problems are not part of a natural cycle. All systems have a certain amount of flexibility and often, they can not operate in the range that management is trying to work in. The use of statistical processes is to reduce the range and work in that small but acceptable variation to have results. Therefore, the only way to manage "chaos", which is often referred to the business environment, is to change the way to look at situations. Deming spoke of this new perception as a difference in thinking where everything is being questioned and analysed for the creation of new knowledge provided that the natural variations are taken into account.

3.2.3 Theory of Systems

Understanding a system is not only based on the function of individual parts but on the whole. This becomes a particularly complex task, as the system is dynamic due to either reinforcing or non-reinforcing systems. In both cases, the results are often unpredictable and this is where the decisions taken are based on doubts. It is not the result of poor understanding of the company's core competencies but the continuous interactions that complicate them. These dynamic interactions of systems are too complex to be understood by anyone in the short term. The results from these complex chained relationships are often overloading the company's ability to deal with them. So establishing the company's Business Idea is a very important starting point for understanding and modelling the process.

Stafford Beer proposed the Viable System Model (Chapter 6), one of the tools from Cybernetics, the science of effective organisation. Since all organisations' aim is to survive and be more competitive than others, it has to adapt to the fast changing environment. To ensure that the company is not overwhelmed by the huge influx of data, there is a need to have a management structure that can control the flow of information. This will ensure that the

resources used by the systems will support the core competencies of the company. If the competitive edge is maintained or better, widened, then the organisation can be considered to be self-organising and have a strong regenerative learning ability.

There are some management tools like the Viable System Model (VSM) for example that are used to try to ensure that the organisation have robust functions to enable its survival. VSM is not THE MODEL that everyone has to use but rather the functions that are essential. The flexibility of the model is that it can also be applied at different levels of complexity of the company. Their functions are also iterative at any level within any type of organisations whether manufacturing or service oriented. These characteristics make the model highly flexible as it is not governed by hierarchy but based on functionality.

The challenge is thus to design or develop an organisation that can satisfy the following:

- Continuously meet clients' needs.
- Learn and adapt rapidly.
- Maintain itself, learning and adapting.

3.3 Strategic management

Once, these fundamentals are understood, the company has to then think of strategic planning for its long and short-term goals. Chandler (1962) defined strategic management as *"the determination of the basic long-term goals and objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out these goals."* Based on this definition, it shows that the organisations are now aiming at using strategic management to adapt to environmental changes. Porter (1980) emphasised that the changes come from external factors mainly but others have also claimed that the company's internal factors, such as organisational structure, decision making

process, and management control systems, are also determinants in the formulation of strategic plans. Thus, the organisation has to understand its external environment as well as its internal organisation.

Hax (Vinzant, 1999) came up with six different concepts of strategy:

1. Strategy as a coherent, unifying, and integrative pattern of decisions;
2. Strategy as a means of establishing an organisation's purposes in terms of its long-term objectives, action programs, and resource allocation priorities.
3. Strategy as a definition of a firm's competitive domain;
4. Strategy as a response to external opportunities and threats and to its internal strengths and weaknesses as a means of achieving competitive advantage.
5. Strategy as a logical system for differentiating managerial tasks at corporate, business, and functional levels
6. Strategy as a definition of the economic and non-economic contribution the firm intends to make its stakeholders.

Based on all six definitions, strategies are created based on both internal and external factors. Deming's concepts closely tied in with these definitions. The whole process started with long-term vision, which needs the support from all levels of management and also from employees lower down the hierarchical level. A survey conducted by Fuchsberg (Vinzant, 1992), for example, was highly critical of the common management tools that have been used for short period of time until a new concept was found. The benefits that other companies reaped after they have effectively transferred the goal of the corporate strategy to the employees, customers and suppliers in the long term by those same tools are enormous. Effective strategic management can only be achieved though the combination of these definitions.

3.4 Importance of Human Factor in Management

Most management has lost some faith in these ideal theories of management concepts that are continuously emerging from academics. This is due to their misunderstanding of the whole philosophy behind it or understanding the ideas partially. For example, Business Process Re-engineering (BPR) is not widely accepted in some companies as the middle managers resist changes by clinging to their obsolete powers. Another concept from *Informated Organisation*[2] by Zuboff (Prujit, 2000) met with some resistance again by managers who refuse to share their knowledge as a form of job security or lack of trust towards the workers. The "failures" of these management concepts then force the academic world to produce more flexible concepts that work for them. Therefore, the goal is not to produce concepts for each and every single situation but to produce capable problem solvers of thinking about the problems using the theories as a starting point and not just applying them blindly to their situation.

In critical theory[3], there is a huge clash between efficiency and humanisation. Mintzberg once said that *As long as society demands cheap, mass-produced goods and services – a great many jobs will remain pretty much as they are now.* The main difference between the ideal world and the real world is the human factor that is not being taken into consideration. There are six examples that show the lack of attention given to the human factor in real life even though the ideal world promotes those concepts. In all the examples given in Table 3.1 (Prujit, 2000), the main message is to educate the workers and managers in the advantages of learning to think more systematically but often, the urgency of learning is also dependent on the level of uncertainty that occurs in the environment.

[2] Informated Organisation: Exploiting the capabilities of information technology to the fullest.
[3] Critical Theory: *self conscious critique that is aimed at change and emancipation through enlightenment and does not cling dogmatically to its own doctrinal assumptions* (Prujit, 2000)

Ideal World	Real World
Companies must innovate to be competitive and this implies that employees must be allowed to unleash their creative talents	The company tends to rely on small, outsourced companies to do the problem solving.
In order to respond to the changing world, the companies must act as one unit, thus teamwork	But the companies use "more talented" personnel to work on the evolving situation while the majority still remains in their traditional jobs.
Within a "chaotic" environment, the information processed is very complex. The obvious solution is to empower the workers.	The tendency is to use information technology to maintain the "old" ways of processing the information.
Learning organisations will promote the culture of continuous improvement, which is again advocating for the empowerment of the workers.	The response from the real world is bureaucracy in which the workers' brains are tapped without empowering them.
Since the new trend is moving from mass production to customisation, the need to have more skilled workers is increasing.	Mass customisation can also be the aim of the company which all allows them to keep their unskilled workforce.
High performance organisations are high trust organisations.	True but high trust organisation is not compatible with downsizing. And that is what shareholders seem to like

Table 3.1: Differences between the ideal and the real world

The real facts of life in this kind of analysis of the real world-ideal world approach are that firstly, workers are highly dependent on their employer and not the other way around. Secondly, the workers are often considered as a "stepping stone" where the profit generated by them is being used either to buy machines to replace them or to relocate the business elsewhere. The result is often a "protest behaviour" (Pruijt, 2000) which appear as turnovers, absenteeism, reduction of performance, withdrawal of efficiency, manipulation of wage standards, verbal expressions and other forms of "striking without quitting". This often leads to passive resistance in training.

3.5 Resistance to training

One key assumption everyone has for training is the ability of the employee to use these new skills to solve problems in the organisation. But training is only effective if it has taught the workers to think by themselves so that they can adapt those theories to their situation. The major obstacle of training is bridging the gap between theory and practice. There are several factors that make this transition very difficult. Lack of power to change things in the organisation, no support for the application of the theories to the working conditions, the threat of losing the job when the manager himself has not been kept updated with the current situation are some of those obstacles of resistance to training. [Rusaw, 2000]

The resistance to training programs is predominantly from the difference in the organisational culture which exerts a "total control" grip, and the attempts to "free" the workers in their work. This type management is never questioned as it might reveal the sources of political powers in the company that keeps things under control. Employees suffer in this type of organisation mainly because they have abandoned their freedom to think and learn to their desire to survive, particularly strong in poor societies. The workers are moulded into the company's image of "model" workers. There is no double loop learning where management can evaluate their policies' in the environment since there is no feedback from the workers.

When educating the workers, the companies are often faced with the difficult tasks of analysing their own values and compare them with those of the workers. There are two main streams of thoughts that go against ideological control (Rusaw, 2000). The first one is radical organisational change, which is thorough testing of the fundamental assumptions of companies' values and changing them to satisfy everyone. The second one is more focussed on the building of awareness of the culture of the company and ways to respond to them

in a "non-destructive" way. In this case, individual learning is being promoted for the workers to think for themselves for the best possible achievable outcome. Schraw (Rusaw, 2000) described that experience-based learning produces "Metacognition", which in turn, gives 3 types of knowledge:

- Declarative knowledge – knowledge about self and factors affecting performance
- Procedural knowledge – how to solve problems
- Conditional knowledge – knowing when and why to use specific strategy.

All these learning concepts that workers are supposed to receive often threaten the validity of managers who have managed to hold on to their positions through tacit approval by senior management, privileged information, status and affiliation (the "in" group). Other group of managers (the "left out" group) has accepted the conditions publicly but criticise the system privately since they consider themselves out of favour of top management. The tendency will be focussed then on the poor performance of the workers and not on the performance of the managers themselves. The attitude will always be of confrontational nature.

3.6 Knowledge Management

The latest help for management come from this relatively new discipline called Knowledge Management, which can be basically defined into 2 parts: Firstly, the intervention method of managers to implement a knowledge perspective on business strategy and secondly, the possible difficulties faced by them in their implementation tasks. A typical example of the problems found in companies was the survey conducted by Ernst & Young in 1997 among 431 US and European organisations (Storey & Barnett, 2000) were "changing people's behaviour" and the existence of an inappropriate "organisational culture".

Chapter 3 –Deming's Concepts of Quality

One of the main stumbling blocks in making Knowledge Management work is also the method of building up the knowledge. Often, the knowledge is tacit and it is only through continuous probing, normally working with someone for a long time, that it is obtained. Even when the knowledge is obtained, the next problem is to record it with all the factors that are relevant to the situation. This type of data capturing is often very difficult and strenuous, as all the normally simple and logical steps have to be thoroughly analysed and tested. It is often this seemingly simple information that makes the whole process work.

The ideal environment for Knowledge Management to prosper is through teamwork and networking with other people. A broader knowledge of a situation can change the paradigm that one is used to work in. Managers often confuse the words: knowledge and information. That misunderstanding has resulted in companies losing huge amounts of money. The main difference is that knowledge is embedded in people and the only way to extract it out is through social interaction [McCampbell, Clare & Gitters, 1999).

In practice, the failure of such program depends firstly on the lack of total support from top management. Secondly, there is misalignment of company's values among different departments and thirdly, companies tend to implement these new ideas without "prototyping" it in a smaller department with more chances to monitor the progress and fourthly, the relationships between management and workers are built on mistrust of each other. Therefore, the Knowledge Management concept rely on the participation of every one in the department, with their thinking process being tested and modified by his peers on the hard data and learn from past failures to improve their learning methods.

Chapter 4 – Shop Floor Management

In this chapter, the focus will be on the characteristics of the Japanese Approach of Shop Floor Management in a manufacturing environment. The aim is to look at the successful companies that have benefited from this management concept. An in-depth analysis of the different ways organisations are managed and the learning processes that they have gone through will be explored in this section.

Most companies can be classified into two types of organisations, traditional and progressive. With the fast changing environment, more and more companies are faced with the problem of not making enough money due to non-competitive products. This can be attributed to different reasons but the main ones are low quality, low performance of workers, and high costs. These are all some of the symptoms of the traditional organisations. Therefore, the aim of this chapter will hopefully show the new direction that organisations should follow, which is progressive organisation.

4.1 Traditional Organisation

The best representation of the two different types of organisations is shown in Figure 4.1 (Suzaki, 1992). The Traditional Organisation consists of a large number of people with low skills while in a progressive organisation, the number of skilled workers are much larger. The problem solving skills in the progressive organisation is much greater and therefore the management has more time to devote to strategic problem solving rather than operational problem solving.

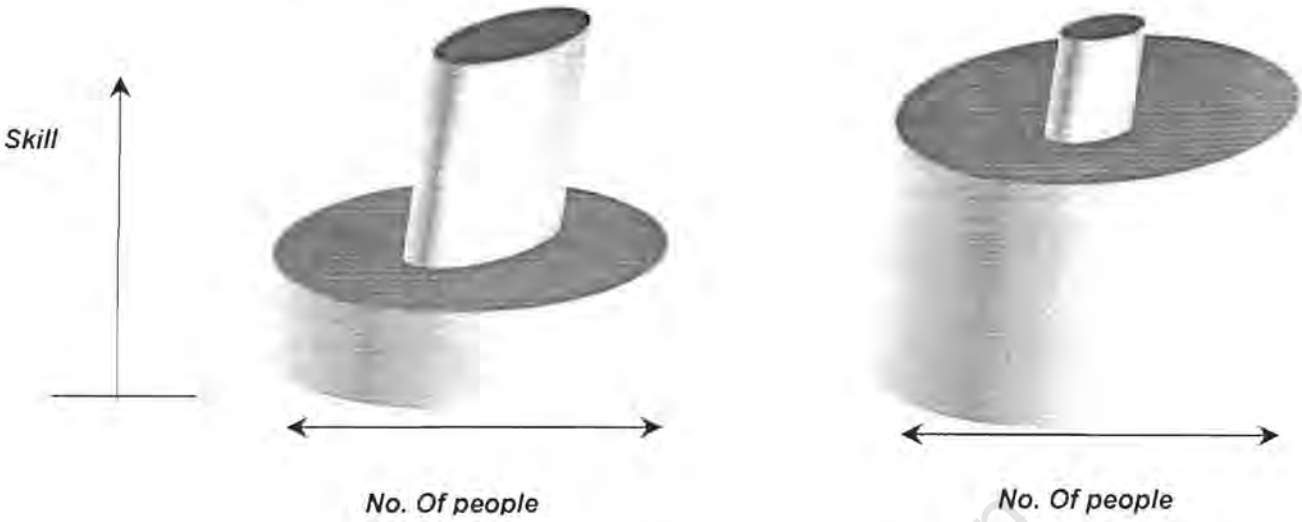


Figure 4.1: Traditional and Progressive Organisations

The rate at which the global economy and business increase is forcing companies to rethink of their partnership between workforce and management. There are some typical views that are inherent of the traditional organisations and these are the typical scenes on the shop floor of the company. Some of the traditional views on the shop floor are summarised in Table 4.1. [Suzaki, 1992]

Traditional Shop Floor Views
• Mundane work is done on the shop floor.
• Because management controls all activities, people on the shop floor are not asked their opinions.
• As long as they do their job, there is no need to educate people on the shop floor.
• Since muscle is all that is needed on the shop floor, it is better to do the work where the labour is cheapest.
• Since people on the shop floor will change jobs for even very little pay differences; it is better not to use any resources to educate them.
• The simpler people' jobs are, the easier it is to hire and fire them.

Table 4.1: Traditional Shop Floor Views

Since traditional organisations' manufacturing rely mainly on the workforce, the aim should be to align the workforce's goals and thinking with those of the company. This will be the work of management to align the workers to the same vision of the future. To try to improve a manufacturing process, the basic characteristic of a production line must be understood. The Japanese rely on 3 aspects of shop floor management for a manufacturing system, namely *Shop Floor, Real Thing and Real Fact* (Suzaki, 1992). Each one of them is dependent on the other and can not be viewed separately. Improvements, if done, must be performed at the same rate and level of complexity.

Shop Floor - This area of the company can be viewed as the testing site of ideas. Often, the implementation phase of theories is not thoroughly put to test on the shop floor but in design offices or on papers. The knowledge and intelligence are often not being used together in real time operations. Therefore, the shop floor should be a hive of activity, as it not only deals with practical activities but also with theories that are continuously tested.

Real Thing - The Real Thing for the company is to look at the products as the company's image to the customers and not just as products. This is one of the reasons why Japanese manufacturing companies focus so strongly on the "zero defect" objective of their final products. Whenever a product has failed in its objective to satisfy the customers needs, the company's image is tarnished and that can have disastrous consequences for any business especially when the competition is fierce.

Real Facts - In order to sustain any claims or theories, the fundamental concepts must be measurable. The need to gather information from which more complex concepts can be derived is essential. Even the measuring instruments or methods are continuously re-assessed to ensure that the data gathered represent what is really happening and not just some ideas with no sustainable proofs behind them.

4.1.1 Understanding the Shop Floor

It is from these 3 main concepts that shop floor management will be more practically orientated. Often, the problems are analysed and simplified in an office far from where the actual problem is. Most of the problems are reported to the engineers and managers, who develop the concepts and then try to implement them on the shop floor. There is always the danger of *thinking that the model or concept is the reality and not a representation of the reality* [Suzaki, 1992]. The solutions do not address the problems completely with some practical issues missing sometimes.

The progressive organisation's management style is to use everyone's ideas and concepts to try to solve the problem or improve the situation. One of Stafford Beer's laws of Cybernetics even advocated that to deal with complex situations, the problem solvers must possess as much complexity as the problem itself to be able to understand it and develop the best solution (Law of Requisite Variety). The best way is to have self-management or self-organising workforce instead of employing external consultants. The workers not only solve their problems within their area but also help to solve the organisations' operational concerns internally, with no delays of understanding the whole processes as would external consultants.

When new ideas or concepts are undertaken, workers know that they can achieve the goals since they were part of the designers. But management must also provide support for them in the long term. If the plans are continuously changed, the workers will then lose trust in management and that can destroy the company in the long term without the company realising it.

4.2 Shop Floor characteristics in a progressive organisation

The transition from traditional to progressive organisation involves a shift in the paradigm the company is used to perform as the complexity in the work

environment has increased dramatically. With the market being more global, the managers are now faced with competitors not only within the country but also with foreign-based competitors. The focus is therefore to maximise the use of the workers' intelligence and experience in their jobs. Daily meetings form part of the communication channels that exist between managers and workers. The dialogue that management has for the workers will stimulate more positive interaction between them. As the problem solving skill level increases, the company becomes more competitive in their products.

The few criteria that a progressive organisation should have are to (1) Develop clarity in the vision of the company, (2) Develop customer awareness (3) Promote involvement of everybody (4) Increase problem-solving capability (5) Provide adequate leadership (6) Clarify the management support system. They can be efficiently used to increase the products' worth by having a clear goal and also the necessary support from top management to be able to perform at their best.

4.2.1 The Learning process

Learning is another difficult issue to deal with, especially with different mental models of people. The need is to have a logical flow of thinking supported by logical explanations. This can then lead to easier identification of the problems and the steps taken to correct them. There are charts, meetings, discussion groups, etc. that are the main tools used to identify the problem but what most managers face is the identification of the **right** problem. The Japanese have invented the "5 WHY" question for example to narrow down the doubtful situation to the root cause. The goal is not only finding the solution immediately but also a learning process for finding future problems' root causes.

The learning process relies on the ability of the workers to increase their skills to be more open minded to problems. Argyris' argument was that there are

two types of learning that occur. The *Single Loop Learning* that most people use is mainly a reactive action in which the immediate problem is solved. Its' solution is only temporary, not definite. The learning cycle is never complete and the problem solver will always be faced with the suppressed problem until it resurfaces again with more disastrous consequences this time. The *Double Loop Learning* is more focussed on finding the root cause and the thinking process will be more thorough. This practical aspect of the learning exercise is the PDCA (Plan Do Check Act) cycle which is often being used with fellow workers to discuss the logic behind the problem solving process as well as its practical implications on the shop floor.

A comfort zone that some managers or workers tend to fall into is the "no problem" attitude where they can not identify the problem. This will result in continuous interference of other employees or top management to help identify and solve the problem in the specific department. There is also the tendency of some traditional organisation of not sharing knowledge with people so as not to make oneself redundant. Believing that one's knowledge (in addition to the growing experience) is sufficient to compete against the new theories advocated by the academics has also been a plague that has caused the bankruptcy of many companies. But learning by oneself is also not complete. Multiple perspectives broaden the scope in which problems can be analysed. Each clarification brought into the discussion also strengthens the mental model of the situation under investigation. The knowledge acquired in this case is more flexible to deal with changes in the business environment and other possible external disturbances. Therefore the stimulation from others is beneficial to one's individual learning.

4.2.2 Building up ownership of their job

In an attempt to increase the awareness of the workers' work, the next step is to create the concept of their unit as a business unit competing with

others. The aim of the manager is to draw out the creativity and problem solving skills of the workers. As the new strategies are being constantly supervised at the beginning, the workers will be more confident and teamwork oriented as they master the basics. To be continuously aware of the progress of the unit, the results are recorded on boards with graphs to show trends, current production level, etc. This not only saves time for managers to call for meetings to be given these data but also for the workers to be aware of the status of other "business" units. Public display of performance also forces the best out of them in their daily work, as they feel proud when they are compared to others. They can even be mentors to other problematic departments once they have developed the ownership feeling and necessary problem solving skills.

To be able to benchmark their performances, the standards set must be fixed. Some problems seem to be constantly changing if the standards are themselves not fixed. The competition can consolidate the standards so that the modifications brought about can be continuously reassessed and improved for the future. In cases where the set standards are not achieved, management will need to re-assess the whole plan starting from the design to the manufacture stages so that new targets can be set. This is therefore a learning process for the workers to know where the problem lies within one unit if others manage to perform up to the fixed standards.

Support from top management is essential for the workers to grow. The company's culture needs to *change from power-oriented to people and customer-oriented thinking* [Suzaki, 1992]. A slow and gradual empowerment of the workers at the shop level will decrease the problems referred to top management since the problems are tackled at the sources. In this case, the managers will have to delegate some of their powers to the operators so that they can feel free to try out their new ideas in their work environment. As the barrier between manager and operator is slowly lowered, the flow of information for improvements or modifications to bring about changes will also increase.

With exposure to lots of information, the younger generation of workers is often more innovative and adventurous in testing the Co.'s tacit assumptions. Suggestion box is the ideal solution to try to pool in their knowledge of the company. This can be particularly productive if the new recruits, who have no paradigms, will challenge the tacit assumptions or beliefs within the organisation. They should be initially considered to solve the problems of the company but to try to test the tacit knowledge of the older workers as well as stretch the paradigms that the company is used to work in. They are mainly the pioneers in paradigm shifts of the company.

One way of measuring the use of employees' creativity is by the number of suggestions, which reached on average 50 suggestions per year per employee in some Japanese companies. And with an adoption rate of 80%, it shows that the workforce was keen to try new ideas on the shop floor. The aim of these companies in implementing these changes is to let the workers perform their daily jobs in slightly better conditions. This is by itself a change in thinking when compared to Western companies of the past where the focus is increase profit while the workers' welfare are forgotten. The possible causes of failure of some types of programs like Total Quality Control, Redesign of layout, Team empowerment, etc. might be:

- Too much emphasis on rewards,
- Too long feedback from management, focus on breakthrough improvements instead of small incremental steps,
- Expecting short term results when having implemented long term plans
- And reliance of others to do the implementation stage.

4.2.4 Having the necessary tools to help the learning process

Some companies focus a lot on training in new methods or theories that can hopefully improve their standards but not much is really practised on the

4.2.3 Upgrading labour's skills

For the workers to have self-managing capability, upgrading their skills is essential for improvements. Managers will therefore have a team that can solve the smaller day to day problems while he can focus on problems at a strategic level. Guidance and advice are the main inputs from the managers. There is a whole series of self-management skills that need to be taught and their focus is mainly on

- Maintenance – Maintaining standards
- Improvement – Identify right problems and solve them
- Individuals – Teaching the analytical and workmanship
- Teamwork – Good communication and leadership skills
- Task specific – Relevant technical knowledge
- Management – Develop a general skill of co-ordination, communication and teamwork.

There is so much emphasis on the workforce nowadays because any organisation's production rely on their workers and their turn over rate have to be reduced to the minimum since they posses valuable information of the shop floor. The reluctance to upgrade workers' skills can be related to different reasons within the organisation. The most common reason is the assumption that the workers are not capable of learning. Another reason for this type of thinking is the focus of the managers to upgrade their own skills first, which might not be good enough to teach the others. All these can have a very detrimental effect not only on the workers but also on the company. There is also the risk of being complacent with the current situation in which the company is doing quite well thus, not investigating new ways of improving one's skills.

... what will happen in the future is a result of what we do today from the sayings of Konosuke Matsushita (Suzuki,1992)

shop floor. Building up knowledge is important but not complete. Implementation is needed for the people to learn to bridge the gap between theory and practice but even then, implementation is not complete if it is not done efficiently and with efficacy. The quality of the work will depend on the existing knowledge and that of the tools used to perform the work. These tools range from basic common knowledge to more advanced ones (more analytical ones).

There are a few guidelines that need to be visible on the shop floor for workers to be reminded of the importance of standards. Visual displays are the easiest way to show what is required of them and what they are being measured on. And the most direct approach for workers to improve their work is the offer of rewards as incentives for them to perform better. The reward can be gifts or awards instead of financial. This strategy is to try to raise one of the key factors that Maslow used in his classification of needs of a human being, physiological as well as self-esteem especially when dealing with workers at the lowest part of the pyramid. Recognition from his peers can also be a motivating factor for workers to perform well.

The typical practising standards in a Traditional Organisation are

- No clear relationship between operating procedures and their impact on quality, cost, delivery, safety and morale.
- Standards that describe the steps of operation are meaningful only for operators who are new to the process, but are not used as a base for continuous improvement.
- There are shared general standards but it is not clear who does what.

The use of Standard Operating Procedure (SOP) is the basic rule that every operator must obey to make a quality product. Operators should create the SOP mainly as they are the experts in the daily manufacture of the products. Also, the number of revisions in the SOP will also determine the rate at which improvements are made to the manufacturing process. Pictures of quality as well

as low quality work must be displayed every day and these pictures should be upgraded daily to make workers aware of the problems in other workstations. With ISO 9000 series as being accepted as the international standards, companies are implementing them as the main benchmark for their business in the global market.

4.2.5 Implementation

The next stage is the implementation of the theoretical ideas of problem solving and also of their immediate effect on the work environment. The main goal is not the success of the implemented ideas but the whole exercise leading to the results. Even if the result is a failure, it prompts more thoughts to be put into the process to determine the reason for failure. If the correct solution is found, then the implementation can be classified then as a success of problem solving lesson. This will hopefully result in a clearer understanding of other factors' impact on the Shop Floor. Most of the time, the success of the improvement plans is from the workers after much testing and thinking involved.

But a lot of companies fail in their suggestion programs because mainly of (1) lack of trust of management on its' people creativity and skills and (2) lack of support of management to modify the program to make it work. Trust of management on engineers on big projects forecasting huge improvements is looked at while the smaller improvement programs designed by workers are often neglected. This creates not only gradual lack of participation of the workers in making the process work but also a complete breakdown of workers' trust in management. As for support from management, the problems faced with the evaluation process of the company to properly test the new ideas are often creating more problems in the administration than the actual implementation. As the problems on the administrative side increases, the company then changes plans.

The implementation of concepts like Total Quality Control, Total Preventive Maintenance, etc. is very complex to try all at once. There is a need to gradually teach the workers and managers of the real implications involved and not just using some secret formula that worked for other companies. It is only through understanding and modifications that some benefits are seen now. Depending on the company's culture and its people, appropriate steps must be taken to fit these world-known concepts to the existing conditions. But changing concepts also involves changing the workers' framework of thinking. A thorough understanding of the new concepts must be understood before they can be taught to workers. This is to avoid operators mixing the theories and getting wrong results.

Incentives are very difficult issues that arise in any company. The need for reward scheme is dependent on the business and the people involved. The scheme must be reassessed annually at least to determine if it still fits the Business Idea of the company. The incentives may not be monetary only but also recognition from his peers or awards. The incentives are essential to ensure that the workers are rewarded for their extra work that they sometimes do for the company. This can then generate a momentum (the way the workers perform their work) that can gradually develop into a core competency. Once this has been achieved, the viability of the business can be stabilised while looking for further small improvements or a breakthrough.

4.2.6 Teamwork

But the lesson of all of these concepts is useless if the ideas can not be combined to form a new vision for the whole team. The vision set up by the workers will drive them to achieve their goals through teamwork. Failures are sometimes "allowed" by managers for the workers to learn from and the cause is analysed afterwards with the necessary input from the relevant external experts, if the need arises. Progressive management will then allow the workers to explore their creative skills to take the company to another level of excellence.

Creating a team is a very difficult task that falls on the leader's shoulders. Finding the common ground and then gradually enlarging it to build the team is often a very long and tedious process. Teamwork can only be achieved by the individuals in the team and not by orders given by managers. Teamwork can not only make the company very rich but also very poor if the company's goals conflict with those of the workers. Strikes are examples of massive dissatisfaction of the employees as a result of culmination for a long period of frustration. Teamwork can only be slowly developed not imposed by leaders nor managers.

4.3 Leadership skills

The catalyst for the whole learning process has to be driven by a leader. The main difference between the leader and the manager is doing the right thing as compared to doing things right. Leaders are not people with power but mostly people with vision and good communication skills. They are not the ones that motivate people by threats or reward scheme for unreasonable targets. Leaders are often more motivated than others in a group on achieving the goal. Since they are driving the process, they need to understand the whole process to give guidance to the people involved. Some ideas of guidance from leaders are:

- Starting with simple improvements, like in workplace arrangements. Then, choose the unpopular chores for analysis.
- Continuously ask questions to trigger a breakthrough in thinking
- Practising the ideas that one has generated
- Reassessing the capability of the workers regularly through teamwork
- Documenting the ideas as a result of a more in-depth thinking process
- Providing help to the paradigm shifter in trying to attain the new goal
- Monitoring the progress of the implementation
- Rewarding the employee by simple recognition among his peers instead of monetary rewards can also be very beneficial to morale

Leaders continuously strive to make things better and they are often not among the top people in a company. They are often hidden in the numerous layers of the organisation but it is what they do that is important, and not who came up with the idea. Creativity is one of the strength of the leaders as they don't have any constraints in their thinking and they will challenge the most basic tacit assumptions. Often, the old employees tend to resist these changes since the new paradigms are uncharted territories for them. They feel uneasy with the unknown, as they don't have the proper mind framework. It is through continuous guidance as well as the teaching of the new analytical process that will gradually break down the barrier of resistance to change.

4.4 Managing Shop Floor Improvement Activities

The next crucial stage of managing shop floor is setting the goals. Often, the vision of top management is not well communicated to the people on the floor. Since the understanding of the vision is only partial, the results achieved will also be incomplete. This is the result of individuals' mental models that are partially overlapping with the Company's goals. This brief success of certain department is often not healthy for the rest of the organisation as some of them are left behind in the wake of others' success. Fire fighting can also be one of the symptoms of this type of mismatch in communication. The reaction from management is cost cutting exercises particularly sever for "less productive" departments. Therefore, the goal setting exercise must be everyone's agreement to be successful.

4.4.1 Benchmarking

While in the pursuit of the new goal, there must be a continuous assessment of competitors' products not only to know their progress but also to improve one's product based on their new standards, if any. This benchmarking is essential especially if one is among the leaders in the field. Widening the gap

between the competitors is always the dream of any company while maintaining their own expenditure to the minimum. This benchmarking exercise can also be used to reassess certain workstations in an attempt to reduce defects in the production line. Benchmarking exercises can also be extended to the suppliers' production line to provide defect free products. One example of a tool for assessing suppliers is the vendor rating system that can provide with a clear picture of the different positions of suppliers in terms of their quality, delivery time and costs of their products.

4.5 Management cycle PDCA (Plan Do Check Act)

One of the most common management technique used is the PDCA cycle. This is a practical management technique that is very logical but not used often and completely. The normal reaction to any problem is purely reactive which is Plan and Do (single loop learning). By that time, a large amount of resources have been used to solve the initially small problem, which have increased in complexity and size. It is not only time consuming but also a very expensive corrective process.

The missing link for proper management is the Check and Act stages, which will reveal the true cause of the problem. More analysis is being done for simulating the situation on paper and computers at first and then practising it on the shop floor. The double loop learning therefore reduces the chances of correcting the wrong problem and increases a stronger knowledge of problem solving. The trend is always pushing the workers to move forward for them to be tackling original problems every time. The PDCA cycle therefore acts as a monitoring system for the whole organisation where intervention is needed when the problem is beyond the level of the practitioners. Once this learning has been absorbed in people' mind, the chances of survival of the company in the changing business environment are greater.

4.5.1 Control points

Since the organisation is continuously testing new ideas, the planning has to undergo Double Loop Learning before it is implemented. As the work is delegated to the lower section of the company, the number of checkpoints increases. But since only the workers can achieve the goal, the next stage of the implementation is the ***introductory phase***, that is, to transfer some ownership to them. Management must be able to sell this new concept to the workers, with a clear list of the requirements and also what is expected of this new change.

At the next stage, called the ***critical stage,*** the project may either fail or succeed. This is when the managers have to continuously reassess the progress by holding meetings to keep everyone aware of it. As the project proceeds, the top management has to review if their new goals can be achieved according to their planning or if modifications are needed to reap the expected benefits. This can also lead to a completely new plan if the practical side is not to the expectation of top management. That is why communication across the departments is essential at this stage.

The final stage is the ***stabilisation phase*** where the new vision is properly understood and the progress made is satisfactory. This then leads to the building up on a solid base where improvements can be brought to the plan. At this stage, the PDCA cycle is used mainly to tweak the well "oiled" plan to be more efficient. This can also be the platform for the next breakthrough vision to be built on. The added bonus is the successful experience from this new approach will encourage the workers to be more reflective on the daily work and hopefully become more productive and efficient.

Proper documentation of the whole process that led to improvement and problem solving is essential to be used as a teaching tool for new recruits. This can also lead to the upgrading of communication skills of everyone with the use of flow charts and graphs when the project was initially implemented. The

company can offer an informal school where the theories are combined with practice to have some tangible and positive results. It is also a documentation stage of the whole process, which can be revised at any time if any assumptions are changed and also when new recruits can use them as case studies for their own knowledge of bridging the difference between their mental models and practice.

4.6 Tying the shop floor management to the total company business

The identity of the different sections in the company needs to be established so that they feel unique and proud of the name that is associated with them. Their mission must be made clear to everyone in the group as well as to others in the company. A flow chart can probably best describe the process that they are involved in and also what their skills are. With a broader understanding of their work, the team can also explore ways to help fellow workers in designing better products to speed up the assembly at their station. Therefore, identifying their customers and drawing them on paper also made them realise the extent of dependency of others on them. It also allows them to do planning for future work orders.

Major objectives that they want to achieve must also be laid out so that there is a goal for them to focus on. Analytical tools used to analyse their business and provide recommendations should also be made clear to everyone. Cause and effect diagrams, Pareto charts, etc. are just examples of some of the tools that can be used to monitor the possible problems experienced by them. When there are recommendations raised by the workers, there is again a need to evaluate them to see if there are any extra benefits in achieving the goals and evaluate their problem solving skills. This can even mark some employees for promotion afterwards. And finally, the control points must reflect what are being measured as well as the acceptable tolerances of the systems.

4.6.1 Co-ordinating the business plan development process

The concepts of internal mini-markets can be used as a teaching tool for the employees to understand the environment they are in. Once the theories are understood and tested, it can be transferred to other departments so that there is a general standard system that can be easily used to benchmark each other. The documentation can be used to build up the knowledge of the company as a whole and can be used as a platform for other business units to operate if ever the business is diversifying into other markets. The knowledge building can also be used to help other struggling departments in their aim to be on the same level. In the fast changing business environment, time is one of the main factors that can make a company competitive. This development program is therefore crucial in the growth of the whole company.

4.6.2 Learning from the business planning process

All the business plans with the proper teamwork and ideas are again useless if the budgeting is not properly tied in the planning. Business plans without budgetary responsibility is **NOT** viable. Some kind of basic training in finance and accounting should be given to the workers for them to do some basic financial planning. When these basics are used in the normal running of the mini-business, the transparency of the unit's health can be more easily viewed. Once, the money issue is brought on the discussion table, the team will be more careful in planning and prioritising the main areas of concern. This extra feature is often a glimpse to the workers of how big organisations are run with their complexities.

All these points mentioned must again be in line with the company's vision. The policy must be supported from the workers to the managers if the plan is to be successful. The focus is not to look at just the revenue generated but to satisfy the customers needs. In order to satisfy them, the company must try to preserve the teams that are meeting the deadlines. And the most common mistake that companies make is to focus on profits and not on the workforce,

who will leave the company for better work conditions if possible. Theoretically, all companies care for their employees but their actions sometimes prove the contrary.

4.7 Self evaluation

For shop floor management to be effective there are 6 major elements (shown in Figure 4.2) that need to be functioning well. Each unit forms the basic structure for the business plan to be feasible. Without them, the business plan may either be impossible to realise or badly implemented. Each one of them relies on the other. This system is permeated to the different levels within the company. Often, emphasis is focussed on certain characteristics and that creates an imbalance in the overall structure. This is the result of traditional thinking, which advocates that the sum of the individual parts' efficiency is greater than the whole.

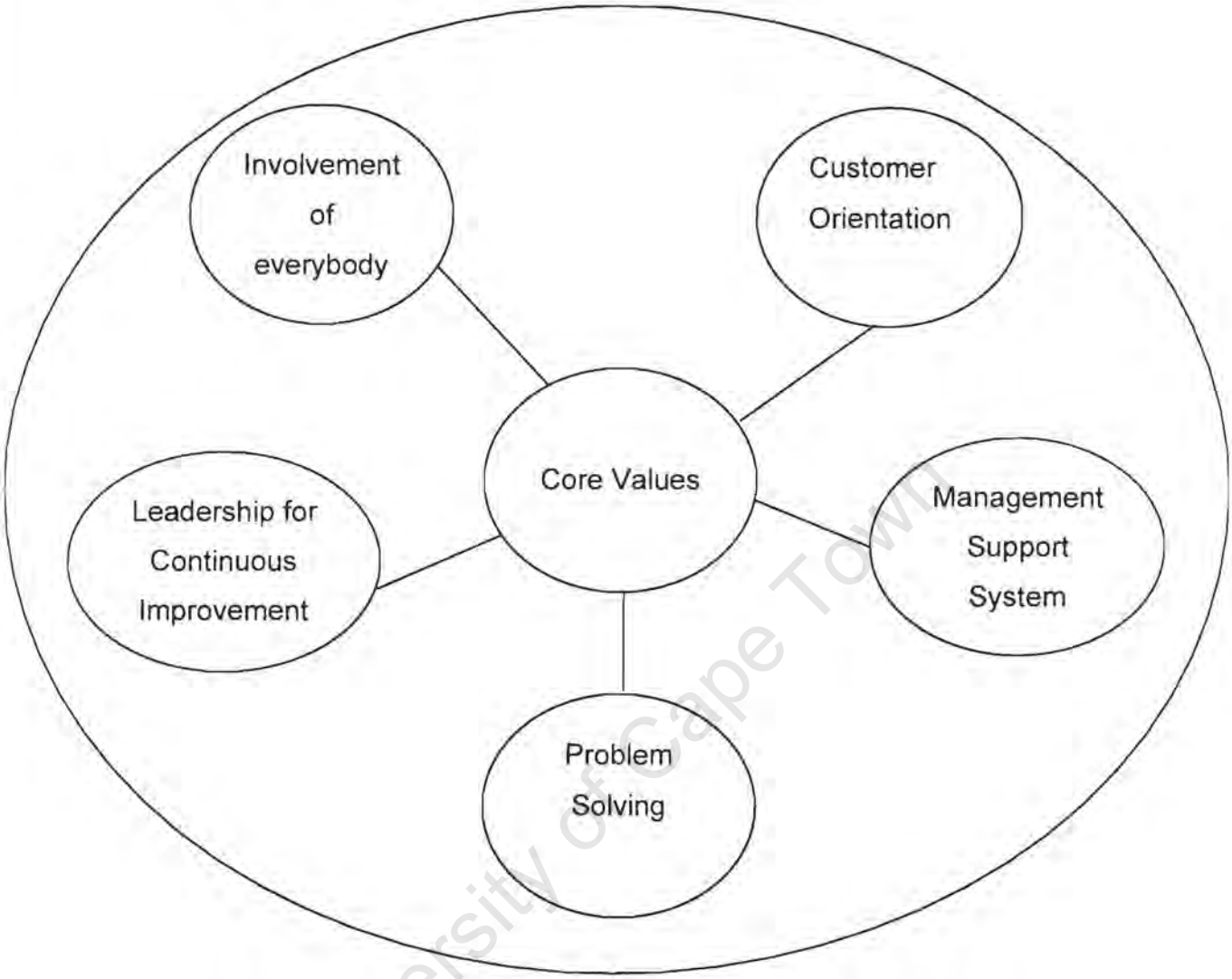


Figure 4.2: Major Elements of Shop Floor Management

Therefore, the goal is to have each of the sub-units with all the characteristics shown above. It will take some time to develop the synergy between them. Core competency may even be developed based on the combination of the six elements if the workers work in a big "family" environment within the company. The final onus rests on the employees who make things happen since every success is based on teamwork and creativity of the people. Management's job is to harness their creativity and individuality and use them as efficiently as possible while respecting them as human beings also.

Chapter 5 – Learning from System Failures

In order to improve, there is a need to learn from past failures but the main problem is identifying the main causes. Failures are often regarded as random and isolated incidents. But based on the Systems Approach, every incident is a result of the interactions of other systems within a defined problem area. The studies of failures are often difficult to do as they are performed *after* the incidents due to public pressure or they are replaced for analysis by other more recent and spectacular failures. In this chapter, the focus will be to understand the meaning of System Failures and to learn from them.

5.1 Basic definition of Failures

The common understanding of failure is the unexpected result based on some plans or extrapolation of past knowledge. Failures can also be classified in 4 categories, namely (Fortune & Peters, 1995)

- Type 1: Objectives not met
  In this case, the design of the system is flawed and the results obtained are often not meeting with the planned results. The corrective actions undertaken are often very costly with sometimes redesign of the whole system.
- Type 2: Objectives met but with undesirable side effects afterwards
  The type 2 failure is often a result of lack of long-term forecast where the different interactions within the system have not been properly predicted. Some organisations are often faced with this type of failure especially after corrective actions are taken in a crisis situation. An example of this type of failure is the amount of noise associated with the Concorde aircraft.
- Type 3: Failure of a small part of a system to protect bigger part
  This type of failure is very common in engineering designs where a smaller system will fail to prevent the bigger system from damaging itself more. The

smaller system was designed particularly to have these protective characteristics. The typical example is the fuse in an electrical appliance.

- Type 4: Meeting requirements but at a too late stage
  Time is of the essence in most businesses and they are common mistakes made by companies when they are promoting products to be made on time for the market at that time. This is particularly important to maximise the life cycle of the product since its design phase. The building of a stadium for an international event must be completed on the specified date.

These 4 types of failure encompass most of the failures that an organisation faces in its life cycle. The main focus is therefore based on identifying the level at which these failures occur and also the most common type of failure that prevails in the organisation. The corrective actions often taken treat the symptoms rather than the root cause of the problems. The task is rendered more difficult by the different perceptions that people have on the outcomes. This is often based on the perception of the original objectives, which might not have been suitable for the later stage of the project. Therefore, the learning from failures do not include only problem solving but also problem identification.

One striking example of failure based on perception is the millennium dome in England. It might be considered as an engineering feat but it was not well accepted by the public, who is the main supporter of the attraction. The whole project was plagued by the three biggest threats to success namely, cost escalation, delay and client dissatisfaction. The future of the building is uncertain based on poor return on investment. The failure can be classified as type 2 with the perception of the aesthetics of the dome as "ugly" even though every technical standard has been satisfied.

not obvious to the operators sometimes as most of the learning is from living that moment. Dörner (1989) once said that *the incompetent people with good intentions rarely suffer the qualms of conscience that sometimes inhibit the doings of competent people with bad intentions.* These causes of failures are the most difficult to find as these actions are based on some tacit knowledge that are supposedly beneficial to everyone.

Missed opportunities are also another form of failures whose results are more long-term. This is particularly common when the business can not meet the demand or missed a certain niche in the market. This type of failure is common in manufacturing companies where new targets can not be met simply because the company's production facility has not been designed for this production capacity in the long run. This can be the result of a sudden boom in the business where demands outstrip supply. As the gap widens, competitors rush in and even overtake the company in their sales' figures.

The reverse of Kaizen can also be applied to failures where small incremental failures will lead to a major break down of a system. This sudden collapse always seems to be unmanageable, as the problems seem to be covering a large area. The typical example is a strike in companies where the unexpected communication breakdown between management and workers can result in huge losses in production and also tarnish the company's image. The costs to repair these damages can only be recovered after years of massive investment. Another striking example is the Tchernobyl Nuclear power station in which small failures have cascaded into the meltdown of the reactor, resulting in the worst accident of this nature.

Therefore the failures are not only based on physical breakdowns of machines but also in human systems where their importance has often been underestimated. Most organisations are slowly learning to understand and use failures for improving the company's targets and policies. In trying to understand

failures, the next stage is to look at failures from a Systemic Approach with emphasis on the human factor and the organisations' structure. One of the great businessmen of the century, Bill Gates (Fortune & Peters, 1995) also mentioned the tendency of underestimating the workers, *It is fine to celebrate success, but it is more important to heed the lessons of failure. How a company deals with mistakes suggests how well it will bring out the best ideas and talents of its people and how effectively it will respond to change.*

5.3 Approaches to Understanding Failure

Since failures are results of human interpretation of the situation, the approaches to finding a possible solution will be focussed on understanding the interaction of the sub-systems - human interactions at different levels of the company. Mintzberg (Fortune & Peters, 1995) said that" *the organisation that will truly excel in the future will be the organisations that discover how to tap people's commitment and capacity to learn at* ***all*** *levels of the organisation."* Starting from the lowest level to the higher level, the different sub-systems are then explored in more detail to understand its characteristics as well as its impact on the rest of the organisation. The inquiry into understanding failure comprises of the human factor, the organisational structure, its politics and its management style. Building a rich picture of the situation with its hypotheses is a lengthy learning process especially with the inputs from all the team members of the project but the rewards from the process is very beneficial in identifying the problem areas.

5.3.1 Individual Learning

Mintzberg defines the person as an individual with a set of *values*, body of *experiences*, set of *skills* and *competencies*, basic *knowledge* and a set of *mental models*. These characteristics will combine together to determine the success or failure of the situation. The mental models in which the practitioner works are being constantly challenged to learn and improve his current practices. Most of

Chapter 5: Learning from System Failures

the learning is a gradual process with the paradigms being shifted slowly and occasionally completely changed. An example is the exponential use of the Internet that is threatening the publishing industries. This change of the information medium was initially overlooked and that has cost numerous companies their strategic plans of the future. And with the explosion of the Internet use, a lot of new Internet companies have also underestimated the needs of the customers. This has resulted in a number of companies closing down after a few initial years of success, especially in the US.

With the change in the paradigms, the knowledge and skills have to be upgraded. The transition of the experience from the past to the present has to be carefully adapted. With the advances in technology (in this instance, the computer), the challenge is to create sustainable plans in the future instead of solving daily problems at a faster rate from the faster responses of the systems. These new technological marvels often force the reaction time to be quicker and more accurate. Computer simulation packages can be used to show patterns instead of focussing on isolated points in time. But, the "corrective" actions may speed up the failure of units within the organisation. The result of these simulations will be more accurate when the information has been captured accurately with all the assumptions taken into account.

Teamwork is therefore another important aspect of individual learning. The learning process involves the identification of the right problems before intervention takes place and the information gathering is not based only on analysing data sheets but also eliciting tacit information that can be of great importance to the process. It is through these group meetings that ideas or data can be immediately discarded or added to the formulation of a new mental model. A common goal can then be more easily reached since it has been built from the synthesis of all the mental models of the people involved in the planning process. Networking is also part of the learning process where an outsider's perspective (personnel from other departments) brings a new angle in solving the

The problem with TQM is the time frame that the company needs to change the way people work. Even though the small improvements are not beneficial to the company in the short term, the support from top management must be present at all times not only to support the scheme but to build up trust with the workers. It is normally after several years that the benefits can be seen. With TQM, co-operation is assumed to be at all levels but with organisational politics, the result is different from the ideal situation. Resistance to change ranging from ignorance to self-preservation will tend to "sabotage" the TQM plan for the company. And at each stage of the implementation, the focus is on the expenditure vs. immediate savings made.

This leads to the next part of the problem of TQM, improvement of the individual processes. Optimising one part of a process may not result in the increase of the general efficiency of the whole process. For example, running one machine at 100% of a production line will not increase the general efficiency as it might create bottlenecks in other sections. So, improvement of the whole process and not on individual processes has to be analysed to achieve the optimum output. The upgrades of other support departments also make short term returns almost impossible especially with the trial time needed for the workers to perform efficiently and effectively.

5.4.2 Failure to improve financial performance in the long term

Assuming that the company manages to pass through the short-term pitfall, the overall increase of the profit of the company is in the range of 5-10% of sales (Mwaluko, 1999). Since the improvement is continuous and at all levels, the process is slow and also complex. This is due to the continuous improvement of the different activities of the company to increase their production. Some activities are not worth improving since it is not on the critical path of the main production line and the result is a larger and more complex process, which is

more prone to errors. Therefore, TQM on the long run will be consuming resources where not really needed and the result is more resources being used to monitor the process and correct them.

The errors mentioned above can be split into two categories mainly, assignable and chance errors (Mwaluko, 1999). The immediate corrective actions taken at an operational level will be targeted on assignable errors, which are mainly human errors, defective materials or machines. They are the most visible and measurable problems based on certain standards calculated by scientific means. The other type is the chance error, which is often inherent in the design of the process. These problems are less visible but more serious. TQM's focus is therefore designed to deal with assignable errors rather than chance errors. But alas, the mistake that most companies make is to correct the symptoms of a badly designed process, which will appear at some later stage.

5.4.3 Failure to improve productivity

The wrong association of TQM and productivity as a linear relationship has resulted in many companies losing their strategic position in the business world. The drive for TQM can be understood due to the claim made by Juran *that the cost of poor quality is between 20% to 40% of sales*. Since TQM is a flexible concept that can be changed based on different factors, there can be different corrective actions also. Some focus on management philosophies, some on performance and others on training but each of these actions taken aims at improving productivity has varying results.

But the variations depend on the level of awareness of customers' own needs. This narrow focus on customers' needs have resulted in huge resources spent on research and development while the customers are not even aware of the extra features resulting in huge pressure on the design and sales engineers. For example, having these extra features on their products while underestimating

the possible problems faced on the assembly line is one common mistake faced by manufacturing companies. TQM focuses on doing things right but not necessarily doing the right things.

5.4.4 Lack of support of Organisational Structure

Without proper support from top and middle management, all these concepts will soon form part of the numerous management fads that managers have rejected to the academics. The focus is shifting from an individual level to the organisational level, with more emphasis on the understanding of the workers in general rather than a few select personnel. Based on Stafford Beer's work, the organisation must be self-driven with senior management providing guidelines to keep the program on track. In general, managers know the theoretical rules of the business well but the detailed operational techniques are well known to the workers mainly. Disagreeing over the procedure of the work processes, the managers then shift their attention to other priorities, neglecting the experts' (the workers) opinions and thus reinforcing the belief of lack of commitment of the workers.

One of the salient characteristics of top to bottom management is the blind faith in the company's goals and its standards. Accepting these "orders" are based on the assumption that every angle of the possible problems has been covered and that the new standards are achievable and maintainable in the long run. This not only restricts the creativity of the workers in the company but also in their decision making. With a tendency to focus on solving problems as soon as they appear, the organisation also have the well known "if it ain't broken, don't fix it" attitude. There are also decoy problems that draw managers' attentions while the true problems go unnoticed. These decoy problems often have their solutions planned for as a root cause and not as a symptom.

With large organisations, the different hierarchies are often the cause of failures too. This is due to the presence of unqualified and newly promoted personnel, namely persons from other departments or backgrounds in certain decision making areas. The training or knowledge that the individuals possess makes them ill equipped to provide constructive help at certain levels, especially with their assumptions of certain facts. If the newcomer's functions are not well understood, the problem will worsen as each staff member will work based on his understanding and not on the real situation. The communication channels through which information is transmitted can also aggravate the problem. With intricate levels of hierarchy, the amount of filters for problems often dilute the problem that by the time it reaches the designated person, it has been simplified to become a daily problem. Administrative channels can also delay the reaction of the company to problems as the reports get mislaid or reported to the wrong department.

Finally, with the huge resources put into problem solving, the companies have often presented the failures experienced earlier in a structured way with its gradual deterioration. It is a false representation of the problem faced by the workers who underestimate the early signs of a problem. Even when the problem has increased in complexity and magnitude, the approach undertaken to solve the problem is often done in a defensive and inadequate way. This self-preservation reaction is often the result of a very unforgiving organisation that eliminates problems by "shooting" the messenger rather than solving it with the "discoverer". The solution is to try to train the personnel to deal with ill-structured problems that emerge most of the time in the beginning.

In the next chapter, the VSM will be explained in more details. The model will hopefully provide the link which can merge these theories of management style to the organisational structure.

Chapter 6 – The Viable System Model

6.1 Introduction

The viable systems model (VSM) was originally developed, because of the increasing amount of learning required on the part of the individuals and organisations. The bottle -neck is the rate, at which one can change to adapt to new circumstances, which is a serious challenge in the business world of today. Currently there are more complexity (people, information, organisations, a higher rate of change and interdependency, etc.) that people can deal with in their work environment and without some kind of a structure to regulate the information, the organisation will experience problems when solving the wrong problems right.

The challenge is thus to design or develop an organisation that can meet the quest for all the above. The aim is to develop an organisation that will satisfy the following:

- Continuously meet client' s needs.
- Learn and adapt rapidly.
- Maintain itself.

Stafford Beer came up with a model for an organisation, which was developed to satisfy all the above, by simulating the human nervous system. The model strongly observed the cybernetics laws, while Beer defined Cybernetics as 'the science of effective organisation' (Clemson, 1984). The model was called the VSM and will be discussed briefly in the next few paragraphs.

6.2 Discussion of the VSM

The VSM focuses on functions rather than structure. It specifies 5 broad functions that must be carried out in any organisation that manages to maintain

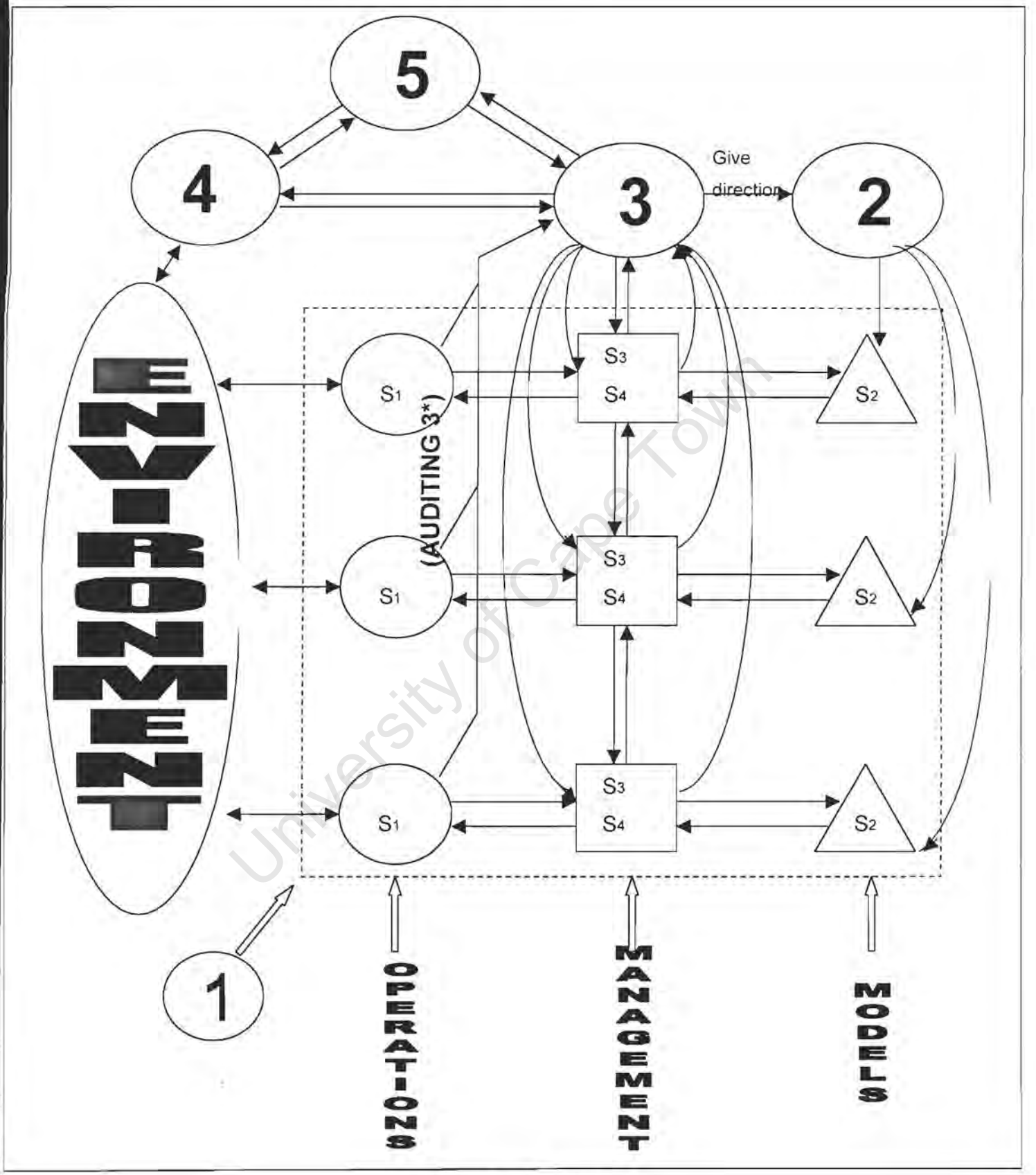


Figure 6.1: The VSM

6.2.1 *System 1 (s_1)*

System 1 mainly refers to the basic units with control capacity (are to be controlled). These units could for example be departments inside an organisation or subsidiaries in a group of companies. This system consists of operations, the management and the models that management holds of the units. The models can either be explicit (a computer simulation or balance sheet) or implicit (intuitions, biases, prejudices, etc.).

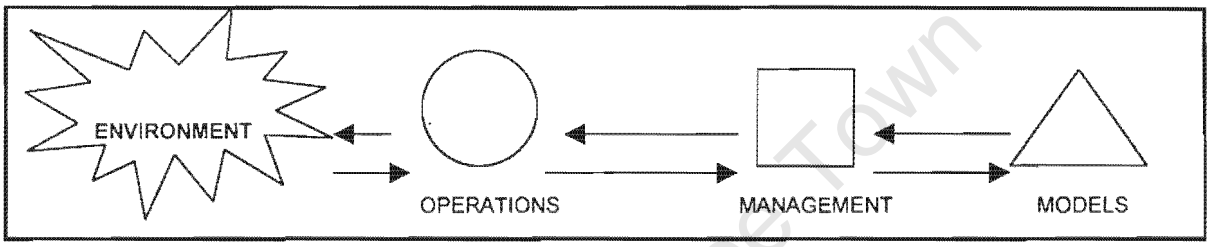


Figure 6.2. System 1 pulled apart to show the major interactions.

- The parts are directly concerned with implementation
- Each part is autonomous in its own right
- Each part must exhibit all the features of a viable system itself. s_1 in operations, s_2 in models and s_3, s_4 and s_5 in management.
- Each part connects to its local environment and so absorbs much of the overall environmental variety.

6.2.2 *System 2 (s_2)*

It is this system's main function to prevent the various operational units from affecting each other adversely through inadequate co-ordination. The workings of internal operational elements have to be co-ordinated and it must be ensured that viscous cycle effects are not generated – that is why the co-ordinator must operate at least as often as either of the two elements makes a

significant change. It is important to note that s_2 is a 'servant', which operates under s_3's direction. (Clemson, 1984)

- s_2 has no right to tell anybody what to do – only when trying to prevent oscillations.
- s_2 needs to maintain homeostasis of the organisation – all the critical variables has to be maintained within their normal limits.
- s_2 is responsible for solving problems which develop between the separate s_1's.
- Dampens uncontrolled oscillations between parts.

6.2.3 System 3 (s_3)

System 3 is responsible for making sure that the organisation produces the outputs that the larger organisation requires of it, as well as maintaining homeostasis within the organisation as a whole

- Must keep things running.
- Interprets policy decisions of higher management.
- Must ensure that the organisation produces the outputs that the larger organisation requires of it – effective implementation of policy.
- Must ensure that internal operational elements produce the outputs that it is assigned to produce.
- Must ensure that internal operational elements (parts of s_1) are able to secure the resources that they need to function.
- s_3 uses s_2: a command channel for giving orders and an audit channel for those occasions in which an in-depth exploration of one or more operational units is necessary.
- s_3's command and audit (s_3*) channels go directly from s_3 to each of the units in s_1 (as do s_2's channels).
- s_3 treats each element as a black box, while it only worries about the outputs – it identifies the critical outputs for each operational element and ignore the rest.

- This is the channel for orders related to current operations - 'Here and now'

6.2.4 *System 4 (s_4)*

s_4 handles contacts with those outside the company, and initiates changes and development work. s_4 explores the environment and the future.

- s_4 explores the following: growth, change, new threats and opportunities.
- s_4 has command over the resources left after s_3.
- s_4 has to identify a set of variables which, taken together, provide a snapshot of the state of the unit at one time. It is important to note that it is more important to know how the indicators are changing over time, than having an accurate value for the variable.
- Must provide a model of the organisation's environment.
- Must rapidly transmit urgent information from s_1, s_2 and s_3 to s_5.
- s_4 distributes environmental information upwards or downwards according to its degree of importance.
- It must be a learning process – must gain insight into the working of the organisation.
- Must create the organisation' s desired future.
- Provide a focus for the organisational explicit self-knowledge of its problematic environment.
- Provide a focus for the organisational explicit self-knowledge.
- s_3 and s_4 maintain a continuous dialogue.
- 'Outside and then'

6.2.5 *System 5 (s_5)*

By using the organisational identity, s_5 has to mediate when the tensions between s_3 and s_4 occur. By doing this, s_5 has to find a balance between stability and the rate of change.

- s_5 is responsible for policy. For example using a vision and mission.

- Must respond to the significant signals that pass through the various 'filters' of S_1, S_2, S_3 and S_4.
- Arbitrates between the antagonistic internal and external demands on the organisation as represented respectively by S_3 and S_4.
- Represents the essential qualities of the 'whole system' to any 'wider system' of which it is part.
- In absence of a clear sense of organisational identity both stability and change will be dealt with, out of personal interest and personal visions of organisational needs. There is no way to recognise what should occur without the vision.
- S_5 is normally the function of the board of directors. (Clemson,1984; Espejo, R. & Schwaninger, class notes of 1998, Flood, R.L. & Jackson, class notes of 1998)

Figure 6.3 is a practical example of the VSM

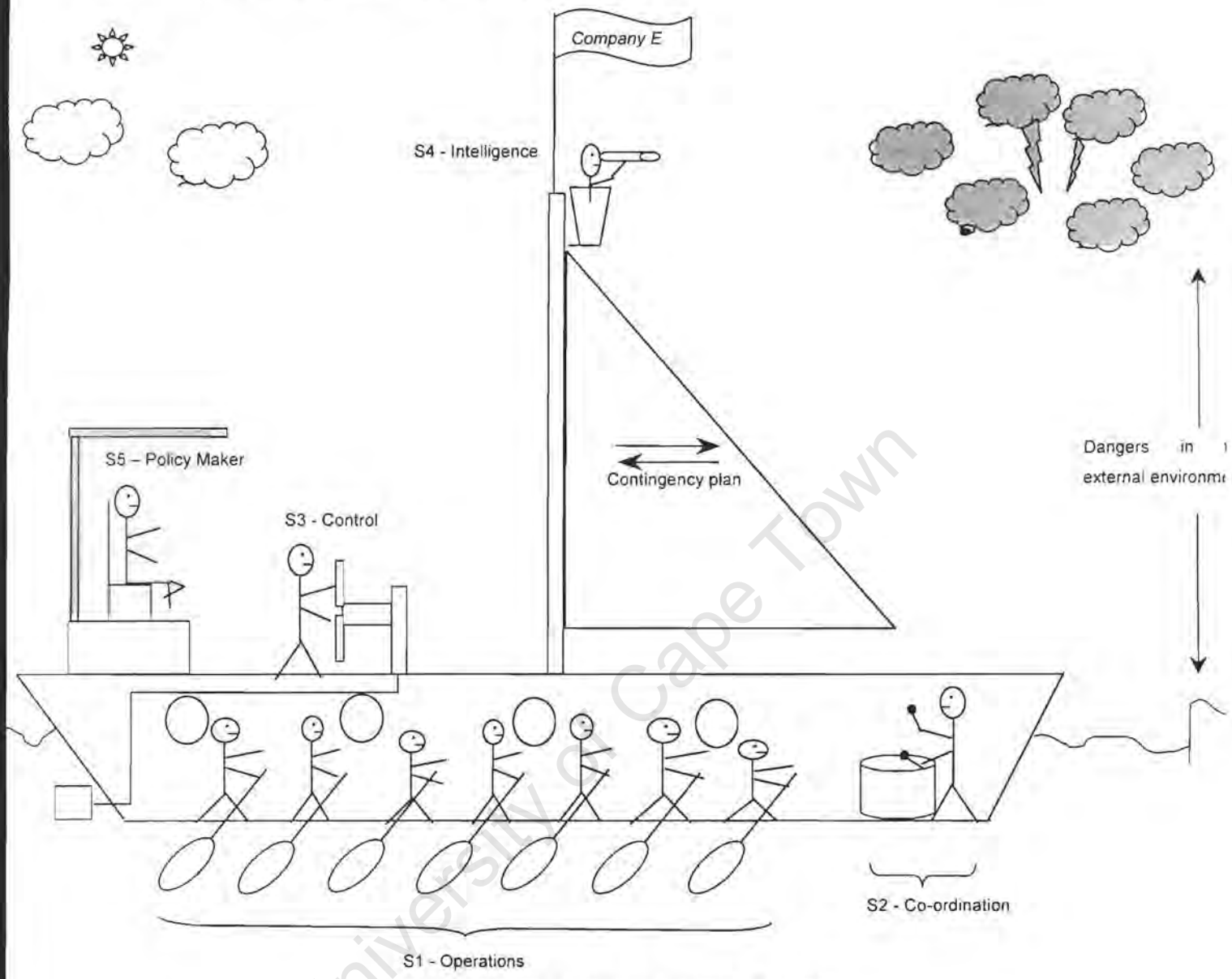


Figure 6.3: The different functions of VSM

6.2.6 VSM and the levels of management

The meta-system (S_3, S_4 and S_5) is also classified in terms of levels of management:

Operational management (O)– S_3 – "here and now"

Strategic management (S)– S_4 – "outside and then"

Normative management (N)- S_5 – "balance inside and outside; short term and long term by means of norms"

At the 3 levels of management different criteria of systemic effectiveness apply:
O : economic efficiency
S : capability in both the competitive and the co-operative sense
N : legitimacy (potential to fulfil the claims of all relevant stakeholders)
The key duty of an integral management is to meet all 3 requirements: ensure that the organisation is successful in operational terms; intelligent – on course, in strategic terms; valuable contributor to the larger whole – normative terms. (Espejo, R. & Schwaninger, class notes of 1998)

There are two very common models that are used by organisations to deal with the flow of information and corrective actions taken. One of them is Internal Market, which deals with creating an environment to continuously evolve to compete for improvement. This model is mostly catered for operational aspects of the organisation where economic efficiency is key indicator being measured. It also creates an environment where the different sub-units are made responsible for their actions as well as their survival. This model allows the employees to be responsible for their work.

The second model is the circular organisation in which the hierarchy is flattened. The aim is to promote communication across the organisation so that every employee is aware of the latest development in other sections. Found mostly at strategic level, the focus is lack of an authority figure. This promotes free flow of information as well as a quicker response to changes. Once the goals of the group together with the impacts on other departments have been clearly understood, the creativity of the employees can be tapped in to develop better systems for the whole organisation.

The two models are going to be discussed in more details in the following sections.

6.3 Internal markets and the VSM

6.3.1 Introduction

Large business institutions are failing because of their inability to cope with the turbulent dynamic new world. A new model of organisational structure and function is required to cope with this new information age. Large corporations are moving to the internal market system, which makes use of concepts such as entrepreneurship and internal customers. Every facet of the organisation is converted into a profit generating centre which sell their services to other units and externally.

The new information technology age has enabled organisations to convert from a top down hierarchical structure to a modern networking system, which link people in diverse locations and enable them to work on common problems. This network's survival is driven by the principle of free enterprise. It will eventually become a self-organising network of entrepreneurs.

If the goal is to convert a previously hierarchical structure to an internal market form, then the first step would be to change the paradigm for control. The manager must give subordinates a certain level of freedom and self-determination within a given set of pre determined parameters. This style of control emphasises accountability and encourages creativity, entrepreneurship and self-management. The new role of the executives is now to provide the super structure for the framework of controls, incentives and communication.

The feedback received from the semi-independent business units within the organisation is viewed as vital information. This information would be used for self-assessment and benchmarking which would lead to an improved efficiency. The network structure of the internal markets would feed that information to all departments and cause a rapid organisational response to the external environment

In an internal market system the role of employee, once seen as a liability can change to become the central players. Survival would necessitate creativity and ingenuity leading to self-determining entrepreneurs who take charge of their own careers and view themselves as professional temporary workers providing a service. The new organisation should be able to accommodate this new style of employee by developing concepts such as pay-for-performance i.e. proper incentives must be in place. This ensures that employees are not paid for holding a position but rather for delivering results (O' Brien, V., 1996).

The demands of competitiveness and accountability from staff would require a change of business ethos. A culture of competitive co-operation is appropriate. An excessively competitive internal culture could be self-destructive and should be avoided by creating internal consortiums, joint ventures and strategic alliances.

The business executives new brief would be to facilitate the development of the internal market system by acquiring new knowledge and developing a cohesive corporate community. The new knowledge would be in the form of improving the organisation's technology, marketing and other strategic knowledge. The corporate community must be convinced by the new beliefs, values, and vision to operate as a cohesive community.

6.3.2 The Internal Markets and the VSM

The internal market concept ties in well with the VSM because they both stress the need to be self organising and autonomous. In both instances survival will depend on adaptability and flexibility .The dynamic external environment demands a rapid reaction time and survival dependent on viability. External interaction would strengthen the organisation and remove those facets that are unproductive. The network nature of the internal market system allows for rapid

reaction time and also accommodates the principle of requisite variety due to the variety of inputs into the network and the accessibility of that information to all business units. The executives would then act as the control and facilitators and develop a culture in the organisation to suit the new structure.

The first trend that can be added to VSM is the addition of Internal Market structure. This arises due to the numerous problems that a non-market economy has e.g. subsidised economy, no buying of resources from outside, bureaucratic interference from top management and no competition within the organisation. With the continuous change in the economic environment, the organisation must be able to tackle the problems to remain competitive.

6.3.3 Internal Market structure

The basic structure of internal market is split into 4 different organisations (functional, divisional, matrix and network) and in the network organisation, it is again broken down in 3 types (stable, internal and dynamic). At each level, the different organisations have the following characteristics, which will be discussed below. (Halal, W.E. et al, class notes 1998)

Functional Organisation

The structure mentioned in this section is targeted at specific functions of the company. It will depend if emphasis is made on their quest for specialising in certain fields. This is mainly to use specialised experts to preserve a competitive advantage when more research is made in that direction, i.e. centrally co-ordinated specialisation.

Divisional Organisation

In this type of organisation, the emphasis is to target a specific section of the environment. For example, creating high quality products for specific

customers. This type of organisation concentrates on new or expanding markets, achieving both flexibility and economics of scope.

Matrix Organisation

Matrix combines the functional and the divisional organisation by using efficiently the engineers and scientists to deal with multiple projects and new products. This method is the preferred method compared with the usual hierarchical structure as they can contract or expand depending on the market opportunity while retaining human assets. An example of the structure is show in Figure 6.4 as shown below.

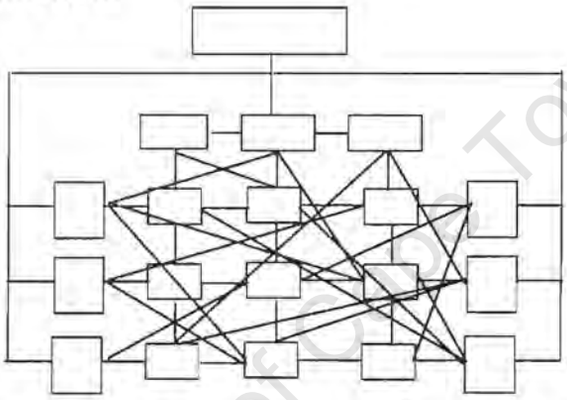


Figure 6.4. The matrix structure of an internal market

6.3.3.1 Network Organisation:

In this form of internal market, the organisation concentrates on its core competencies by eliminating any other sub-divisions that are not important or not profitable to keep. It typically purchases all its materials from external suppliers. But network organisations are also broken into 3 kinds of networks:

- Stable network where it is designed to serve a predictable market linking together independently owned specialised assets along a given product.
- Internal network where it is a market economy inside the firm
- Dynamic network's ability to adapt to different divisions on related products.

It is from these kinds of organisations and functions that a balance must be achieved to have an efficient way of dealing with the complex and unpredictable nature of the economic environment. But whatever these functions or organisations are, they all must exhibit the same characteristics to be considered as an internal market structure. Another example of a network is shown below with examples of universities and companies as the main organisations in Figure 6.5.

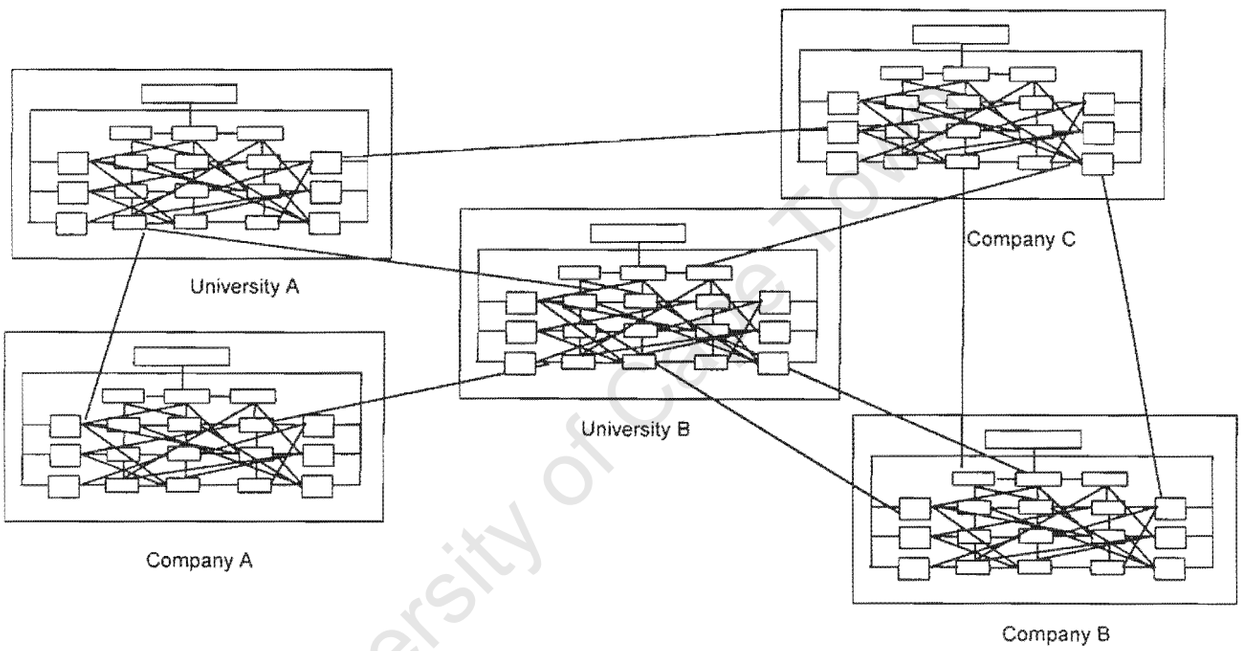


Figure 6.5. The network organisation

6.3.4 Characteristics of Internal Market

The 3 main characteristics of internal markets are:

- Pay for performance
- Free enterprise
- Self-organising network of entrepreneurs

This section will also show some other characteristics of the internal markets.

6.3.4.1 Pay for performance from the Profit Centres

Within the internal market structure, business units are independent and their aim is to remain competitive and be sustainable by making profits. Getting the best products from the external environment as compared to the internal environment will give the organisation a better quality product for a lower price. There might be an overriding factor from the higher management but the manager will be responsible for the difference in price that may result. This will promote more thorough thinking from them before implementing their decisions. But in some cases, the need to preserve a non-profit sub-division is greater than shutting down if it brings value to the corporation as a whole. (Ackoff, R.L.,1994 & Halal, W.E. et al., class notes of 1998) If they do not bring revenue in the organisation, they can act as cost centres, part of profit centres. The workers are then rewarded if the ventures are successful.

6.3.4.2 Entrepreneurs

Every individual is responsible for the actions they take. Creative thinking is encouraged in the groups as they always try to predict the various opportunities that arise in the environment to be able to survive. With this flexible control over them, they are freed as executives to become leaders. They have to create a strong spirit of teamwork and open to information from different sources. Creation of new successful ventures will be the main aim for these entrepreneurs. This can only be achieved by the full support from their workers. The transformation process changes the hierarchy to "enterprise of entrepreneurs" (Halal, W.E. et al, class notes of 1998). It allows each unit to deal with the external environment.

6.3.4.3 Self-Organising

Free internal markets promote competition within the firm and the units have to find the cheapest and highest quality products to be able to sustain them. The building block is to have a workforce that thinks the same and that is bringing the younger generation. They possess autonomy, have the tendency to

advance and personal fulfilment. Once the leaders have set the goals (within the company's concepts), the process is like the black box concept: Given the inputs in the environment and the expected results, the transformation process is up to the workforce where there are no constraints.

6.3.5 Possible Causes of Failures

Looking at the possible causes of failures of the internal market structure that may arise when implementing it will force the design of control features. It is based either on the functional or the personnel side.

Communication

Bad communication from the top management level to the lower levels conveys the wrong picture and there is misinterpretation. Different units run in different directions without the managers knowing and the results are known at the time of report most of the time.

Design structure

The internal market is designed to accommodate certain organisations, e.g. functional organisation and within the units, the leader diversifies in all directions resulting in the collapse of the structure. Over-extension of the units' area of expertise, modification of the unit' s goals that violate the logic associated with each of its variations.

6.3.6 Avoiding failure

Adjustments to environmental shifts within the operating logic or adopting a new form to fit a new environment are being made to avoid failures of internal markets. Listed below are some ways of achieving success of implementation of internal market.

6.3.6.1 Developing the competence for self-renewal

2 characteristics of network:

1. Essential relationships among components are market transactions (highly visible)
2. Relationships are voluntary (must reflect explicit commitments)

Dynamics of market relationships:

The main point is to have clearly specified, objectively structured contracts that guide interactions rather than internal schedules, procedures and routines.

Dynamics of Voluntary Relationships:

Value of openness and explicitness

Fairness and teamwork

6.4 Circular Organisation and VSM

The previous section looked at Internal Market systems along the lines of VSM as a means of developing a group management model for a viable organisation. This section looks at the possible application of circular organisation in the organisation structure in the model being developed.

6.4.1 Introduction

The concept of circular organisation becomes increasingly popular and appropriate as the needs of organisations and their employees change. It is defined as a democratic structure that has the following three characteristics, namely absence of the ultimate authority ("boss"), direct participation (open book management [O' Brien, V.,1996]) in decision making, and ability to make and implement own decisions. The objectives of circular organisation are to:

- operationalise democracy in organisations
- increase the readiness, willingness and ability of organisations to change
- improve the quality of working life

- Facilitate management of the way parts of the organisation interact and the way the organisation interacts with parts of its environment. It improves and facilitates the organisation's homeostasis.

These objectives are briefly discussed below.

6.4.2 Quality of Work Life

This defines the sense of usefulness and value the employees derive from their work environment. As the educational level and amount of publicly and privately provided economic security of non-managerial employee's increases, the more they expect a satisfying quality of working life. Job rotation, personal development programs, work enrichment and semi-autonomous work groups are among the many innovations directed at improving the quality of work life. It is apparent that unless participation in relevant decision making is increased, changes will produce only temporary improvements in employee and organisational performance, which are drawbacks to organisational competence (Holmberg, B.A.,1989)

To increase employee participation, communication must be improved. Consultation must be added to communication. Managers cannot effectively implement their decisions in the current work environment unless they understand two kinds of power, namely, power over and power to. ***"Power over"*** is the ability to get people to do things they do not want to do or things they would not do voluntarily. This kind of power is based on the ability to reward and punish e.g. autocratic rulers and dictators. ***"Power to"*** is the ability to get people to do what one wants them to do and this is about to lead and not to command. This is a direct manifestation of employees' empowerment. The more educated the workforce, the more negatively correlated are power over and power to.

Employees are becoming more assertive in their demand for a satisfying work life. When people are given the opportunity to participate in decisions that

are among the most onerous to them, they tend to participate constructively and without ill will. Decentralisation gives lower level personnel the right to make decisions normally made at a higher level. (Ackoff, R.L., 1994, Holmberg, B.A., 1989) Improvements in the quality of work life can be achieved through proper management and maintenance of organisational homeostasis (i.e. managing interactions within the organisation).

6.4.3 Management of interactions

Organisational performance depends on both the interactions of its parts and its interactions with other systems in its environment (Ackoff, R.L., 1994). Going "through channels" is seen as one of the most common rules of the game and is viewed as an effective way of suppressing interactions, involvement and participation. Within an organisation there are two types of interactions namely:

- Horizontal interactions involve people at the same level. This is about co-ordination and is an s_2 function.
- Vertical interactions involve interacting with others who are at the different levels of the organisation.

6.4.4 Readiness, willingness and ability to change

Organisational resistance often hampers the effective implementation of change. The circular organisation aims at increasing the organisation power to implement decisions and ability to adapt to environmental changes. This is part of the VSM, which is about responding very quickly and fast to bring about change. Circular organisation is viewed as democratic hierarchy that is capable of providing lubricants to change [Charles Handy], thus avoiding having a rigid organisation.

6.4.5 *Composition of boards*

Each board should have the manager whose board it is, that manager's immediate subordinates and that manager's immediate superior. Any board has the right to add members drawn from inside or outside the organisation. The subordinates normally constitute a majority. One normally gets two types of boards, the one at the top and the one at the lowest level. The structure of the circular organisation is given in Figure 6.6. The Boards once formed take or assume their responsibilities for smooth operation of units, thus leading to viability of the whole.

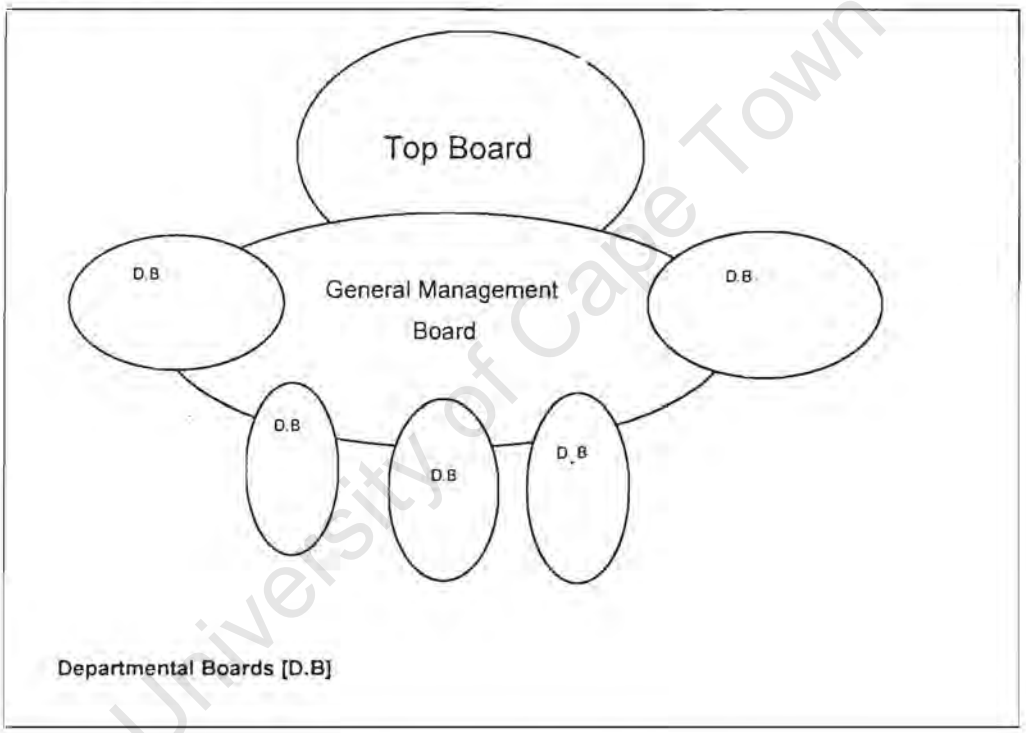


Figure 6.6. The Structure of the Circular Organisation

6.4.6 *Characteristics of Boards*

Responsibilities of the boards

- Planning for the unit whose board it is.
- Policy making and monitoring policies applicable to their units.
- Co-ordinating and Integrating plans and policies.
- Improving the quality of work life of subordinates.

- Enhancing and evaluating the performance of the manager.

Operations of boards

- Operate by consensus rather than majority rule, thereby removing the possibility of a tyranny of the majority.
- Chaired by the manager whose board it is. In certain cases chairing rotates.
- Each board designates a member to record and prepare the minutes. The secretary of the board using inputs from any of the board members prepares agenda.

6.4.7 How Circular Organisation relates to VSM

- At any level of the organisation there is an S_5 function that is filled by the definition of the board. There is also a recursive level due to the style of leadership adopted at different levels.
- Job rotation - S_5 sets policies. Job rotation is an S_3 function because S_3 makes sure that things happen.
- Vertical and horizontal interactions are functions of S_5 level of management. These interactions satisfy the need for job rotation. S_3 makes sure that the process of interaction actually happens.
- Work environment (S_3 and S_4 functions). The task of managers is to motivate the staff and to create an environment in which the purposes of the organisation as a whole are served. Human Resource (HR) creates systems that not only allow employees to discuss their roles, but also permit them to suggest ways of improving their performance (O' Brien, V., 1996).
- Personal development programs are S_3 functions. Development is an S_4 function since it is a long-term activity that involves an external environment.
- Semi-autonomous / self-organising is an S_1 function.

6.5 Relevance of the theories in the overall framework:

Establishing the criteria for a learning organisation is very difficult as there are numerous factors that affect the process. With most businesses, their goal is to maximise profits by any means but their typical reaction is to reduce the cost of overheads, often at the expenses of the workforce. There are better long-term solutions in reducing expenditure which involve a change in thinking. In this case, the different theories (Deming, Shop Floor Management, Learning from Failures and Stafford Beer's VSM) are used to try to create an organisation with the proper functions that will survive by learning from its mistakes and from others competitors.

6.5.1 Structure of the organisation based on the VSM

Starting with the VSM as the framework for developing a learning organisation, the focus will be on its different functions and management style. These functions form the core of the organisation for their normal operation. Both Deming and Stafford Beer agreed that the core values of the company need to be properly established for employees to identify themselves with them. These goals' aim is to create a sense of identity that workers can relate to and be proud to be associated with. These policy makers therefore need to have a clear vision of what future they are aiming for and how to reach them.

But to reach these goals, the organisation must have the proper structure to capture data from both the internal and external environment. The performances of the different sub-units must be properly appraised for accurate strategizing of new plans and their work are continuously monitored and improved by feedback from their superiors. The knowledge of the business of their leaders and managers are strengthened by the inputs from the external environment. The intelligence function must not only be aware of the latest technology breakthroughs but also management issues where for example, a

better tool can be used for measuring morale since it is a determinant factor in the company's survival.

The operational aspect of the organisation is where the new strategies are translated into tangible results. These strategies require a new framework of operation which must be taught to the employees. This often takes form as informal training where the workers are gradually exposed to the concepts. The mentoring at this stage is crucial with the continuous flow of information between the shop floor and management. It is at this stage that co-ordination is crucial as the theories often clash with the practical implications. This has resulted in modifications of the theories to suit in this particular environment.

6.5.3 The Learning stage

Deming's Theory of Profound Knowledge raised the issue on how organisations are managed as companies are often faced with unexpected results from their actions. This is due to the unsystemic view of the world as each sub-unit is treated as an isolated part whenever there is a problem. With his theory of systems, Deming provided some explanations on the behaviour of an organisation. It is often the interactions further in time and space that creates problems and any tampering can easily offset the delicate balance of stability and anarchy. His "red bead" experiment demonstrated this issue where the system (mistakes and all) is stable.

To avoid upsetting this balance, the variation within systems must be understood. This is the reason why Statistical Process Control (SPC) are used to often provide scientific means to measure the variations and an acceptable range of values to differentiate between the system's own variation to that of a problem. Also, the corrective actions will also depend on the time frame at which the results are being considered. The short-term solutions must not erode the

long-term goals set by the policy makers as they can have a ripple effect on their future. That is why the learning process is crucial.

Learning therefore plays the most important role of management which is to avoid repeating the same mistakes or taking uncalculated risks. Understanding the systems and its characteristics provide the practitioner a clear model of the organisation. With the proper measurements being provided, his decisions must reflect a systemic view of the organisation. The learning process must not be based only on results but on the process of problem solving. It is the use of the different methods and tools to identify the right problem and develop a process for the solution that constitute learning.

But learning also has to occur on the shop floor where results are visible. Theoretical learning differs from practical learning as it involves translating mental models into physical products. The learning process for operators and management differ in content as one is based more on theory than practice but the aim is to build the logical sequencing of information that can result in a solid thinking process. This new way of thinking enables the employees at all level in the organisation to build up their knowledge in a systemic way to be able to deal with the disturbances in the environment.

6.5.4 Ideal Situation

The ideal situation is to have versatile workers who are rapid learners in new theories and practical methods. This can be further enhanced with an internal market structure where the different units compete with each other to maximise the use of the limited resources. The pressure is on the employees to continuously find the best methods to perform and also relevant training courses that can help them in their work. With each change in their operational procedures, their controllers must also reassess their measurement criteria to ensure that the organisation is still within its designed parameters.

And the best way to ensure that the new way of work is aligned with the company's policies is to promote communications across systems. The structure of a circular organisation should be used to ensure that the policies are properly understood at all levels and that their feedback has been taken into consideration. This applies particularly to labour intensive organisations which tend to treat the operators' inputs lightly. These two concepts will hopefully catalyse the shift from traditional to progressive organisation.

Progressive organisation also creates a dynamic environment for learning as the skilled employees have to continuously compete against each other constructively to make the business move forward. The ownership of the employees on their work ensures that the managers can deal with problems at their level, resulting in less tampering. They can then plan for the next stages of the organisation's development by looking at new training syllabus and courses that they will need to know beforehand. With fewer problems coming from the Shop Floor, managers can have more constructive meetings to clarify any doubts about their goals with other managers.

The next section will be looking at the differences between the ideal situation and that of *CE*. The current situation will demonstrate their inability to learn from their failures from a systemic point of view. The aim to transform the traditional to the progressive organisation can only add value to their knowledge of management starting with Shop Floor Management which starts the problem identification phase.

PART III: Application of the theories to the situation in context

Part III will try to address the problems identified in Part I (Chapter 1) with the theories in Part II (Chapters 3, 4, 5 and 6). This section will show the differences in current management in the company and that of the ideal situation. The aims of this section will be to understand some of the decisions taken by the company and the reasoning behind them.

This chapter will be basically split into two parts, the first part dealing with "hard issues" which are mainly the possible ways to reduce the quality aspects of the dish ends in the Spinning Shop and the container tanks in the Standard Production line. The investigation will be mainly based on what was observed and also what data the company had offered in terms of their records and interviews. The understanding of the whole procedure of tank manufacturing and ways to increase the production not only in quantity but quality will also be explored.

The other issue that is going to be looked at is the "soft issue" where the data is mainly extracted from interviews and observations by the researcher. This focuses on the problems felt in the company by the employees. It was deemed to be essential since the management style and current organisational structure are all part of the key aspects in understanding the whole situation. Also, when attempting to find solutions to the problem, it is not only just targets or numbers that need to be addressed but to look at other existing or developing factors that are affecting the results.

The common mistake that was mentioned in the theories was the focus of organisations on hard rather than the soft issues. This was again being seen as the typical systems failure that most organisations are experiencing, that is, underestimating the complexity of a system. The company's aptitude to learn from their failures have not been as successful as it would have been expected. The "14 points" of management of Deming was proven to be invaluable in this research as the systems' "failures" were directly linked to them. In this chapter, parts of

the theories can be linked to examples in the company, to the researcher's perspective and also from hard data.

The VSM is also used to try to explain the characteristics that a viable organisation needs to have in place for it to function properly. The VSM provides the context in which it can function and the theories of Deming; Learning from Failures and Shop Floor Management form part of the management process. The goal of this chapter is to bring some input to the intelligence function of the organisation about the practices that some successful companies are currently using. This also enables the organisation to benchmark itself to a certain standard not only on its productivity but also on its management efficiency.

The evaluation of this thesis will be more focussed on the soft issues rather than the hard facts since the hard data available was very little and most of them were of confidential nature.

Chapter 7 – Bridging the gap between theory and practice

With qualitative research, the methods of data collection are mainly based on observations and interviews. The "blending in" of the researcher in the environment is a gradual process in which his role has been continuously reminded to the actors. The need to have a methodology to try to capture as much data as possible ranging from hard data to observations of human behaviour where possible.

Soft data together with hard data can provide a better picture of the validity of the methods used in the collection of information. For example, threats of punitive actions can prompt some data to be falsified thus creating an awareness of data captured. The "shoot the messenger" type of management is very common and it is with some scepticism that this qualitative research is undertaken to test one's theory of data collection. In the next sections, the different methodologies of observations as well as interviews will be discussed in more details, starting with observational techniques.

7.1 Different types of observations

One of the advantages of observation is the non-intervention of the researcher in the environment since its aim is to observe the system under natural conditions. The data that is being collected are often unstructured and open to other interpretations. Qualitative researchers look for some kind of pattern that will emerge from the data captured and not on specific elements of the environment.

There are four ways that data can be gathered through observation. There is complete participant, the participant as observer, the observer as participant and complete observer. But then the observations' research shifted to more involvement with fieldwork and even in some cases, forms membership roles. These membership roles can be classified as their main data gathering methods, namely complete member researcher, active member

researcher and peripheral member researcher. These methods differ in the overt and covert stance that the researcher adopts for their role.

Gold described the *complete observer's* role as *researchers who are fundamentally removed from their settings* (Denzin & Lincoln, 1994). They are observing from some distance, without being seen or noticed. They often use machines like cameras or audio tapes to record data for later use. The role of an observer as participant is to *observe the situation for a short period of time as he attempts to conduct structured interviews* (Denzin & Lincoln, 1994). But both these methods of observation were more overt in the sense that the researchers' roles are clearly defined and their interactions are very informal to the "actors". But qualitative researchers do not favour these methods, as their perception of the values of their observation will be stronger if they can experience the situation with the actors. This has led to more naturalistic type of observation, which is becoming a member of the group.

The peripheral member researcher *observes and interacts closely enough with members to establish the insider's identity without participating in those activities constituting the core of group membership* (Denzin & Lincoln, 1994). This form of "buying in" the group's culture enables the researcher to understand the situation better from their perspectives. He will form part of the situation's main activities, sharing in the responsibilities but not committed to the group's goals and values, as he has to remain neutral in the process of collecting data. As for the complete member researchers, they are studying a situation that they are already part of or which they were converted to during their research period. Their role is to fully experience the changes within the situation so as not to modify the normal flow of interactions.

But this research method has also encountered strong criticisms from other researchers about the accuracy of the data captured. The next section will be looking at some of the claims from researchers from other fields of study.

7.1.1 Proving the method of observation as a valid research tool

The first criticism is the ***validity of the data*** captured since there are no scientific methods to verify it. As these data are based mainly on the mental models of the researcher (Refer Figure 2.1), there is wariness that the data observed and captured are biased. One of the ways to reduce this possible error is to use a team or group of researchers to cross-check the data captured against every team members' mental models. This can then eliminate inaccurate conclusions from team members. The second way to prove the validity of the data is to look for negative cases which can disprove the rule obtained from an inductive reasoning (refer Section 2.6.1). If there are no disproving rules, then the data can be declared valid. Thirdly, the way that the data is presented to the reader with examples of situations that readers can relate to can strengthen the belief that the conclusions drawn from them can also be classified as true.

The second criticism is the ***reliability*** of the data. Without statistical tools to give meaning to the patterns observed, the data can not be classified as hard evidence as it can be classified as random events. The goal of the qualitative researcher is to therefore reduce the "chance" factor that is generally associated with events by recording observations for a long period of time and at different places, depending on the case under study. The typical time frame for case studies is annual as the different seasons can sometimes generate flawed data for generalisation if they are taken at one particular moment of the year. Therefore patterns are mostly based on annual data.

7.1.2 Rigors of Observation

One of the advantages of observational methods is the low level of interference that the researcher has on the situation. Since the method is often based on observations, direct interaction is minimised, thus not affecting the normal environment of interactions. Another of its strengths is the emergence of patterns of from data gathered. Since the investigation is often not predetermined, the data gathering method can be changed at any time depending on the nature of the problem. The researcher has to continuously look for new methods and reasoning processes to deal with some surprising patterns sometimes.

The quest for new theories or methods has made observations susceptible to other methods to strengthen its weaknesses. The observation of the actor within his natural environment provides the researcher a better picture of the situation rather than recollections of the situation based on the actor's recollection. This can be considered as hard data as other researchers can verify it if needed. What is also a valid point is the consistent bias, if any, that the researcher will have when observing any situations. This can be noted as part of the data captured.

7.1.3 The Ethics of observational methods

One of the crucial rules that qualitative researchers need to have is to obey some ethics while performing their studies. The most common one is the invasion of privacy of the subjects. The two ways in which this rule can be violated are (1) misinterpretation of one's role and (2) venturing into private places. Most of the time, punitive actions are taken when sensitive information has been uncovered. Therefore, the researcher has to live with his code of conduct that he has ascribed to when he gained entry in the research within the specific environment, preserving the anonymity of all sources of information at all costs.

7.2 Interviews

Interview is an additional tool to help out the observations in gathering the thoughts and ideas of the people that has been voiced by them. The information is based on their understanding of the situation. Normally, informal interviews are conducted as a starting point for building up trust as well as understanding the mental model of the interviewee. Once the trust has been established, the data gathering can be brought to the next level, which are unstructured, semi-structured and structured interviews.

7.2.1 Unstructured Interviews

This type of interview though lacking in structure is often the source of a lot of data. This can be achieved if they are assured of their anonymity in their inputs to the research. The trust building can be further enhanced if they are being told that they are being

considered as experts. The flow of information must be free flowing with the possibility of the subject adding information at any stage during the interview. Normally, the whole unstructured interview is being recorded after permission has been given. This is to capture the data that are sometimes unexpected.

The aim of this type of interview is to raise an issue of interest and then let the subject give his idea on the whole situation. Provide additional information for clarification of own mental model and if possible, explain the questions raised, normally based on theoretical concepts. The most important of all is to let the subject define the environment in his own terms. This type of interview is normally used to investigate conflicts that are sensitive to study. The relaxed and confidential atmosphere will help to obtain sensitive information that is normally hidden.

When conducting unstructured interviews, there are several methods that are used to make the subject supply continuous information. Probing effectively and efficiently is the key to a successful interview while preserving the trust between interviewer and subject. Below are some of the techniques used:

- Silent probe – Remain silent while waiting for subject to continue
- Echo probe – Repeat last thing that informant has said and then ask them to continue
- The Uh-huh probe – Encourage informant by making affirmative noises
- The Long question probe – Make questions longer and more general so that a long answer is required
- Probing by leading – Be direct in questions and be careful ***not to lead*** the informant with questions.

Some of these techniques can also be used in conjunction with assertive comments to make people believe that the researcher is already aware of some data so that they can feel safe to open up. Extra care should be made to protect them when such information is made available. Probing for the sensitive information must be cautiously assessed based on the relationship that the researcher has with his subjects. But under no circumstances must

these data be forced out of the informant through persistent questioning. All this will then lead to a better structure for a more formal interview at a later stage if possible.

7.2.2 Semi-structured Interviews

This type of interview is a mixture of both unstructured and structured interviews. They are often carried out when the subject is too busy for interviews and that he has allocated only one interview. The content is often based on unstructured interviews from other subjects that have raised concern and that need clarification. Normally, these people are in the middle management to top management where their knowledge is very accurate. This type of interview is usually held in the middle of the whole project where unfounded theories need to be ascertained or discarded.

These interviews are often granted to a team of interviewers so that time is used efficiently. This also helps the researchers to build up on the answers from others and see the impact on certain aspects relevant to his study. The help from a team of researchers is to use their data to set up a comparison with own data. Semi-structured interviews are very difficult to conduct based on the frequency of the meeting and also on the possible surprises that can be revealed in them. This will then lead to structured interviews which are more focussed on the wanted goals.

7.2.3 Structured Interviews

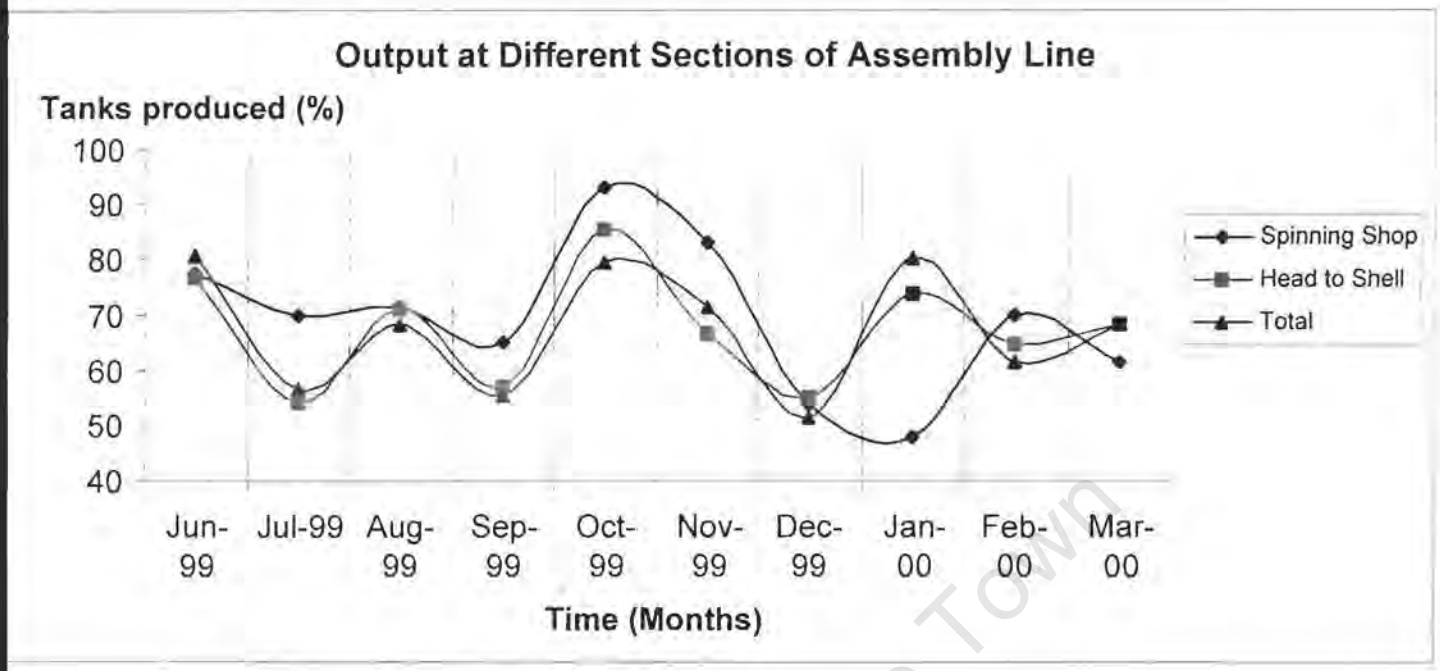
Structured interviews are conducted on a very fixed program that is designed for specific issues. Setting up a structured interview requires a thorough understanding of the situation from the interviewer. The questions raised will show his understanding and also prompt accurate answers to them. Care must be taken for possible false data given out whenever some threat has been detected in the questioning. The risk of these structured interviews also shows the interviewee the goals that has been set and therefore, the potentially dangerous answers can be anticipated and lied about.

This type of interviews is often based on accurate facts that need to be clarified. Depending on the availability of the subject for further interviews, the issues can be verified but most of the time, the interviews are also conducted on a once-off basis. Therefore, structured interviews resemble questionnaires or flow charts where each answer can lead to another situation. This therefore requires accurate planning of the researcher on the different possibilities that the interviewee can answer.

All these methods of capturing soft data are not complete without hard evidence. The next section will be looking at some hard data obtained from *CE*.

7.3 Data Analysis

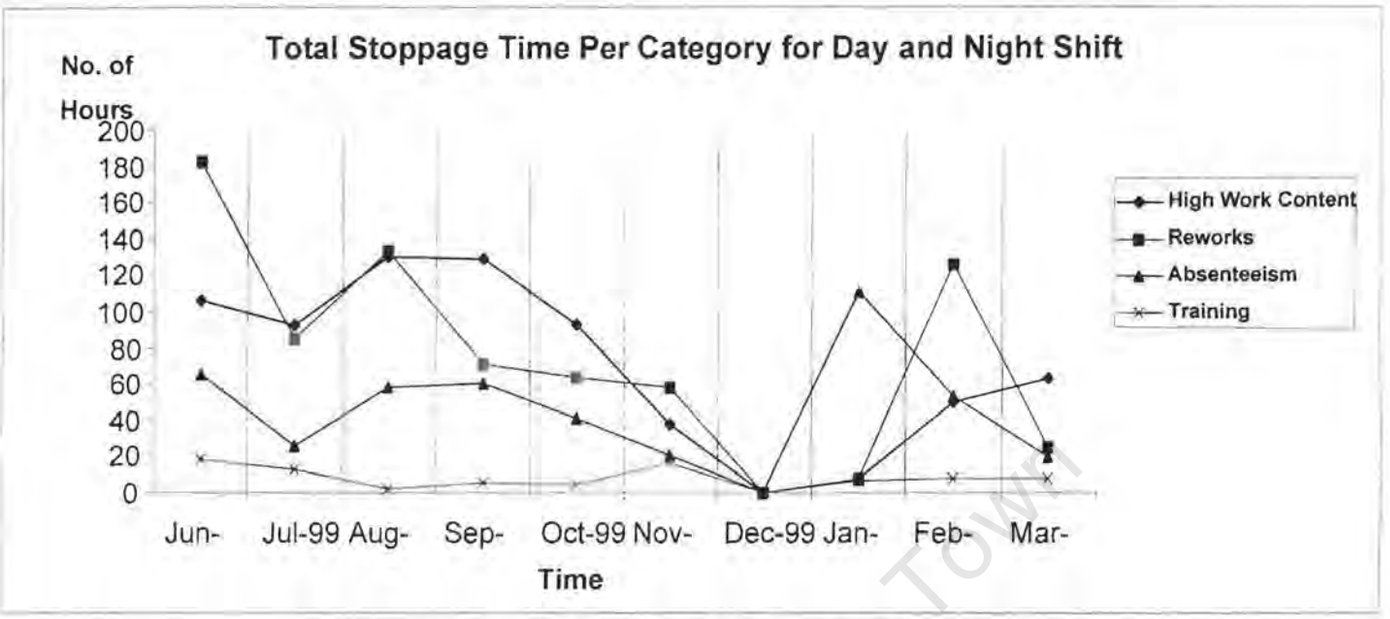
This section will be focussed on analysing the trends that exist in the company's production of tanks together with the possible factors that impact on its production schedule. Since the world class manufacturing production line was recently introduced, the data available is also very scarce, with the earliest records obtained for the number of tanks produced in the year 1998 and more detailed information in 1999. The data from 1998 was incomplete, thus the use of the 1999 data. The personnel of the Industrial Engineering Department have been recently appointed to work on smoothing the work flow as well as cycle times of the standard production line. The time studies and other data analysis only started in 1999 while the 1998 data was used mainly as a starting point for planning.



Graph 7.1: Output of tanks at different sections of Assembly line

The spinning shop's output of Dish ends seems to be just in time with the production line as shown in Graph 7.1. But this chart does not reflect the "consumption" of the dish ends not only by the standard line but by the special line also. Balancing the production lines (a mixture of "easy" and "difficult" tanks on both standard and special lines) helps the spinning shop in meeting its targets. The lead of the Spinning Shop can be seen at times when the Standard line is producing maybe "difficult" tanks. The barrels from *Head to Shell* are also supplied to the Special line. With the new grinding machine, the consumption rate of the *Standard line* will also increase dramatically, putting pressure on the *Spinning Shop*.

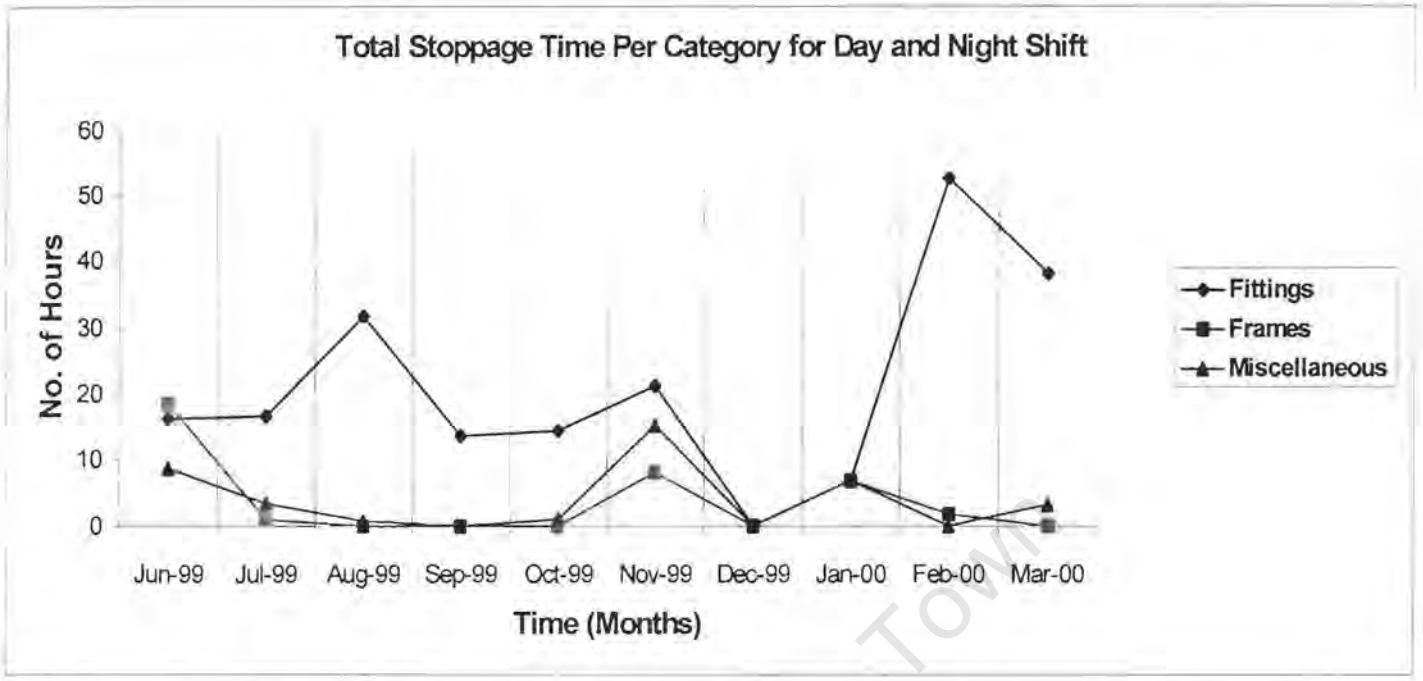
Looking at the graphs of the past year, the market trend seems to be highly volatile with double the amount in the month of October. Every year, the dip forces the company to take drastic measures to reduce their overhead costs. The decrease in work order is particularly acute for the month of July, resulting in the retrenchment of the temporary workers. These cyclical demands have forced the company to strain its relationship with the workforce. The trust between management and workers is gradually disappearing, compounded by the increase in contract workers.



Graph 7.2: The different factors affecting the Production line

Throughout the June 1999 to March 2000 period, the training (including meetings also) in the company has been minimal except with a sudden increase in June 1999. Also, just before the deadline (end of the financial year), the workers were faced with incomplete tanks pushed by others off the line to prevent bottlenecks. This crisis has prompted meeting with managers in an attempt to solve the problem. This has been caused by gradual build up of backlogs. As can be seen from this graph 7.2, the company did not hold meetings regularly to solve problems, as it seemed there were no problems. Yet, when the pressure increases, problems start to appear everywhere within the production's support departments.

Although the company had a high absenteeism rate in August, the high work content and reworks drop because of the remaining skilled workers after the retrenchment. With low output of tanks in January, the reworks and high work content are minimised even with very high absenteeism. But the reworks for the month of February have increased tremendously, showing weak control mechanisms for pressured work for the January outputs. This therefore builds up pressure for later stages of the production line with increasing work contents at other stations.

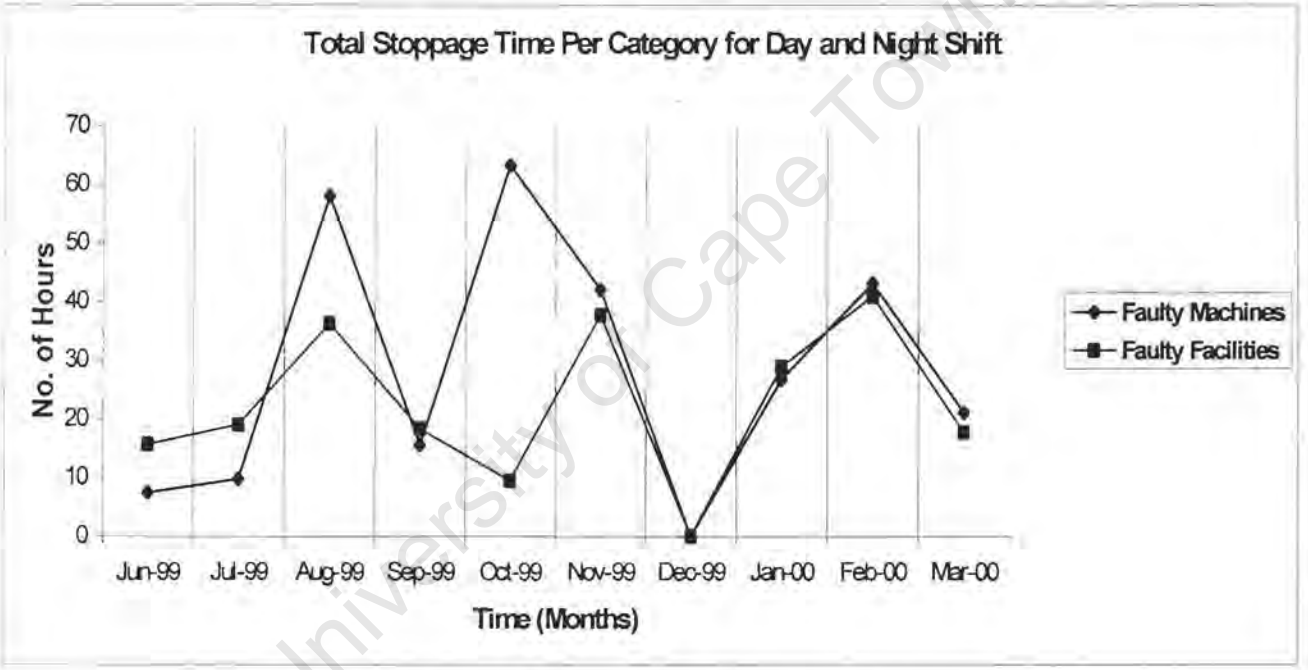


Graph 7.3: Missing fittings, frames and miscellaneous – Standard line

With a world class manufacturing system functioning on the basis of Just In Time, the efficiency of the standard and special production line also rely on the support of the different sections for parts. For example, waiting for dish ends can have disastrous consequences for the whole production line, with lost cycles to the standard line in this case (as shown in Graph 7.3). Gaps in the production line also creates havoc in the manufacture of the fittings and frames of tanks since certain models are drawn out of the buffer zones to fill in the gaps and which are not accounted for in the suppliers' list of materials. Since most of the tanks are standards, some of the parts are interchangeable with other models drawn from the buffer zones. It is only when the planned tanks are assembled that the problem of missing parts are felt.

Frames are normally fixtures or machines that help in the movement of tanks on the lines. Since these equipment are more robust to wear and tear, the production line is more sensitive to the supply of the smaller fittings, which are essential for the production line to run smoothly. With a flexible production line, especially with the buffers at different locations, communication between departments and also co-ordination of the resources to produce the parts on time are essential ingredients for the smooth operation of the production line.

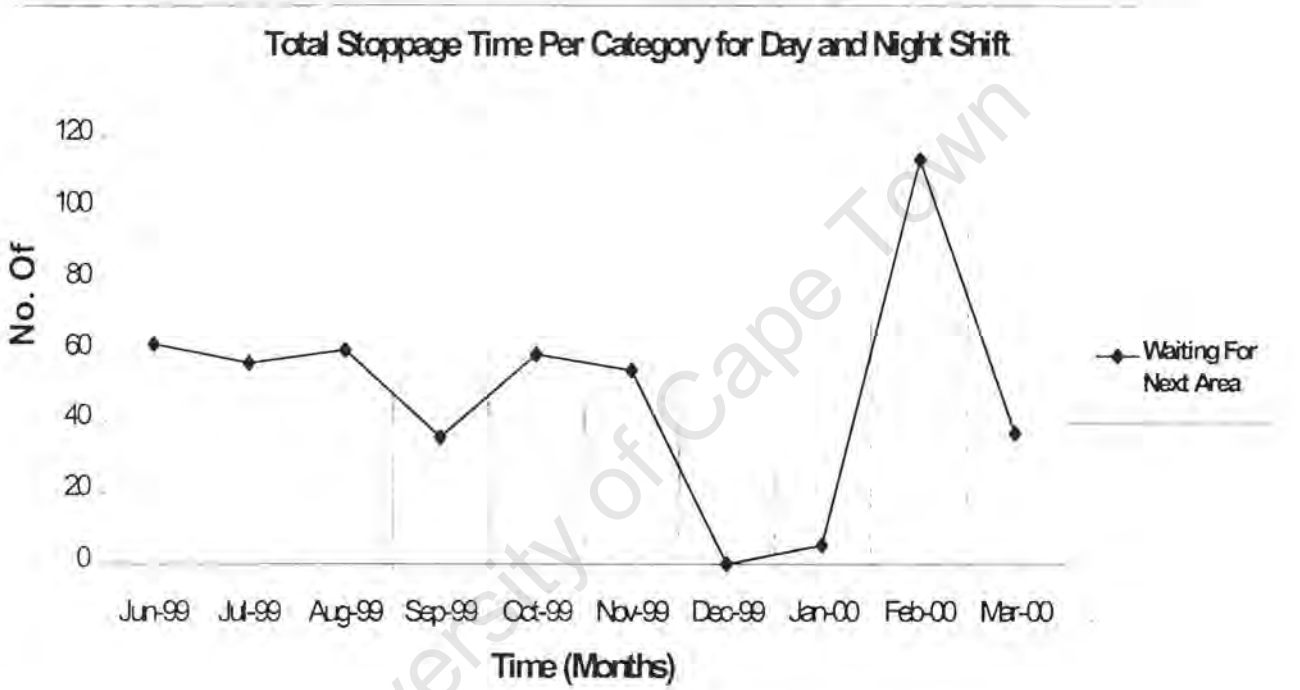
Some miscellaneous factors include time lost due to failed tests for leakage, material rejected for poor quality and buff marks. Buff marks are one of the most stringent criteria set by certain customers. The fixed number of buff marks is often used to either pass or fail a tank. Most of these problems are located at the end of the production line when the final visual inspection is carried out. Extra care is taken not to damage the work performed at previous stations especially when reworks are performed. Even though the frequency of occurrence of these marks is very low, their impact on the output of the production line is crucial since all the resources used will be wasted if the tank is failed at that stage.



Graph 7.4: Faulty Equipment – Maintenance Department

The consequences of continuous usage of the machines result in breakdowns happening more regularly. Looking at the month of August in Graph 7.4, the stoppage time for faulty machines is very high as the company was working overtime in an attempt to catch up on the backlog. It was during that period also that the company had just recruited the temporary staff again for the increase in work order. The workers then have to get used to the equipment resulting in straining the limits of the machines sometimes, creating backlogs.

The number of hours for breakdowns increases every time that the work order increases. In some cases, the frequency of breakdowns exceeds the rate at which spare parts are ordered. Building ownership of the tools to workers, the breakdown rate has decreased but still not to the satisfaction of the managers. This shows the lack of control that team leaders and managers have over the proper use of the equipment and the poor knowledge of the capacity of the tools. The preventative maintenance of the tools during these high pressure times is almost non-existent as fire fighting takes all their time.



Graph 7.5: Waiting for the Next Area– Management

Judging from the graph 7.5, the number of cycles lost due to those numerous problems on the production line has resulted in large number of tanks lost. Without proper planning, the small effect of one factor can lead to a chain reaction within the production line. One worker's mistake can put the production line on hold for several cycles and that in turn will lead to an accumulation of work for the coming days. Even though the company's demands after the June period seems to be stable, the support departments for the production lines seem to be missing. Looking at the different graphs, it can be seen that even

though the demands is approximately the same in February, the wait for fittings for example has slowed the whole production line down resulting in huge losses.

The general perception of the operation of the production line seems to be running at less than optimal conditions. With the supposedly large number of tight controls, the problems still manage to filter on the company's critical production line. The amount of reworks whether it is completion of an aesthetically unfinished tank or the physical rework of a tank has not been classified into categories so that the appropriate actions are taken for each case. Generalisation of reworks is creating a false sense of security on certain departments of the company. The true relationship diagram has not been drawn as to the frequency of these seemingly trivial matters that are making the company's production costs escalate.

The next sections will be focussed on the differences in the management style advocated in theory and the one at *Company E*. Using VSM as the framework, the company's structure is broken down into functions which are essential for the viability of the company. The management style is also discussed in the following sections providing reasons of why some sub-systems' failure is affecting the overall organisation.

7.4 Operations' Level

The problem raised by Management has been the defective dish ends from the *Spinning Shop* that reach the production line and even in some cases, the customers. This fault has been appearing at random and the corrective actions taken has all been unsuccessful. The problem does appear to be localised at certain parts in the factory and the question now is to look at what may have caused it to happen in the first case. The fault can originate from the suppliers to the Production Department. Since, the issue seems to be on the practical aspect, the search for the root cause will therefore start with the *Spinning Shop* and going down the production chain.

7.4.1 Spinning Shop

Starting with this production line, the focus will be on the machines and techniques used. The seemingly first major cause of problem for dish ends is the flow-forming machine. With only 3 die casts used for all the models of tanks, the quality of the dish ends relies heavily on the operator. Whenever there is human factor involved, the chances of errors also increase. The first step is to try to normalise the operating procedure so that one variable is eliminated at a time. The best way is to fully understand the limits of the machines and utilise their full functions. For example, its copying function has broken down for the past 15 years and nothing has been done to fix it. If the flow forming of the dish ends can be standardised, then other alleys of improvement can be explored. Until then, the errors will be at random and will be compounded with others down the production line.

The knuckling stations are the next stage of problem finding. With the crown radius already set by the flow forming radius, the angle at which the dish end can be "brought" up to form the knuckle radius is also limited. Again, this knuckling process is relied on the operator's experience to judge this radius of the dish end. Making a skirt (Refer Figure 1.4) of 1 mm depends on the number of turns of a grinding machine and not on a scale. And at the end of the production line the margin of errors is less than 1mm for the thickness and the range of +0 and –4mm for the circumference of the dish end. The whole process has relied on the human operator and the highly mechanised equipment. Based on these figures, the skills of the operators can be considered quite high.

Since the whole *Spinning Shop* relies on the experience of the operators, their welfare should also be of primary concern to the company. The company decided to build an area for their daily meetings and also for the storage of their personal belongings. But this has never happened because the money allocated for that specific department has been used for other more pressing issues. Another problem is the health hazard from the dust from the grinding machines. Even though there are machines for the extraction of dust, they seem to be either too weak for the work or badly positioned. The workers do not use the given face masks as it is very uncomfortable to work with them. These problems are affecting their morale as nothing has been done to improve their work conditions.

Communication with and among the workers seems to be non-existent. The noise during working hours makes it impossible to communicate and during lunchtime, the workers are scattered all over the factory. As for the line manager who is in charge of other supply shops located in other buildings, the individual time allocated for personal meetings is very limited. There is no cycle meeting to monitor the hourly progress but reliance is on the team leader to do the job. The only time for meeting is the daily morning meetings and when there are urgent matters to be discussed or followed upon. Even though there is an open door policy, the communication appears to be one way.

7.4.2 Standard production line

One of the main bottlenecks that exist on the standard line is the grinding section for one specific tank. With 15 grinders split into two shifts, the output is very slow. Only 4 tanks are produced per day on average from *Head to Shell* and that has prompted *Company E* to buy a grinding machine that can replace the 15 grinders and also speed up the output. This is a gradual automation process that is being implemented to try to remove bottleneck problems on the production line. But in the meantime, these delays have helped the *Spinning Shop* to build up buffer zones for the other work orders when *Head to Shell* manufactures that specific tank for example.

Once the dish ends are produced, they are sent to the *Head to Shell* section of the standard production line where the dish ends are welded to the barrels. Most of the time, the workers on this line assume that the dish ends conform to the standards set by the Quality Department. They also perform their measurements to give them an idea whether the tanks can be welded easily or if the tolerances are too big. They perform these measurements even though the Quality Inspector of the *Spinning Shop* has already measured and written them on the dish end. When the boilermakers weld the dish ends, they tend to force the dish end to fit if they are a bit tight. But this has made some of the tanks to be distorted at later stations. The blame (perceived by Management) then shifts to the *Spinning Shop* on their

non-standard dish ends. But sometimes, the fault lies with the barrels whose two ends are of different dimensions.

The differences in barrel do occur even though the last plate is being machined off to ensure that the plates are within standards. The line manager still thinks that the measurements of each plate are done and recorded for references but the team leader has discontinued the practice. The main reason advanced is that the process is time consuming and the operators have reverted to measuring each plate individually. The recording of these dimensions by the operators are double-checked by the quality inspector at random.

Some of the experienced workers at specific stations have developed a very relaxed attitude concerning the accuracy of their work. For example, when measuring the circumference of the dish ends, the worker will pull the measuring tape across the dish end with one person holding the end. Other workers will use clips to ensure that the measurements are accurate. These are the basic steps that the operators should take before trying to fit the dish end to the barrels. Any dimensions outside the allocated range are then sent back to the *Spinning Shop* for rework. Sometimes, the returned work based on relaxed measurement has caused gaps on the production line, resulting in lost cycles.

Operators on the standard production line send their products to the next station even though they have not finished their work. Often, their managers force them to push their tanks to the next station so that they don't create gaps in the production line. Normally, the few workers who finish ahead of schedule tend to make tanks for the buffer zones or do reworks in the buffer zones. If they are late in their schedule, they are asked to work during the weekend to either smooth out the bottlenecks or catch up on the delay. They then get paid overtime. There is no incentive for them to produce more during normal working hours except the possible bonus at the end of the year if the company is profitable. This has prompted some of the workers to guarantee their "bonus" by working overtime every time the occasion arises.

With only one manager running the whole company at night, the control is very slack. This results in low quality work at night and the day shift has to often fix the problems. The productivity of the day shift then suffers which results in the intervention of senior managers to push the tanks down the line and sometimes increasing the buffer's quantities. With huge pressure from top management, some tanks are taken off line to be reworked while the rest goes on line, creating havoc in the supply of parts to the production line as well as planning of other departments. This complex interaction within *CE*'s production Department has caused problems to appear at support departments too, showing poor flexibility and planning of work.

The reliance of the company on temporary workers (about 60 % of the workforce) is mainly to reduce the overhead costs during off-peak seasons when they can be retrenched without any problems with the unions. But when the peak season starts again, the production line then works on two lines, day and night shifts and also during weekends. This practice of firing and rehiring has occurred for the past 5 years with a slight increase in the number of retrenched every year. *CE* had a huge profit last year and this year; they had a huge loss, rumoured to be more than what they earned as last year's bonus. The reason attributed to this huge change was the market demand, which have decreased dramatically. Therefore, the message that management conveyed to the workers is to reduce expenditure at all costs even at the expense of other workers.

The accountability factor also seems to be missing on the shop floor with a possible link to lack of training. Workers push their unfinished work to the next station when they exceeded the allocated cycle time. This is particularly common on the standard production line, as managers see only number of tanks moving on the production line. The reworks performed in the "hospital" and in buffer zones mostly during weekends are considered as completed tanks, thus satisfying the managers' requirements. With the huge buffers for the standard line, the problems are often not that apparent until the inventories are empty. This problem was particularly severe when the company was trying to meet their financial year-end target in June 2000.

7.5 Co-ordination - Involvement of everyone

Some of the workers are very familiar with the way the company works especially when the deadline approaches. The company always advocates no overtime but they always have to change plans afterwards due to delays or problems in their planning. The workers then earn more income since their pay increases with overtimes. Another interesting point was the reluctance of certain permanent workers to work at other stations even though they are performing the same work. This has prompted the shifting of temporary staffs to perform at certain stations. There seems to be a huge gap in the way the permanent and temporary workers' think. Some of the permanent staff does not mix well with the temporary staff. The communication gap seems to exist also at that level also.

The interdepartmental communication seems to be very poor, as the workers tend to remain at their workstations. Even with daily meetings, the different units are kept updated by their team leaders and not by their normal communication channel of workers. Also, with the different cultures in South Africa, the people tend to cluster themselves more, resulting in a lot of fragmented groups, each uninterested of the others. This kind of cluster is found to be in any shop even during lunchtime. Even though they have social and sports events, the whole company still remains highly fragmented especially the administrative staffs and the workers. And even within their cultural groups, the different levels of hierarchy can also be very complex to understand for any outsider.

The management of other departments also seems to be isolated in their own little area of control. Meetings between managers of different departments are held every week where the important issues are discussed but judging by the amount of line stoppages and problems happening to other departments' outputs, the root cause of problems have still not been found. One striking example was the query of the newly appointed production manager concerning problems in the supply of parts and services to his department. After sending e-mails to eight different managers and team leaders concerning several issues of this nature, there was only one reply after 4 weeks. Changing his strategy, he is now placing all the

problems on a highly visible board with the time and person responsible for the problem and that has resulted in immediate responses. For the moment, it seems to work.

7.5.1 Learning from failures

The performance of each department had remained relatively unknown to the others. Judging from the different problems experienced on the production line, there is no sharing of knowledge from successful departments on how to manage teams. An example will be the help from the accounting department in managing the department's costs or the help from the IT department on how to use certain software to capture the daily production figures. These simple helps can raise the awareness of these departments on those issues and also understand on how the departments are being measured. The concepts of the external Consultant Company about Quality, Costs, Delivery, Morale and Safety are some of the indices that are needed by management to determine the "health" of each unit.

There is sometimes lack of support from the workers to perform in their normal duties, especially when time studies are being carried out. The thinking of workers is to set a relaxed pace so that the new targets are not strenuous for them to achieve. Management uses these flawed figures to plan on their sales and possible profits and the workers still can not achieve the targets set. Without realising it, the workers are setting themselves up for tougher times in the future. The time studies can also be a benchmarking tool to see if there is any improvement in the production and also possible ways of reducing workload by providing new machines or redesign of the layout of the workstations. It also allows the company to look for more contracts to continuously use the equipment to the maximum.

Therefore, the aim of this involvement of everyone is to try to learn from the failures of other people to improve one's practice of learning and work. This will also help reduce the time spent to find a solution to an already solved problem. These learning from failures are particularly useful if they can form part of the normal learning cycle of everyone, without any trace of destructive competition but of teamwork. A lot of companies face the problem of losing experienced workers to competitors who buy not only the practical skills of the worker

but also his knowledge, which can also be of prime importance to the new company's new plans.

7.5.2 Teamwork

Teamwork is such a common term that everyone knows about it but its real problem surfaces when trying to implement it. A number of artisans do not share their complete knowledge fearing of making themselves redundant. This is one aspect of teamwork failure where not all knowledge is shared. Without any apparent benefits from this sharing of knowledge, the practitioner will revert back to his normal state of individualistic thinking. The benefits must be quickly made obvious for all employees involved. But teamwork must come from top down to promote group learning where solutions to problems are thoroughly analysed with different perspectives, thus being more robust to disturbances and implementation problems.

Teamwork also relies on the characteristic of the persons. Normally, a leader will be able to draw out the teamwork spirit in the group when trying to achieve the goal set. Every company tries to have a closely-knit workforce so as to eliminate mistrust that can settle in the team. This will require transparency of the team members. For example, the distrust between the Maintenance Department and the workers are based on the regular breakdown of equipment. Each one is blaming the other for the problems. Failures should be considered as a case study to test their tacit assumptions of the situation and not as a blaming contest. If the cause of the failure is found, then it can then be turned into a success story of team learning and not a targeted team or person for continuous blame.

On a bigger scale of teamwork is the planning of the manufacture of tanks, starting from the acceptance of customer orders to the ordering of raw materials for the different shops. With an agreed time frame, the parts are then delivered to the relevant workstations on the production line. But the parts are often missing, resulting in tanks pushed in the buffer zones where the rework team can complete the tanks. Somehow, the team efforts have broken down as a result of communication break down or a change in priorities. This is

particular crucial if the standard production line is running with six different tanks on one line for a day. And the company's main source of income relies on them. Therefore, the management's function seem to be unclear as the problems propagate down the line.

7.6 Management Support System

The focus of *Company E* is on *quantity* and **not** *quality*, as the workers are expected to produce the theoretical target of 80 tanks per week, no matter what models of tanks. This puts the workers under huge pressure. The learning curve has been very steep for the production line since it has almost doubled its production target within 5 years since implementation. Tremendous changes have occurred to cater for this huge increase in production like the change in layout of the *Spinning Shop* last year to be able to maintain the production rate of the whole company.

Another surprising observation made was based on the organogram of the company. As can be seen in (Appendix C), the two "missing" departments, which are essential for the normal functioning of the company's production line are Industrial Engineering and Maintenance Departments. Omission would seem to be a very lame excuse if the welding supervisors and document clerks are on the chart but not two departments. This has then led to some confusion on the hierarchy of command on the production line if not the whole organisation. This has been seen on the production line when problems are reported to the wrong persons for immediate corrective actions to be taken.

An interesting fact was the Quality Department's control often seems to be overridden by the Standard Production Line. Since they are working according to cycle times, the tendency is to push the tanks down the line at every cycle and when the tanks reach a bottleneck, they are taken into a buffer zone. Sometimes, the assembly of tanks was undergoing through a lot of problems on the line with missing parts and poor workmanship. The tanks are still sent down the line where the last station will perform all the reworks necessary to complete the tank. The quality supervisors are unable to perform their measurements, as the tanks are incomplete. But the problem arises when faults are found at

the last stage and often, managers are called in to try to salvage the defective tank while the incomplete tank has passed through the different stages of assembly.

7.6.1 Communication

Communication with the workers seems to be non-existent as redesigning the layout of their stations was done without consulting them. This has resulted in the costly project of building a bogey track to move the products to the next stations being unused for the moment. It seems that the previous layout of the tracks was done together with the streamlining of the whole process of the *Spinning Shop*. The bogey track was not practical, as it would have required workers to be pushing heavy loads of metal sheets and dish ends, leaving their stations. The overhead cranes have done the work completely without using the track. If the production was big enough, then the track would have been of use but for the moment, the workers view that as a breakdown in communication between management and them for a better use of the investment.

In an attempt to promote communication, a suggestion box scheme was placed in the different shops to have feedback from the operators since they are the specialists in their field. There was feedback initially because there were some prospects of incentives. But the number of suggestions decreased because the company continuously changes their reward policy from rewarding the proposed ideas to see the benefits of the proposed idea first before any rewards are given. Some operators did not get replies from their suggestions at some stage and with ever decreasing participation, management decided to remove the official suggestion box and to promote communication between workers and them with an open door policy. The result still remains to be a huge gap between the two levels within the company.

Another area of dissatisfaction is the problem of late feedback. Differences in opinions between the operators and the quality controllers often resulted in the intervention of a more senior manager to solve the problem. This also happens when the Quality Controllers are changed. The time taken for the senior manager to be made aware of the problem can result in lost cycle time. With the Lotus Notes (the electronic reporting system), the feedback from

managers in this case are also very slow even though the template of the form is very user friendly, even asking specific question like "Where was the fault found? What can be done to prevent this from happening, etc...?" Those electronic forms are left empty. There is no proposed solution for the problems reported via the system. The collapse of the system has prevented a learning opportunity for other team leaders or newly appointed managers.

7.6.2 Leadership Skills

At one stage during time spent at *CE*, the spinning shop had run out of plates for dish ends. This has forced the line manager to refocus his attention on the other sub units, namely the component shops, to continuously provide plates for the spinning shop. The surprising fact is that the work order was fully booked for the next 2 months and those parts should have been already planned for, especially if the work order was placed 10 days earlier. Somehow, there were some problems at the other shops that the line manager and its team leader have not noticed. But luckily, buffers were used to ensure that the rest of the line was still operating. But missing batches of parts on their plans should have alerted the responsible parties to take immediate corrective actions.

During the last stage of the investigation, there was a surprising appointment of a new line manager at the standard production line's *Head to Shell* section. Being equal to the other two managers, he is in charge of the supply of barrels to the production line. The workers were also surprised on the appointment of the manager and when asked what prompted the creation of this post, there was no clear answer. With their new manager, the *Head to Shell* section was then providing completed barrels on a Just In Time (JIT) system while the rest of the production line was running on Constant Work In Progress (ConWIP) system. The difference in management style has nearly brought the standard production line to a standstill when all the barrels, even those in the buffer zones, were completely used up at one stage.

The manager seemed to have worked on his own since the rest of the production line was unaware of his new strategy. Even the experienced team leaders were quite surprised by this bold move to change the production line to a new system. With such a big mistake, he

was immediately transferred to a new post, namely the Head of a Department. There was no consultation with team leaders or other line managers before his rash decision was taken. In this case, the company was lucky to have buffers, otherwise, the backlog would have been more severe.

7.6.3 Resistance to change

Recognising the need to upgrade the current production's performance and management skills, the top management had decided to use an external Consulting company to try to improve the output of the company as well as reduce the problems faced by their management. Presenting the company with the concepts of mini-Businesses and tools to measure their different indices for productivity (Quality, Cost, Safety, Delivery and Morale), *Company E* has fully implemented these concepts after the personnel have followed the courses. The application of these concepts is not being done until the day before the audits (known months in advance). And till now, the program is considered to be "successful" since no major problems are found in those audits.

The reason to this resistance to change from both the workers and managers is the typical "don't have time" or " it is not going to work" attitude. It will follow the same fate as the other programs" and then these new theories will be classified as useless management fads. The possible reasons for this are their lack of comfort to work in this "new" environment with the new rules. *They do not fit into their profile of what was "right" or they feel threatened by the possible erosion of their powers* (Young, 2000). This might be a side effect of lack of structured training programs that exist within the company for personnel at all levels or even the wrong training for the selected personnel.

7.7 Customer Orientation

Customer orientation is one of the key aspects that any company must have to be able to survive. This simple and yet crucial concept is often not well understood. The basic meaning is to understand what the customers want and transfer them to the products. But these needs often create problems on the production line or in the design offices. And these

problems require the help of experts, (the operators on the shop floor) for the final product to be completed.

Problem solving skills are another important learning stage for the company. With the dish end problems, the management has still not selected a team to solve the problem. The focus has only been to streamline the whole production line and also to look at the possibilities to increase the production speed. The tendency is to give the problems to the engineers and managers to come up with solutions. The creativity of the true specialists has been omitted in the problem solving team, the operators on the shop floor. The approach taken by the company to solve them seems to be against the progressive organisation that Suzaki advocates.

7.7.1 Technical constraints

Looking at the technical problems, there has also been a problem in the non-conformance of the depth of the dish ends after knuckling. The solution was to use the press machine to increase the depth of the dish ends. Even though the dish end depth is a major problem, there have been no ideas of how to solve the problem by the operators. Everyone has his own theories of what is happening in the process. No one has tried to solve the problem once and for all with other departments. Theories such as low quality plates, the limits of the flow forming to achieve the required depth are a few of them but no final solutions have been agreed on. Therefore, the team spends more time fixing the products after their allocated cycle times. This is made possible with large inventories.

The flow forming may have reached its limits with the 3 dies used for the whole range of products that *CE* offers. There have also been some doubts that the flow forming (a critical stage of the manufacturing process) is badly done. Instead of running the press twice, some operators run it once at higher pressure. This may also cause the thickness of the dish ends to be too thin but that problem occurs mostly when the deadline is close for a customer. The mistake is only noticed when reaching the Quality inspector at the end of the production line.

This is again being forced on the operator driven by a time cycle to reach the set targets. These problems have never appeared in report forms.

7.7.2 Team problem solving

Out of the huge amount of dish ends produced, there has never been any corrective action taken to ensure that the defects are not repeated again. There was no record of the first time of these problems and if there was, the problems were never properly recorded especially with focus on what station did it happen and when it happened. The analysis of the records is compiled at either the Quality or the Industrial Engineering departments after a week. By the time these problems are noticed, there might have been more pressing problems at hand for a team to solve the previous one. With incomplete data and delays, solutions are impossible to design for.

Looking at the *Head to Shell Section*, the plates bought by the company were assured of being good quality and correct dimensions. But, when inspections were carried out, the plates were often of wrong dimensions even though the supplier have certified that the plates have been checked individually. Now, extra work is being done to correct these mistakes. For example, two workers on the shop floor are measuring the plates and cutting them so that a barrel of the required dimensions can be rolled. This could have been avoided if the supplier had provided plates of the required dimensions the first time.

The frequency of these deformed plates are quite low but again, this issue should have been addressed by management since they are paying for the quality of the products. Small changes like these are slow improvements that can be quickly implemented instead of the search for breakthroughs. Little problems like, ensuring that all the plates are of the same dimensions, can be given to the team leaders and their respective teams to come up with solutions while the line managers or engineers try to draw out the problem solving process behind it. This problem solving can also be the platform for the learning process for the operators as Argyris mentioned in his Double Loop Learning theory.

One example of good relationship between supplier and customer is by helping in controlling the costs of their materials used. They will warn managers if too many materials are being used. By keeping the company's expenditure low, they keep *CE* from going to competitors, preserving a long lasting relationship with their customer. This is the type of customer relationship that is needed in businesses nowadays. One of the suppliers of the company is doing this function but *Company E* is not learning from this supplier to try to implement the same kind of help to their suppliers. If this learning can be transferred to the different departments about customers' expectations, they can start to be attentive to the needs from the other sections within the company.

The main problem experienced by managers is the pay for performance attitude of the workers who see quality checks as the Quality Inspectors' job and not theirs. If they are required to do the work, then they should be paid for it even though that should form part of their job description. This was blamed on the previous management style that was focussed on monetary rewards to have things done. Now, the company has to slowly change the way of thinking of the workers and it is encountering some serious resistance from the workers. The strong emphasis on monetary rewards from the past is creating problems for the company to even think of implementing any incentive scheme.

7.7.3 External environment

Looking at the *Sales Department,* they accept the orders of the customers after consultation with different support departments for the production lines. With its team of pre-empt engineer and draftsmen, the sales department analyses each work order to determine its schedule and the assigned production line. Even with a very diverse range of products, *CE*'s good delivery records have been maintained over the years. But the costs involved with on time delivery have reduced the company's profits. This was demonstrated by their current financial year balance sheet when there was no bonus for the workers even though they met their annual target. But this year, the costs were just too high.

Their closest local competitor is often being used as a benchmarking standard for their products as well as their management functions. Even though they have a computerised system to produce container tanks, they can not produce the volume and quality standards of *CE*. This basically means no competition, reinforcing their belief of being dominant in their field and thus more relaxed in their daily operations. This reinforces their self-fulfilling prophecies when their closest competitor are foreign companies that are too far for the workers to visualise the threat. Therefore, the lack of local competitors has created a false sense of security among some employees of *CE*.

7.7.4 Internal Environment

The concept of customers in a production line is the way the different stations treat the next ones as their customers. With this relationship, the expectation is to have a quality product from the "suppliers'. An independent inspector checks the quality based on an agreed set of standards. In order to satisfy their next station and what is required of them, the internal "market" is continuously monitored by different departments to ensure the on time delivery of the products and services. Competition will be mostly on reducing costs and saving time whenever possible. It will be for the workers to set a standard for their practice while managers will try to move them to the next level once the improvements reached stagnation.

The standards set in the internal environment are by the industrial engineers for their targets, the maintenance department in providing the support for the machines and the quality department for the standards. These departments set the standards for operators to work with and they also change the requirements once their goal has been achieved. Support for attaining the targets are also provided in terms of advises and equipment.

7.7.4.1 Industrial Engineering Department

Time studies are one of the main tools used by the department in determining the targets for the production line with the limited resources available. There are continuous improvement plans to try to increase the output of products using different methods such as

streamlining the production line, by reducing the number of bottlenecks on the line, etc. It is also from these calculations that the company can plan their sales from the production capacity. Currently, the company is producing about 75% of the theoretical target set. At one stage, the production manager succeeded in producing 94% of the weekly target for two consecutive weeks (an all time record for the production line), before dropping back to 84% during the pressure month of June. This above average total was prompted by the overtimes during the weekends in an attempt to reduce the backlog.

	Shifts (day)	
Monday – Thursday	07 00 – 16 45 (50min official break + 60min)	4.52 tanks
Friday	07 00 – 13 00 (20min official break + 60min)	2.95 tanks
Saturday - Sunday	07 30 – 16 45 (40min official break + 60min)	4.90 tanks

	Shifts (night)	
Monday – Thursday	19 00 – 06 15 (50min official break + 60min)	6.43 tanks
Friday	19 00 – 06 15 (50min official break + 60min)	6.43 tanks
Sunday	19 00 – 06 15 (50min official break + 60min)	6.43 tanks

Where the official break includes lunch and tea break and the one-hour is the time lost with workers moving parts on the line and other disturbances on the line

The theoretical value is calculated based on two production lines, with the Saturdays and Sundays dedicated to finish incomplete tanks. Therefore the calculation is as follows:

Monday to Thursday (day and night shift)	= (4.5+6.4)*4 = 43.8
Friday (day and night shift)	= (2.95+6.43) = 9.38
With two lines, the production should be	= (43.8+9.38) = 106.36
Approximating to *an* 80% efficiency, the target should be	= (0.8*106.36)= 85 tanks

The time studies are still an ongoing process as the different models of tanks are produced. With new prototypes or new machines, the time studies are taken only at

bottleneck stations to find new ways to reduce the times. Their task is made more difficult with the huge diversity of tanks that are made available to the customers. This is therefore an ongoing learning process for the whole company as the targets are continuously being reassessed. Since the production line was upgraded to a world class manufacturing, the *Spinning Shop* has to be upgraded also to be able to support the demands of the whole production line ranging from the special line to the gas tanks. The redesign of the supply shop's layout was implemented one month before the research was started.

7.7.4.2 Maintenance Department

The maintenance department has been upgraded from a machine repair centre to a more design-oriented section, involved in making equipment that can speed up production and also make quality products. The communication between the different departments has been more oriented to maintenance especially during peak period. The department's resources were stretched to the limits, with numerous breakdowns in different departments. With the production line working almost non-stop, preventive maintenance at that stage was impossible. It was based more on fixing machines as they break down.

As for the design function, the company often buys standardised machines that are later modified to suit specific function of the assembly line. The newly bought machines are often the result of thorough discussions with the line managers and the different team leaders of the departments to decide if the machines can be manufactured internally. But sometimes, the machines bought are not to the expected design standards. An example is the newly bought machine, which broke down six times within 5 days of delivery. The maintenance personnel were busy fixing the problematic machine every time. The goal therefore is to have a proper understanding of the department's needs so as to translate them into technical characteristics for engineers to design the equipment or buy the required one.

For the moment, maintenance is dealing mainly with recordings of incidents and possible planning of parts required for the servicing of some specific machines. Preventative maintenance should be the main criteria that the department controls but the production line has priority over the availability of the machines. The current situation is fixing the machine

when it is broken, as all the works are urgent. A lot of these problems could have been solved with proper guidance from technicians and managers to the workers who are badly trained maintenance personnel.

With the line running almost 24 hours a day seven days a week, the machines are breaking down due to the lack of care from workers. Most of the time, the workers fix the machine until they can not fix it anymore. Then the maintenance staff is called in but at that time, the machine is so badly worn that more time is spent to fix it. At the end of the financial year, it is particularly stressful as the absenteeism rate starts to increase. This puts more pressure on the remaining workers to produce at the normal rate. This is when mistakes are made, resulting in the breakdown of "overworked" machines. And with breakdowns happening on the line, the maintenance department has to prioritise its repairs based on the "political" powers of the managers. During this period of pressure, the goal is then quantity and not quality.

7.7.4.3 Quality Department

Since the company had always designed its own tanks, their experience in this domain is very robust. The quality of their tanks is internationally famous as they control more than one quarter of the whole market. The quality at the different stations is based on the ISO 9000 series with pictures of good workmanship at workstations for example. The quality department seems to be the only department to be continuously involved with the training of staffs by recognised institutions. There is an awareness of the new methods developed to improve quality, like new welding techniques, which can result in fewer defects on the tanks. This has proved by certificates of personnel having completed these courses.

But the support from the other departments is lacking judging by the reports on the Lotus Notes program. Some of these reports have been left incomplete for the past year. The reporting system then relies on filled in forms, which are then captured on the computer. The time taken to provide feedback to the relevant departments is then outdated, resulting in lack of interest from the other departments and thus, slowly undermining the importance of the quality department. The new production manager is attempting to address the issue by

putting up a list in their cycle meeting room. This is to try to improve the reaction time of the teams in solving the defect problems.

About 50% of the defects are poor welding workmanship in the manufacture of container tanks. The skills which new welders have learnt in technical schools are often not to the requirements of the company. Because of *CE*'s specialisation in tank building, the required welders are more task-oriented. For example, they are required to weld inside a tank or on a curved surface. Most welding schools teach welding horizontal plates, which a six months course will not cater for. Even though they are qualified on paper, the required practical work is very different from their theories. This problem is further compounded by the amount of contract workers who change jobs whenever there is a more rewarding job elsewhere. Their flexibility is a one-day notice. Therefore, the company is constantly having new workers who take time to get used to their specific welding on tanks, resulting in increase in defects at most non-critical stations.

7.7.4.4 *CE*'s Management Style

Looking at the number of defects occurring on the line, there are no corrective measure taken to ensure that the same mistakes are not repeated. Some workers are placed in positions that are not suited to their qualifications. It is through long years of service to the company that certain personnel have been promoted but with the new machines and production concepts, they are sometimes overwhelmed by their role in the whole process. Their "corrective" actions worsen the situation and that just add to more confusion on the already overloaded production line. The team leaders are often caught in the crossfire between managers and workers. And within this tense environment, their productivity is expected to be normal and of high quality according to senior managers.

Looking at the production line, the workers are not rotated enough for them to be exposed to different machines. This has strained the production line especially with high absenteeism rates. Managers are often struggling to make the tanks on time and there is no time for the workers to get used to the stations' work. But some managers are happy with their workforce and they tend to remain with the same team at these stations even during off

peak season. What is interesting is the fact that apart from the standard line, there is no cross-departmental meeting where people with different perspectives can probably help solve each others' problems.

With the forming of new positions since the departure of 3 directors and a few senior managers three months ago, there is total confusion about the new structure that exists in the company. This confusion does not help the standard line when they do not know the newly appointed personnel in their support departments. The new organogram only came out 3 months later with re-structuring still happening (Appendix C).

When *Company E* had retrenched operators, they are often forced to take the workers back through the CCMA (Court of Conciliation, Mediation and Arbitration) due to lack of proofs or wrong procedures. Sometimes, the team leaders have written in the retrenchment forms that certain workers are not welcomed back but the company still re-employs them afterwards. This puts a lot of resentment between the workers, team leaders and managers. But the responsibility also lies with them for not following the correct procedures, resulting in court appearances of senior management at some stage. Another interesting fact was the voluntary severance package that some operators took in the past to be later re-employed at the company. This is not only a waste of resources for the company but an erosion of the management's ability to plan for the future.

The different head of departments which held meetings to solve the problems do not seem to be effective as the problems still appear. It seems that the company's 10% late delivery is an acceptable margin and that has lasted for the past few years. Customers change their work orders sometimes with no penalties incurred and these little favours seem to be quite flexible to the customers but create chaos on the production line. The tendency from the company is to satisfy the customers at any costs, even at the expense of the workers. The cost of these 10% delays can be very high and yet no preventative action is taken. Whether the delays are from the late change of customers' needs or addition of new customers work orders, the root cause is unknown, as there were no studies to try to find why these delays occurred annually.

7.8 Leadership for continuous improvement

Since the new production manager has taken over, the production has increased. But the question is: **how long can this increase last?** The next step he has taken was to increase the weekly targets as well as shorten the cycle time by 20%. Since the company is running only on day shift, the workers are also forced to produce the extra tanks that is now being imposed on them. To the top management, the drive seems to be very good as the manager is attacking the problem on two fronts in an attempt to increase production.

The new approach concerning the production line was to look at the number of tanks produced to be viable and work from backwards. For example, in order to cover the overhead costs and meet customers' needs, x amount of tanks are needed in time t. Therefore, to reach this target, the workers have to produce more in this shortened time period. Also, since their productivity is below the theoretical target, a higher target will make them work harder according to the new manager's philosophy. This has created some serious discontent among workers but they still have to bear the pressure as they need to survive.

In an attempt to pre-empt further problems, the design and maintenance engineers are looking at trying to simplify the work to very simple tasks. And if possible, certain departments' work can be outsourced so as to protect the core business from wasting resources. Some departments rely on product mix, others on one product, which they can produce at high volume. Any changes brought about on the production line will affect their daily performance. There is also no time for engineers to design ergonomic work stations to improve the production rate with the changing products on the line. Also, the parts are being custom made so that it provides more flexibility to the people on the production line and fewer errors are made once the operators are used to the same products. This can seem to be a good move for the logistics but not very different in terms of product difference.

The "protection syndrome" is quite strong among the different departments where some managers are still influencing their previous sections as they are used to. They will influence decision makers by assigning one of his friends to the position so that his work will always be given priorities over others. The creation of these groups has caused more harms than good especially if the employee is not qualified for the job. The lack of discipline seems to be a direct result from the poor control of the company since one line manager has already been assaulted three times. The reason why the manager has been targeted so many times still remains unknown officially. The ideology of a large family at the company is non-existent. The attitude of the workers is therefore "don't care" to the company's future as well as to their equipment and targets set.

It seems that the core values of the company are understood differently by each worker. The environment created by management is to intervene only when there are major problems. The vision of the workers is more oriented towards short-term goals and the company is managing under these premises since the future of the company seems to be uncertain. The workers do not see long term benefits as they always wonder who will be next to go.

7.9 Conclusion

This section has shown the remarkable difference between the real and theoretical world. Logically, the aim of any organisation is to take care of its employees welfare and that has been continuously refuted in this research. Every action taken by the company seems to contradict this strong point that Deming mentioned. It is surprising that a company that relies so much on its employees is continuously striving to replace them with contract workers.

The mechanistic way of analysing problems is also another concern for the organisation's future. Without properly analysing the problem, the blame has already been pinpointed at one department. The different interactions that may have caused the problem have been neglected in their quick search for solution. This has been uncovered during this research. Also, the number of steps missing in the normal procedure of fault reporting has

been very shocking especially with a world leader in container tanks. The number of under performing personnel within the different departments is frightening just by judging on the amount of unsolved problems within the different departments.

Using a systemic point of view to look at *CE's Spinning Shop*, the accuracy with which the operators manage to achieve with the dish ends is quite impressive considering the limitations of the machines. The sheer determination of Management to reduce that to zero defects is ideal but not practical. Understanding the theory of variation reduces tampering from Management, allowing the system to settle within its in-built range of stability. The determination to reduce defects to zero shows the lack of understanding of the systems' operation and characteristics in general.

The Theory of Systems advocates that managers tend to oversimplify problems to be able to understand them. When the problems have been broken down, it is simpler but it is no longer the problem as it is not in its normal environment. It is the interactions between the parts that have created the problem. The variables involved are no longer a small number but hundreds of them when viewed in a company's structure. Therefore, the problems should be viewed as part of a bigger problem and not as a single one. This has created quick fix solutions for seemingly straight forward problems.

The normal understanding of the simple word ***learning*** has also shown the difference in perception in people' mind. Double Loop learning should be the way people think in solving problems but most of them do not use it consciously. This process for finding the root cause problem is essential for the company to learn and evolve instead of just reacting to the problems especially when major disturbances occur. Without Double Loop Learning, the company will never improve its practice both in production nor management. And without them, the company's workforce will not improve on their efficiency and efficacy.

Therefore, before implementing any management concepts, the organisation must be able to understand itself, the variation that exist, their knowledge of the business, organisation and psychology of human beings must be known before the program can be successful. In this

case, *Company E* attempted to implement Total Quality Control when they were not even aware of their limitations. This new Shop Floor Management will hopefully provide them with the framework to analyse the company's current practice. This program will not be a success if there is not a radical change in management style, not only in its organisational structure but also in its way of treating the workers.

PART IV: Evaluation

The evaluation stage of this thesis will be aimed at confirming the hypothesis that was drawn in chapter 1 by abduction. The whole research was done based on the problem perceived by Management and the subsequent re-evaluation of the problem. Theoretical rules used as foundations for understanding the concepts used by most successful companies are the same concepts used by the company in Part II. The complex interactions are then analysed for their viability in the company in Part III. Part IV then completes the final stage where the discussion of the Implementation of a New Shop Floor Management will be successful or not in the current situation.

Chapter 8 will be looking at *Company E*'s current situation and the insight was helpful in assessing their management style during the crisis time. It shows not only their method of dealing with problem situations but also their organisational structures that identified the problem areas. The employees' automatic behaviour to solving problems when they are faced with a crisis has also been observed. This research has been an eye opener as to what framework they were operating in. The mechanistic way of viewing the organisation can be seen in the company as problems are treated as isolated incidents. This short-term vision is eroding the company's long term strategic plans.

The three months spent at the company was not only a very steep, personal learning curve on the academic side but also on the social aspect. It shows the lack of awareness of practical fallacies in bridging the gap between theory and practice. The complex interactions of the different sub-systems were also very interesting in their daily survival. The art of obtaining accurate information was also very difficult to achieve in a time of mistrust. In general, the personal learning has been greatly enhanced.

Note that the evaluations made will be more of theoretical than practical value since the focus was on a learning organisation and that results can only be predicted not calculated.

Chapter 8 – Recommendations of research

8.1 The Results of the Research

The initial focus on Total Quality Control of the Supply Department due to rejected tanks from customers has prompted intervention from top management. Since the problems were found to be non-standard dish ends, the investigation started at the production of dish ends. But as the investigation probed deeper, it was found that the true cause is not localised in the Supply Department but to an overall organisational problem.

Chapter 1 was concerned about problem identification and the new direction of this research was found to be towards implementing a Shop Floor Management (SFM) instead of implementing Total Quality Control in an attempt to collect accurate data for analysis. It also provides a platform to develop the problem solving skills of the operators and managers as how to measure the correct indicators of specific problems. The SFM will also provide a standardised way of analysing problems for other departments in their daily operation. A Systems Approach was used to conceptualise the problem holistically so that the chances of failure will be lower when dealing with complex interacting sub systems.

After the three months, the restructuring continued with the appointment of a new Industrial Engineering team to solve the problems. With only one production line functioning, the production manager has also reduced the cycle time while increasing the targets closer to the theoretical one. The head of the Quality Department was also moved to the Special Production line to help solve their quality problems. Several senior managers were also retrenched as well as voluntary resignation with severance packages. This shows the continuous reshuffling of management personnel even after the three months of restructuring.

All these changes were forced upon by the main company based on the unsatisfactory return on investment. It seems that the measures taken are quite drastic and one wonders how could this situation have become so critical and goes unnoticed for such a long time.

8.2 Failure to identify problem

Deming's approach is to implement small changes so that the workers can learn from the exercise to build up momentum and then let them take over from the learning process. It will no longer be a top down approach but a bottom up organisation where the workers will help in solving the main problems on the shop floor, namely quality of products. Again, the moral tone of Deming is to treat the workers well for long term benefits rather than short term goals. Especially with the threat of globalisation and the existing European Union, the aim should be more focussed on strengthening core competencies as well as increasing the number of competitive advantages of the company for survival in the long term. Therefore, problem identification should have occurred on Shop Floor early in the manufacture of process and not in the sales Department when tanks are rejected.

Looking at the production lines, the SOP and quality standards are all placed in a visible place for continuous referrals for the workers. Even with the ISO 9000 standards, the production line in theory is well equipped to produce quality goods. Engineers are certain that the standards are easily attainable and yet, they can not explain why the current operators are unable to get the exact dimensions for some parts for example. The "blaming contest" between *Head to Shell* and *Spinning Shop* is not a problem solving method but tension creating. Both sections are responsible for low quality tanks on the line with each department's own internal production problems, overflowing on the standard production line and subsequently to the organisation.

Spinning Shop think that it has identified some of the possible causes of the dish end problems but the costs involved to correct them is too expensive to warrant buying the equipment just to "try out". The shape of the dish end will still rely on the operator's skill to be within the boilermakers' acceptable range on the production line. In an attempt to standardise the work, the copying function on the flow forming machine should be repaired so that at least one variable is fixed. Not understanding the full capacity of the machines is not helping

the production team in developing a better work process. Improvements from other work processes can help reduce the amount of errors made on production line.

If the practical standards are different from the theoretical ones, then the engineers must use this new standard as the practical one. Benchmarking can then be applied to find ways to improve the dimensions. Until a major improvement can be found to change the dimensions dramatically, engineers will use them in their design and quality control checks. The other point mentioned was the quality of raw materials used. The company is currently using different materials to produce lightweight container tanks and that can also change the characteristics of the material when it is being physically modified with bending and grinding. The possibility that operators still use old settings on machines can affect the results but this can not be verified as no tests have been performed to find the effects of wrong operating procedures, e.g. the elastic effect when too much pressure was used to flow form a dish end.

Looking at the *Head to Shell's* responsibility, their different end sized barrels still occur in spite of the individual measurement of each plate. This indicates that errors are made, and the control mechanism is not working. The technique suggested by one line manager was rejected, as it was too time consuming but the logic of measuring only once (measuring the last plate and correcting it) suggests the contrary. The opposition to this improvement plan can be used to demonstrate the resistance to change from old employees who are used to work in their traditional way. Not collecting the data on the measurements have also resulted in shifting blames when the barrel ends' differ, and until now, no one knows where the real problem lies for this particular problem.

The logical solution to defective raw materials is to impose some penalty to the supplier for providing low quality products. Or the company can implement some kind of quality control at the supplier's factory before the parts are delivered. Reducing reworks on the company's premises also lowers the inventory levels and quality supervisors, thus saving money. The benefits reaped from a co-operative supplier also helps to develop a partnership and any improvement of production techniques or discovery of a market niche can be shared

among them. But *CE* must be able to create this relationship with the supplier for positive co-operation to take place.

The suggestions from Quality Department are often neglected even though their functions are known to be crucial in this line of business. This is due to their late feedback to reports. But the problem arises not from their side if the data delivered to them are late. Figure 8.1 shows the possible situation where a reinforcing loop can occur within the departments. If the cycle is not properly understood, the departments will always be trapped in it. But the Quality Department did try to implement a faster response system with the help of an IT project. The responses were so poor from the production and supply departments that the project is on the verge of being abandoned. If no one takes a step to break out of this cycle, there will be no solution to the problem. Also, the new production manager was unaware of the Lotus Notes program for reporting defects on the line even though he was part of the operations department in the company for some years now.

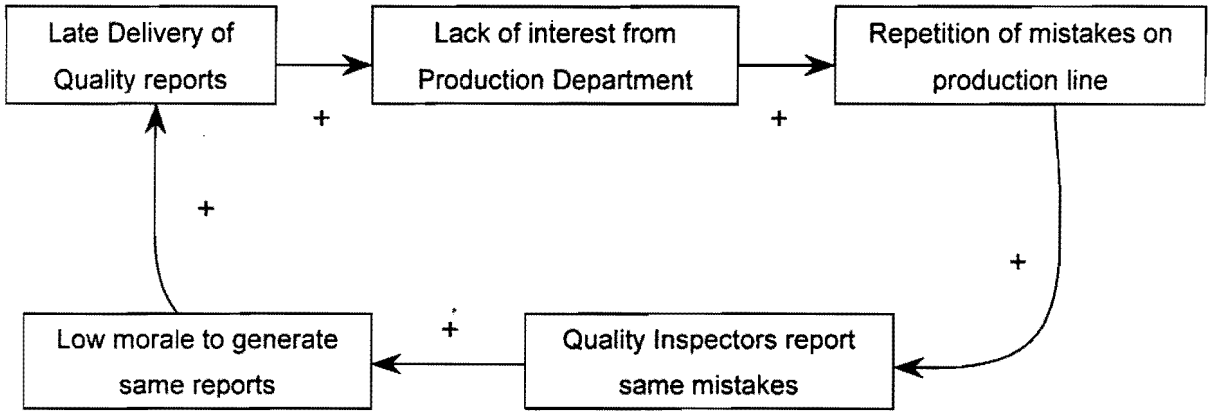


Figure 8.1: An example of a reinforcing loop of a vicious cycle of "decay" in CE

Looking at the production department's targets, their demands are justified if the productivity of the workers is even less than the calculated standard. The increase in their targets will not increase their productivity as the relationship between them is anything but linear. The aim is to increase profits not by accepting more work orders but by reducing costs. In an attempt to prove one's worth, the "greed" of the manager can either pull the

company down with very low morale workforce or pull the company up with an energetic workforce. But, based on the current situation, the first scenario seems to be more probable.

The production manager had actually forced this increase in target over the industrial engineers. This again was prompted by the need to prove oneself to get the workers on the "right" track to produce the theoretical targets for the company. What didn't help the manager was an incident that was later known. On his first week at his new position, he had actually sworn at team leaders and operators during a meeting blaming them for being lazy. He later had to apologise for it as workers wanted to sue him in a disciplinary meeting. Not really understanding the situation and acting on the current data has landed the new manager into a very bad start with the workers.

Also, instead of accepting new work orders, the goal should be to find solutions to reduce the tanks lost due to lost time cycles. The ten per cent annual loss represents a substantial amount of revenue. Instead of fixing the current leaky structure, the whole organisation is pushing tanks across the production lines again. This continuous struggle for earning more revenue is already taking its toll on the workers who see the company as a money making machine at their expense.

8.3 The resistance of employees to improve

Workers

The workers are resistant to change simply because they can not see the benefits of improving their work practice when they get nothing in return. Learning some new theories that is later going to be abandoned is of no value to them. Their long-term vision is simply non-existent, as their aim is survival and not improvement at this stage. Their learning curve will be longer as their level of education is quite low. The gap between theory and practice will always seem too big to be crossed. To bring the workers from the bottom level of Maslow's hierarchy of needs up, the work involved will be enormous but then the aim is to try to change the paradigms that the workers are used to work in. And this learning project will take time, which most companies do not have in time of crisis.

Workers' resistance to all these Quality control plans is very strong because there is no incentive scheme for them to produce more or better quality products. They often use the overtime as an excuse to earn that extra cash at the end of the month. This might seem trivial but based from the recent financial reports, the company has spent too many resources to produce tanks on time and the expenditure has even exceeded the expected profits. The workers therefore prefer to earn overtime money monthly rather than from the elusive bonus at the end of the year. They might therefore create work for themselves by delaying the production on purpose. Most of the overtime workers are always the same people.

The existing training schemes apply only to newcomers. Nothing has been done to upgrade and broaden the other workers' level of knowledge or skills with other courses. The training offered can be categorised as stagnant as the older workers learn nothing new from it. They are often taught what to do but not the reason. In teaching the logic behind the theories, the training will be more insightful to them. For example, certain defective welds occur because of the wrong combination of gases. To correct the problem, gas **X** should be controlled more often as it burns stronger. Examples like these are better suited for operators who can relate to something that they have experienced before.

With the growing focus of the company to rely on contract workers to help them cut costs during off peak periods, *CE* has also "passed" the message that the company is not interested in their welfare. The sole aim of the operators is to provide the muscle that is needed, not the brainpower. With this continuous change in the workforce, the core competency of the company may be slowly eroding as the team spirit that was formed between the workers are constantly broken to make new ones. The team building exercise is then considered useless, as no one is sure of his future in the company.

Management

The quality standards seem to be changing as the quality inspectors fail certain aspects of the tanks when it should have been picked up at earlier stations. This not only makes the workers lose trust in the system but also in the standards. The result is more fire

This new plan is also an exercise for the workers to learn the benefits of Double Loop Learning in their daily life. The goal is therefore to not only empower them to improve their working conditions but also to improve their knowledge. Learning has to be monitored by the managers who have undergone training first. The learning will be easier remembered not because of good theoretical concepts but of the practical aspects when they are immediately tested on the shop floor. This is in itself a paradigm shift in the way they are taught and used to think. Once that has been achieved, the next stage of the plan can be implemented, which is problem solving with specific tools.

A lot of tools developed by academics and practitioners have been made available and often, the tools used depend on the situation. If there is no understanding of the real situation, then the tools used will give erroneous results, which will lead to unwarranted intervention from management. The manager's job is to not only learn these tools and use them but also to be aware of when and where to use them. This learning can be easier by following courses or building relationships with Universities or other Technical institutions. In this way, the company does not lose time re-inventing the wheel by communicating with these experts who can easily identify and implement practical solutions quickly.

The company must also be made aware of the problems faced by the workers, who are sometimes powerless against situations out of their control. For example, the plates supplied by an external supplier are non-confirming to standards, even though they have been certified to be of certain composition. The production rate will drop if the batch of materials contains high number of defects. Frequent defective batches will automatically increase the backlog, which is then being pressurised on the workers. This shows the irresponsibility of management in understanding the workers' plight in some cases.

The recommendations of the external consultant were implemented in an attempt to focus everyone's vision with the company's goals about 2 years ago. A lot of those concepts are theoretical and not very practical in the eyes of the operators. Therefore the response to these concepts have been very weak. The follow up of their implementation has been too

predictable for any real data to be captured especially with dates of audit known six months in advance. Calculations, analysis of graphs, meetings, etc. are not fed back to the workers as an indication of their performance. Without these proofs, any new "orders" from top management are viewed with suspicion and often met with fierce resistance.

The amount of pressure that the managers have applied on the workers has been very high since they are involved in every small aspects of problems. The managers have even performed the team leaders' works sometimes. This therefore creates confusion about the real power that the team leaders have over their workers. There is a tendency for the workers and team leaders to wait for the manager's opinion when they should have tried to solve the problem themselves. Hopefully, with the new Shop Floor Management, the work will be split according to the level of details analysed and the level of responsibility for everyone.

8.5 Conclusion

Without establishing a clear identity of the Company, the uncertainty has permeated through the whole organisation. The strategic plans of their future seem sometimes, erratic to workers as the goal post is continuously changing. Especially with the shift to World Class Manufacturing system, *CE's* traditional management structure seems to be unable to deal with these unexpected problems that never existed before.

Operating on this type of production line, the co-ordination is crucial for the organisation to run smoothly. Proper planning and defect free products seem to be missing in the current goals of the departments considering their frequent occurrence. With the continuous reshuffling of management personnel, the leadership/mentoring teachings for the workers are too erratic to see any concrete results. And with each manager's mental model and working ethics, the workers are continuously learning until they just give up trying to build relationships. In some cases, some managers have never been moved, ensuring a very stable position with continuously changing operators. Therefore, the trust factor is very rarely built among the employees at certain departments.

What the theory of systems recommended was to draw the relationships between the different sub-systems so that a general picture of the supplier-producer interactions is known. And with the dynamic nature of systems, the key indicators on the critical path should also be identified to ensure that the well being of the system is being accurately measured. The different sections can then communicate their needs on the plan so that the suppliers are made aware of them. This can ensure a learning process for all those concerned in finding the best practice for each and every one of them.

Deming's theory of Profound Knowledge explains a lot of the company's actions especially with emphasis on their tampering of the system due to unclear goals. Running an organisation by financial targets goes against the philosophy of Quality. The striking example is the increase in work order to generate profit while no investigation is conducted to try to find ways to reduce their annual late delivery numbers. And with wild fluctuations of the system, management has no time to develop Double Loop Learning but to react to changes. The fire fighting has also permeated throughout the whole company's different support systems.

And what constitutes the different systems is the human factor. The treatment of the company to the operators is very poor as the manpower in South Africa is very high. With very complicated labour law, the emergence of contract workers has overshadowed the importance of development of own workers. The training of internal workers being very poor has provided an opportunity for labour brokers to provide less problematic workers with less financial threat the *CE*. And the company has responded with removal of most incentive schemes to reduce their overhead costs. It can also be attributed to poor data capturing process that the organisation has.

And without these figures, the workers then "create" their own bonus scheme with poor work, resulting in overtime pays. This is then a start of a vicious cycle that management need to address. With Shop Floor Management, the whole process of data capture will hopefully reduce these negative practices and stimulate learning at all levels of the organisation with continuous emphasis on Deming's work.

Chapter 9 – Personal Learning

At the start of this research, the goal was to evaluate the amount of theories used in real work situation and if possible understand the differences between theory and practice where applicable. The learning environment was deemed to be extremely rich since the company has been in the business for the past 60 years with a 30% control of the world market. By changing from a job shop level to a World-Class Manufacturing production line in the past 5 years, the company has also undergone a very steep learning curve. Therefore, it seemed to be a very good place for the researcher to learn from a real competitive business.

Without any previous knowledge of a production plant, the researcher had to undergo trust building among the workers to be able to extract information about the production environment from them in an informal way. Normally, information from informal meetings provides more quality data than documents. It also provides a bigger picture of the company and its complex interacting systems from the workers point of view. This action research was also a test for the researcher's ability to detect patterns and analyse them. Verifying information from different sources has also proved to be crucial, as this will form the only method of testing the validity of data. The goal is to have the "dark" region" (shown in Figure 9.1.) where there is a general agreement on the validity of the data.

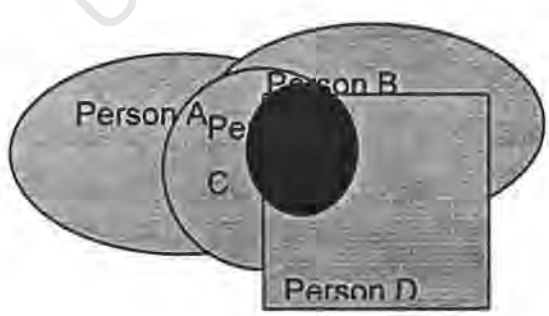


Figure 9.1: Dialectic Research

After meeting with the Director of Production, Production Manager, Supply Manager and the Head of the Industrial Engineering Department, the focus was initially set on practical ways of Total Quality Control in improving the manufacture of dish ends. "Defective" tanks were the cause of this interest in implementing quality control in the supply department. Therefore, the responsibility of the researcher is to first understand the whole production system and then make recommendations on improvement of the production process.

9.1 Implementing Total Quality Control in the Spinning Shop

The Industrial Engineering Department provided a guided tour of the whole production plant starting with the entry of raw materials to the final product that is being shipped out to customers. The initial stage of the research was to look at the different workstations within the Supply department. The line manager allowed the researcher to mix with the operators where more practical explanations can be provided. The team leader also provided a general overview of the *Spinning Shop's* production capability

9.1.1 First Learning Cycle – Trust building among workers

The first stage of the information gathering was trust building as the researcher was considered not only as an outsider to their social cycle but also as a potential threat to their future in the company. Even after a brief introduction by their line manager of the researcher as being a student, the researcher was still being considered as being one of them (meaning management). The office space allocated to the researcher in the Industrial Engineering Department slowed down the trust building exercise. In an attempt to bridge the gap, the researcher tried to meet them in an informal way such as during their tea break and lunchtime. But the canteen was almost deserted as management and operators each take their lunch to their respective work places. And most of the operators leave the company premises to buy lunch outside since it is cheaper.

Among the operators, the group is segmented into different clusters of people of similar race. Some of the languages they speak are foreign to the researcher and trying to hold a conversation with them was very difficult. The author targeted the groups with English

speakers mainly as it was the only common language known between them. One advantage that the researcher might possible had in the trust building exercise was that he was from a different country and race. Participant observation was thoroughly practised with the operators. Gradually, the gap between them narrowed down to a workable level. The time frame was about two weeks when another problem surfaced. The operators change shifts every two weeks.

The researcher is suddenly faced with another problem of rebuilding trust with completely new workers again. With the new found knowledge of trust building, the researcher decided to start the exercise at both the *Spinning Shop* and the *Head to Shell* section. The exercise was slightly faster with both groups as one shift has talked to the others about the researcher and his work. As for the *Head to Shell* operators, the contact was easier as they take their lunch near their workstations thus providing the occasion for trust building. It is through these seemingly informal conversations that questions of a more formal nature have taken place for interviews with managers. Then, unexpected problems came up. A restructuring of the organisation's management structure occurred with the retrenchment of the Director of Production and the sudden death of the Production Manager. Now, the interviews of managers had to wait for the new structure to be put in place.

At that time, the attitudes of most employees (whether managers or operators) were stressed as their future were uncertain. This has in turn made interviews very difficult, as everyone has to be seen performing very hard to avoid being retrenched especially with the restructuring across the company. It was also very interesting to observe the company's reaction to this unique set of events and its impact on the workforce. But then, the permanent operators were used to these changes and the investigation continued at that level.

9.1.2 Operational aspect of the problem

The first striking feature of the manufacturing standards was the high degree of accuracy expected from the workers. With precision of the order of mm, the equipment used seems to be very old and yet the results are quite remarkable. Based on the operators'

experience and skill, the theoretical standards of the dish ends might be achieved if some new equipment is provided. For example, the upgrading of the flow forming process with better moulds to form the plates can reduce the errors on the dish end. With only 3 casts, the plates are formed to a fixed dimension before being hard pressed to achieve the required shape. All these operations introduce possibilities of human errors.

The quality of the products are only known at the end of the production line where the Quality Supervisor performs a series of test from verifying the dimensions to measuring the thickness of the dish ends. What is surprising was the lack of mobility of the Quality Supervisor to the different assembly stations to verify their quality. Detecting any initial signs of defects occurring to the products can be an easy way to reduce reworks and lost time cycles. Most of the tools used are easily transportable. When asked about the reason of why the Quality Supervisor is located at the end of the production line, there were contradicting reasons from personnel of different departments.

As for the gap between the template and the dish end, the Quality Supervisor uses his judgement to "pass" or "fail" it. This is one of the possible reasons why there are problems in assembling the dish ends on the barrels sometimes. The company has not yet determined a scientific way to measure the gap or even a way to standardise the gap so that one variable is fixed at least. As for the designs of the tanks, the dish ends can supposedly be manufactured to the exact standards. What the designers have been advocating is the lack of skilled workers that can do the required job, as they did not have any problems in the past. But without any records to support the claim, there is no way to prove that indeed, there were no problems then.

The green area meeting held everyday before work starts provides the opportunity for workers to share their experience or grievances with team members but participation is low as they find it a waste of time. There are no discussions of previous problems experienced the day before, as everyone believes that they know the solution. And yet, the problems keep appearing. This should have been an indication to the line manager and the team leaders that their solution is not dealing with the real problem but the after effects. Control and

communication can be immediately considered as the problem but as to why these characteristics are not operating, the solution is still unknown at this stage.

Looking at the maintenance of equipment, it seems to be on an adhoc basis. Basic maintenance is performed, like checking on the oils in the hydraulic systems but not for the wear and tear of parts affecting the performance of the machines. There was no check up for the accuracy of the reassembled machines either. One common problem happening on the shop floor of the *Spinning Shop* was bolts breaking off when knuckling dish ends several times in one shift. No special comments were made about this incident, as it was common practice for the operator to replace them themselves and continue to work. Technicians are present only when the machines are broken down beyond the operator's repair knowledge. There was no group meeting to analyse the causes of these breakdowns.

These problems not discussed in the daily green area meeting do make the section lose dish ends due to lost time cycles when producing their daily targets. The operators rely on engineers from relevant departments to solve problems which are reported to the engineers. The section continues to produce dish ends until some other problem stops the line or creates gap on the standard production line.

9.1.3 Sharing of responsibility of Head to Shell and Spinning Shop

The initial goal of the researcher to the implementation of TQC in the *Spinning Shop* section was changed after being made aware that the end sizes of the barrels were not made to dimensions. The differences can even be seen by naked eye in some instances and yet, the dish ends were sent back for rework. It is always easier to rework on a dish end than work on a welded barrel. What was also interesting was this problem was being made aware to the other managers by the line manager of the *Spinning Shop* and even after corrective measures were taken, the problem still keeps on surfacing. As for team leaders, verbal agreement is used to ensure that the dish ends are reworked and that the mistakes will not be repeated. But when dish ends do not fit barrels, a blaming contest starts with the *Spinning Shop* reworking them all the time.

The researcher then went to investigate on the process of barrel making. Measuring several dozens of metal plates daily is a boring work and this can result in mistakes going through the production system in a moment of inattention. The dimensions of plates were initially recorded on paper to draw attention to have uniform barrels. Now, the dimensions and the circumference are written on the interior of the barrels as this exercise is considered as part of their standard operating procedures. A Quality Supervisor then performs random checks on the measurements and sometimes the results differ, as the scale on the equipment is different. This seemingly trivial matter could have resulted in operators sending dish end to be reworked creating gaps in the production line's schedule.

The work of the Quality Supervisors is often not respected as they are seen as problem creators. Not only is their feedback late but also their judgement on quality of the products is often not accurate according to workers. The scepticism of the operators is creating a lack of purpose of the Quality supervisors' reports and they are only referred to when there is an immediate problem on the production line, which is at a deadlock stage between the operators. The Quality Department works mostly with the Industrial Engineering Department to design workstations and work processes.

As for the Industrial Engineering Department, they were busy with time studies on the whole standard production line. Operating with very few personnel, the department had to redo their time studies, as results from the previous ones conducted two years ago by students were inaccurate. The current cycle time is based on the average of the major workstations and it will be revised once all the workstations' operational times are measured. They also analyse data from the production line with focus on breakdowns, production output, quality of tanks, etc. and meetings are set if any one of the factors occur too frequently. The late creation of the Industrial Engineering Department is causing problems on planning as the cycle time are inconsistent revised for mixed batches of tanks on the production line.

The Maintenance Department provides the support in the implementation phase in addition to their normal duties. They make changes to newly acquired equipment to suit the production line's needs as well as design their own tools. Their maintenance schedule is not closely followed by the production line, which tends to operate on a JIT system. Therefore, fire fighting is also a very common practice for the maintenance department and preventative maintenance is only done during December period just before shutdown.

9.1.4 The Driving force behind the Production line

The driving force behind the whole production line is the Sales Department. They discuss the work order as well as the delivery dates with the production manager before accepting customers' requests. Depending on the work orders, the Sales Department also makes decisions as to what types of tanks go to which production lines. This is based on the complexity of the work order and the possible bottlenecks that might be caused on the standard production line for example. Since Standard line is the main income earner for the company, their requests are rarely turned down. When asked about the ordering process, the Sales Manager was adamant that any decisions taken to accept a work order have got the approval of all managers before the order is accepted. Then, it becomes the responsibility of the production department who has to meet the deadline of supplying the tanks.

But the other characteristic of *CE* that is creating disturbances on the production lines and the planning is to satisfy as many customers' orders as possible. Sometimes, a small work order causes bottlenecks on a critical workstation and that changes the whole planning schedule. This also happened when the company goes to international trade fairs where their newest products are marketed. These new tanks did not cause any problems when their prototypes were on the production lines but problems did arise when running on full-scale production. Some employees complained about the timing of the new tanks operating on the production line at a critical time of their delivery schedules and also at the insufficient prototyping time allocated.

What was interesting to note was the immediate change in "opinions" when the employees were questioned again the next day about the poor prototyping period allocated. Everything was "fine" again. What was even more surprising was that when the lack of training was mentioned to the Sales Manager, he was surprised that their training centre was not functioning. Again, the next day, the centre was full with people after two months of inactivity. When queried about the use of the centre, the researcher was told that the training only occurs when there is free time. All these "incidents" started to show that the problem is not a straightforward case of quality within products but something more complex and dynamic.

9.2 The validity of Total Quality Control

These different incidents have started to modify the initial goal of the researcher to implement Total Quality Control within the *Spinning Shop*. Implementing Total Quality Control at the *Spinning Shop* was not the ideal solution. The quality issue is no longer the main problem but their causes. Therefore, the next question is the relevance of the Total Quality Control concept in the Company at this stage.

9.2.1 Current Quality system

CE has implemented Quality control within the company but somehow the system is not working as expected. For example, the defective dish ends have undergone the whole production line's scrutiny not only from the operators but also from quality inspectors and yet, they all passed the tanks as within standards. A mistake from one or two persons can be understood but through a whole production line? These current quality controls may satisfy the ISO 9000 series' requirements in general and the international safety standards of container tanks but it is when the tanks pass through the different control points undetected that puts the whole Quality Control system of *CE* in question.

Even the quality project from an external consultant company has not brought about any major changes about the operating procedures for improvements. The key indicators captured are not being analysed fast enough from the line managers and the engineers to

discern if the problems are within acceptable limits. Not all the personnel are supporting the project, as the latest data on the boards were about two months old. This was explained by the fact that the production line had been trying to meet the delivery dates for several work orders and that no time was found to capture the data and analyse them. The managers were often on the Shop Floor tampering with the system rather than solving problems. Not using the key indicators for analysis shows the workers have not assimilated the quality program as part of their standard operating procedures.

With the death of the Production manager, the plan of Total Quality Control was put on hold since they did not find another person to support this project. With the appointment of a new Production manager, his goal at that time was to meet the targets by pushing tanks, even incomplete ones to the next workstation. Reworks are then done in buffer zones or even in the "hospital". This new goal puts the pressure on the operators to just push the tanks and this creates a "business" for workers to earn extra money as they are approached for overtime. It was discovered that there are no incentives for the workers to produce defect-free products or more tanks. They were simply paid an hourly or monthly rate depending on their skill level.

Their only extra income depends on their annual performance, which is paid out at the end of the financial year. The work expected from the workers is to meet the targets throughout the year. That has created anger among some workers who had been pushed to work harder at that time of the year and then be told they have not earned any bonuses. Profit margins earned in the beginning of the year have been quickly overtaken by manufacturing costs at the end of the financial year with overtimes and even subcontracting part of the work to other companies. The whole issue of Quantity vs. Quality is raised and Deming's view on targets and tampering have all been violated by the company at this stage.

9.2.2 The support from management

From the workers' perspective, the targets set are too high and from the management's point of view, the workers are not productive enough. For example, to

increase their profit margins, the company accepts more orders of tanks putting more pressure on the workers to produce more. Since they are already struggling to produce the set targets, this new work order only decreases their morale, rendering them less productive. The drop in revenue then prompts management to either restructure or look for more work orders as shown in Figure 9.2. This is due to the fact that the last moment effort to catch up on the existing backlog and the new work order use up the profits that the company has built throughout the year. This self-reinforcing loop undermines the support from management too.

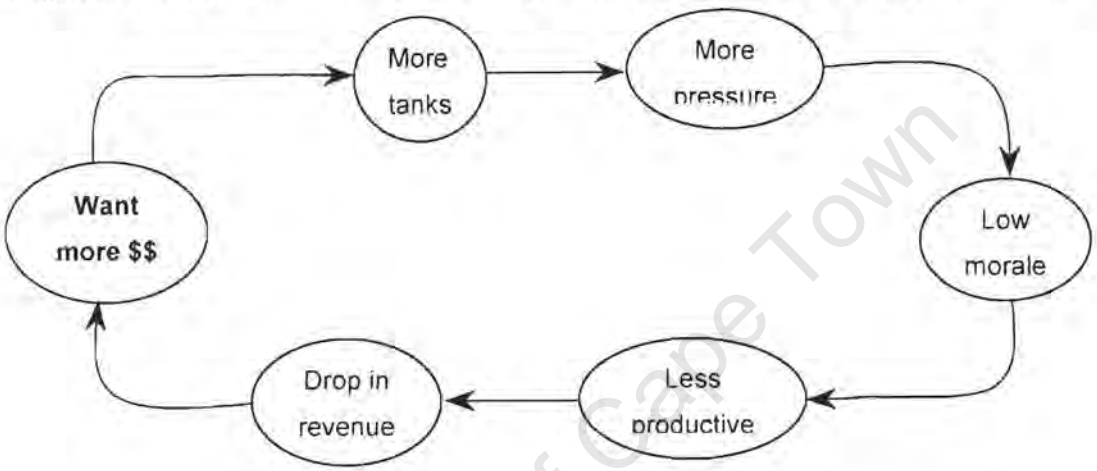


Figure 9.2: Simple model of the vicious cycle of increasing profit

The incentive scheme was rejected because it is too complicated to have according to some managers. Mentions of creating two business units that are competing in the production of tanks with rewards for the most productive team was rejected. Some of the reasons advanced were the uncertain outcome of the rewards if firstly, some external factors forces one section of the production line out. Secondly, if the company runs into problems that require immediate investment which had already been paid out as monthly incentive schemes to workers, it can bankrupt the company. Thirdly, the logistics of implementing such a program is a nightmare for the Human Resource Department[7]. Some of the problems are true but then so is the function of certain recruited personnel to solve these issues specifically.

[7] The Human Resource Department's views were not included as it was declared to be off limits for this research

The researcher thought that the Human Resource Department develops incentive scheme and skill training so that workers can perform their work at their best abilities and conditions. But in *CE*, the training syllabus is dependent on the availability of the workers. There was a suggestion box project where operators give insights for improvements in their work conditions or work methods but the project was abandoned due to initially irrelevant recommendations and then later to lack of participation as operators were not being rewarded as promised. The communication channel between managers and workers have been reduced to the strict minimum now (green area meetings and the occasional emergency meetings).

Thus, without any kind of immediate incentive scheme that rewards the innovative and creative employees, the company is hindering the growth of the workforce. The hiring of contract workers is not conducive to building trust relationships with workers, as their future is uncertain. Capturing the experience of the contract workers to improve the company's own knowledge does not seem to exist as the groups do not bond closely enough. To reduce the complexity of the work, the company is standardising parts. This is to reduce problems on the production line, e.g. less reliance on the craftsmanship of the workers, higher flexibility to manufacture different tanks in the allocated average cycle times and less problems with uncertain quality issues.

9.2.3 *Communication across the departments different hierarchies*

Running a Just In Time system is the ideal dream that every *CE* manager wants to have but the problems are too numerous. The most important one is the lack of communication between departments to co-ordinate their interactions. Real time data exchanged between departments is essential when a production line is running on cycles and that any corrective action must be immediately implemented to save reworks at a later stage. Even with the creation of an Intranet fault reporting system, the response from most production departments has been very low. Since the recommendations from the Quality Department are often not received on time on the assembly lines, the team leaders and managers have to make urgent decisions to keep the production line running. Therefore, Just

In Time system relies on very well trained and experienced workers to make those costly decisions. As for *CE*, this concept is not applicable at this stage.

As for the lack of response of the Intranet fault reporting system, the main causes were attributed to lack of computers and understanding of the software. The infrastructure for this fault reporting system is not even present and yet the line managers still want real time data. Operating in a traditional framework relying on verbal agreements, the tendency is to deny any wrongdoing when problems do occur. Emails or any other documents prove the accountability of one's work and that has prompted the non-use of these data capturing systems. The most striking example of this breakdown in communication is the lack of response to the production manager when he highlighted problems on the shop floor. Without proper data, the intervention for quality is flawed as the defects may arise not only from quality of parts or products or even from services provided.

Theoretically, the operator or the quality supervisor can stop the whole production line if not satisfied with the work but in practice, managers always override the decision as it is too costly to solve problems with the whole production put on hold. The result is buffer zones scattered along the production line where there are reworks. Continuous bypass of orders by Production over Quality Department is creating a less strict work environment where the "producing the right product the first time" phrase is no longer applicable. The reason given by the Production Department over the continuous overriding was the unfounded proofs given by quality Inspectors. The "they" syndrome is the easiest way to shift blame and the results up to now seems to be working as there are no concrete proofs of what really happened.

But in the end, it is people who generate all the defects. This is the reason for continuous training where the logic behind some actions is analysed for improvement. Workers with low educational background have the tendency to follow orders blindly and this method of operation does not promote thinking and creativity among them. Their reliance on the Quality controller is therefore to have the final decision on the quality of their work. More advanced and continuous training is required for them before they can make those costly

decisions on Quality. The Quality Department has sent several staff members to training but as for passing the knowledge to the operators and managers, it seems that there is no structured training time allocated for it.

As for assessing the validity of the issues raised by operators as well as quality supervisors, the company has no structure to analyse them. There is no Knowledge Management (KM) structure to deal with the valuable information on practical aspects of problem identification. All these data can be used to train newcomers in differentiating good and bad craftsmanship for example. The basic data capturing structure exists but the lack of participation of the employees is preventing the capture of real data and hindering the process of problem solving. Without proper information, the actions taken often worsen the situation. The goal is to have feedback to the employees on what criteria they are being benchmarked so that more accurate data can be recorded. Total Quality Control is needed but not at this stage where data gathering as well as results of their analysis is essential. Therefore, Shop Floor Management is the better option to Total Quality Control, which can be developed on the SFM platform if needed at a later stage.

9.3 Viability of Shop Floor Management

Suzaki (1992) mentioned that the current business environment does not support traditional organisations but more on progressive ones. Referring to Figure 4.1, the goal of the company is to have skilled workers can be transferred to other workstations if needed. They will also have a better understanding of the difficulties that other sections of the production line face. They can even provide help by giving relevant practical feedback to engineers when implementing quality controls on the production process. And once, they have a holistic approach in problem solving, their learning curve is greatly increased for new strategic goals that the company is striving towards to.

9.3.1 Ability to identify customers' needs

Looking at the external environment, the supplier's inability to provide *CE* with defect free metal sheets for its barrels is absolutely incomprehensible. Operating with an inefficient

quality control system, the supplier is creating problems for its customers. But since it is the unique supplier of raw materials in South Africa for the moment, *CE* is helpless with them. The costs to check the quality of supplied plates is added to the costs of the tanks and the chances of making errors increase as the number of workstations also increase.

Based on the model of Internal Markets, the main criterion in any business is to know their customers' needs and to exceed them if possible. Looking at the standard production line's processes, the goal is to produce completed quality products to the next workstations. With two production lines, the company can create a competitive atmosphere where a learning culture within the workforce will also help to remove any unproductive elements. The drive to continuously prove that one is better than the other will also open ways for innovations and improvements to occur on the Shop Floor.

The functions of the different support departments within the company must be clearly explained to the workers. For example, the cycle times set by the Industrial Engineering Department must be calculated when operators are operating under normal working conditions and the improvements brought about will possible mean an increase in bonus or an improvement in work conditions depending on the company's policies. Any data can be "tampered" with by operators if they see any future changes as detrimental to them. Some operators even see Quality Supervisors as faultfinding employees in order to prove their worth to the company. These misunderstanding of the departments' functions often lead to failures within the company. But the company will have to clearly define its policies.

9.3.2 Establishing a set of Core Values

Without a clear set of core values, the company will have a very confused workforce as to what direction the company is moving towards to. The Japanese Companies in the 50's were focussed heavily on its workers with even lifetime employment in most cases. Western companies initially view this as impossible but nowadays the success of the Japanese economy is world renown. In this current case, the Company's focus was on the quality of its tanks as well as its flexibility to satisfy its customers. These goals have been reached but the

workers see little advantages to them. What the employees see about the company is their maximum use before being replaced by new equipment or new recruits.

These core values are essential for the company's survival in the long run, as they have to compete with other companies in the same field across the world. This is harder to manage as the competitors are foreign based companies with a different working culture and environment. Also, these core values must be feasible within the environment. This is deemed necessary especially when the company's survival depend on a highly labour intensive workforce like in *CE*. In South Africa, the use of low skilled labour is very high but so is the large number of workers available in the market. The goal is therefore to have a Business Idea that coincides with the core values of the company with the interest of the workforce in consideration.

Aligning business plans with the core values of the company will be easier to implement as the basic infrastructures already exist. But the values can also be changed if the external environment has undergone tremendous changes. This can again be demonstrated with the Japanese companies where lifetime employment is on the verge of disappearing in most major companies as the world economy is slowing down these days. The core values of the company can also help the operators in reaching some of their needs and then strive to reach the next level as depicted in Maslow's hierarchy of Needs (Refer to Figure 1.2).

9.3.3 Developing a Problem Solving Company

Every company spends part of their profits for training in an attempt to improve their current practice to reach higher international standards. With ISO 9000 series, the drive was to have these standards to be internationally competitive. Once the work process was standardised, the goal was to increase problem-solving skills. The typical teaching was to break down problems into manageable parts and then optimise them. But often, the managers identify the wrong problem areas on the shop floor and when they try to solve the problems, the results are often unexpected. Defects are not analysed in the light of why it

started and in what conditions but how it started only. And often the immediate reaction is to repair the "problem". This is a typical reaction from a single loop learning, which does not cater development of problem solving.

Problem solvers require double loop learning for their work to be effective. The understanding of the limitations of the environment is essential for designing an effective solution. For example, the production capacity will rely on the slowest workstation no matter how well optimised the others are. Therefore it will be unnecessary in running all the other machines at optimum capacity. This shows that problems must be viewed within their normal environment and if separated, the solutions are often flawed.

Deming's views on tampering was very public as they are often the cause of the downfall of companies. Once the root causes of the problems are found, the solutions devised must be thoroughly analysed to see its impact on the symptoms and if needed, other control mechanisms are needed to lower the variations to an acceptable level. This is the reason why the problem must be analysed within its normal operating conditions as well as any data on previous behaviour. All these information can tell the problem solvers about the natural pattern of the problem and whether further intervention is required. Often, if the correct solution is applied to the root cause, the cascade effect also solves other problems.

9.3.4 Leadership for continuous improvement

For an effective group of workers to be good problem solvers, they will need leaders to direct them in the right direction. Setting up a motivated team is the first step that a good leader needs to do. Normally, a good team must contain people from different areas of expertise not only from management level but also from operators' levels. But this can be difficult considering that South African's history have not allowed people from different cultures to mix easily and that has formed some prejudice in the workplace even in present times. This can be seen from the company's management where certain people occupy important positions while others remain on lower levels.

The selection of the team therefore relies not only on the cultures of the people but also on their practical skills. The multicultural and multitalented team can help to devise solutions that are more easily accepted by fellow workers as their perspectives were also taken into consideration. They must also be given the power to investigate and make changes when needed so as to reduce reaction time when problems do arise. But empowerment has to be continuously monitored so that errors are not made. It is only through success that they can market their efficiency and thus help to increase the trust of fellow employees.

But success only can also be detrimental, as the learning experience is less rich in content. Failures must not be punished in every situation but used as a learning opportunity to avoid repetition of same mistakes. It also puts the pressure on problem solvers when the results do not go according to plans. Sometimes, failures are the catalyst for employees to "discover" learning and keep them on their guard. Unexpected results also make the whole planning process more vivid to memory and increase the amount of thinking for future plans. The learning is based on practical results as well as flaws. But all these form part of the education that the workers receive in the "Real World University" where theories must be complemented with practical experience.

For successful plans to be implemented, the interactions between departments must be fluent as every one is made aware of the needs of each department. Team members usually select the leader as they are working with the person daily. The choice of the team leaders must be done in a transparent way so those operators will listen to him and if needed, continuously reassessed so that his core competencies are used optimally. Normally, the leader of the group raises the needs from each section without stretching beyond their limits. This is particularly important when dealing with different issues where each person is specialised in one specific field. But the education process as well as knowledge management must be continuously updated so that there is improvement for the company and the workers. Therefore, selecting a leader is of the utmost importance for the company's future.

9.4 The desired results from Shop Floor Management

The goal of SFM is therefore to have real data that is correctly representing the situation on the shop floor. Without it, any analysis will be flawed. Since the concept of Total Quality Control is well known in most companies, it has created a benchmarking process among South African workers in which they are competing against the best in the world. The aim that the companies are setting for the workers to be at is unattainable with the existing work conditions and the organisational structure. So, the concept SFM will hopefully ease the tension that is usually associated with Total Quality Control and can be used as a starting point for making future changes.

9.4.1 The role of the managers

Manager's role in the creation of an effective work environment is crucial at the stage when a company is implementing a new strategic plan. Their role is to transfer the strategic plans from top management to some practical examples for the operators on the Shop Floor. And that can only be achieved with the support from his staff. The communication between the operators, team leaders and managers must be a two-way communication channel, which can then promote learning. Whether it is a double or single loop learning, the responsibility lies with the leadership that top management is providing. The different control mechanisms in place are not tools of mistrust but of learning. The attitude to targets not met should not be of punishment but of understanding.

By continuously discussing with his team members, the manager can reduce the mistrust. Breakdown of communication to preserve one's supposedly high knowledge in the field is the opposite of communication. This has led to teams breaking down without any warning to the manager. Looking at the current case study, the managers are supposedly dealing with relatively uneducated workforce but with the company's shift towards World-Class Manufacturing processes, it has pushed some of the managers out of their normal operating environment. Therefore, the company must ensure that all its managers are aware of the implications of this new strategic direction that the company is aiming for and provide training if needed.

This has brought the company's new strategic goal in question especially with the possibility of unqualified personnel leading the operators in a traditional organisation within an environment suited for a progressive organisation. The long-term goals of the company have not taken into consideration of the lack of experience of its employees in this new production process. If the managers can not understand the key concepts behind World Class Manufacturing, they will not be able to lead the operators in supporting this new plan. For the moment, the managers are just targeting short-term goals, which is following the targets imposed while fire fighting problems on the shop floor.

The new production manager has started to implement some highly visible control mechanisms in which for example results are publicly displayed on notice boards. This has immediately made its impact and now it is starting to cause employees to think more when they are working. It has also put pressure on line managers and team leaders to be more aware of the problems on the shop floor. This simple and yet highly effective method is having its impact on some performances. But these data collected are often made at the expense of others' reputation and this is where organisational politics will play a major part in job preservation.

9.4.2 Operators' importance within the company

The impact of operators within a labour intensive company like *CE* can not be ignored. The wellbeing of the employees should be the priority of management as most of the tanks rely on the expertise of the veteran artisans on the production line. All the company is interested are the numbers set by engineers. The attitude of management in some cases is to push the workers to meet these targets without any changes in their working environment. It has also created some friction in several departments.

All these little incidents (dust in the *Spinning Shop,* lack of structured training, surprising promotion of personnel at key positions) form part of the gradual increasing discontent between workers and management on the importance given to them. And with the

restructuring process this time, some permanent workers have been retrenched together with the contract workers. This has been a very big surprise for some of the employees as it is creating a sense of uncertainty within the company about one's future. With the move towards standardisation, the number of contract workers will increase, as the work performed will be easier. The direction in which the company is moving seems to be very cost effective but the way that the results are obtained is creating doubt within the workforce. Any improvements made by the employees may result in losing their job as the company will replace them.

One of the main indicators of the employees' satisfaction or morale can be linked to the number of cases in the disciplinary committee of the company and that of the CCMA (Court of Conciliation, Mediation and Arbitration). There were some complaints from team leaders and managers about the poor success rate of the company in those court cases. Whether the proper procedures were not respected in terms of administration or in terms or proofs, the workers are losing trust in the company's monitoring system in which unproductive workers are not retrenched. Whenever the company is forced to rehire retrenched workers, the social dynamics of the team is broken down. This is also one more reason for the company to use contract workers where termination of contract can be immediate and without any other problems.

But the concern that arises is the usefulness of control mechanisms to determine if some workers are productive or not. If the company can not prove their claims, then the monitoring process is flawed. Once that the employees' accountability can be ascertained, the company can start to narrow down and identify areas of frequent problems. This will also ensure that the retrenched workers are the real culprits in the problems affecting the production line.

9.4.3 The teamwork effort

In a World-Class company, the importance of each department is equal. Competing to be the most important department by setting high targets while others are struggling to reach

the normal standards is a sure recipe to systems failure. Optimising all the systems capabilities do not necessarily mean the better performance of the whole system but it can possibly lead to breakdowns of the whole structure.

For example, the work orders set by the Sales Department drives the Production Department's planning and scheduling. Based on the capacity calculated by the Industrial Engineering Department, the work orders can be increased since these theoretical targets set are often taken as granted even if they have never been achieved. With an increase in work order and a shortened time cycle, the quality of the tanks are still expected to be the same. This new work order also pushes the design limits of the production line to try to produce a few extra tanks on the production line. Often, extra workers are brought in to perform off line work so as to speed up the process, resulting in increasing costs.

Figure 9.3 demonstrates the effect of morale on work the different functions on the production of container tanks. With an increase in the order, the quality of tanks decreases as well as the morale of workers. Delivery will be maintained on time even though there will be more reworks. With quality decreasing, the safety standards will decrease as the workers will have less time to check their work within the reduced cycle time. The reworks will then increase the production costs as more help is hired to do the job as well as more overtime is required. Morale may go high at this stage with the prospect of making more money or morale may decrease if the work pressure is too high. Management will then intervene in an attempt to reduce costs by increasing work orders from satisfied customers. But this process can not last in the long run as the quantity of resources (production costs, overtime salaries, hiring of extra help due to looming deadline, repairs of broken down equipment, etc.)

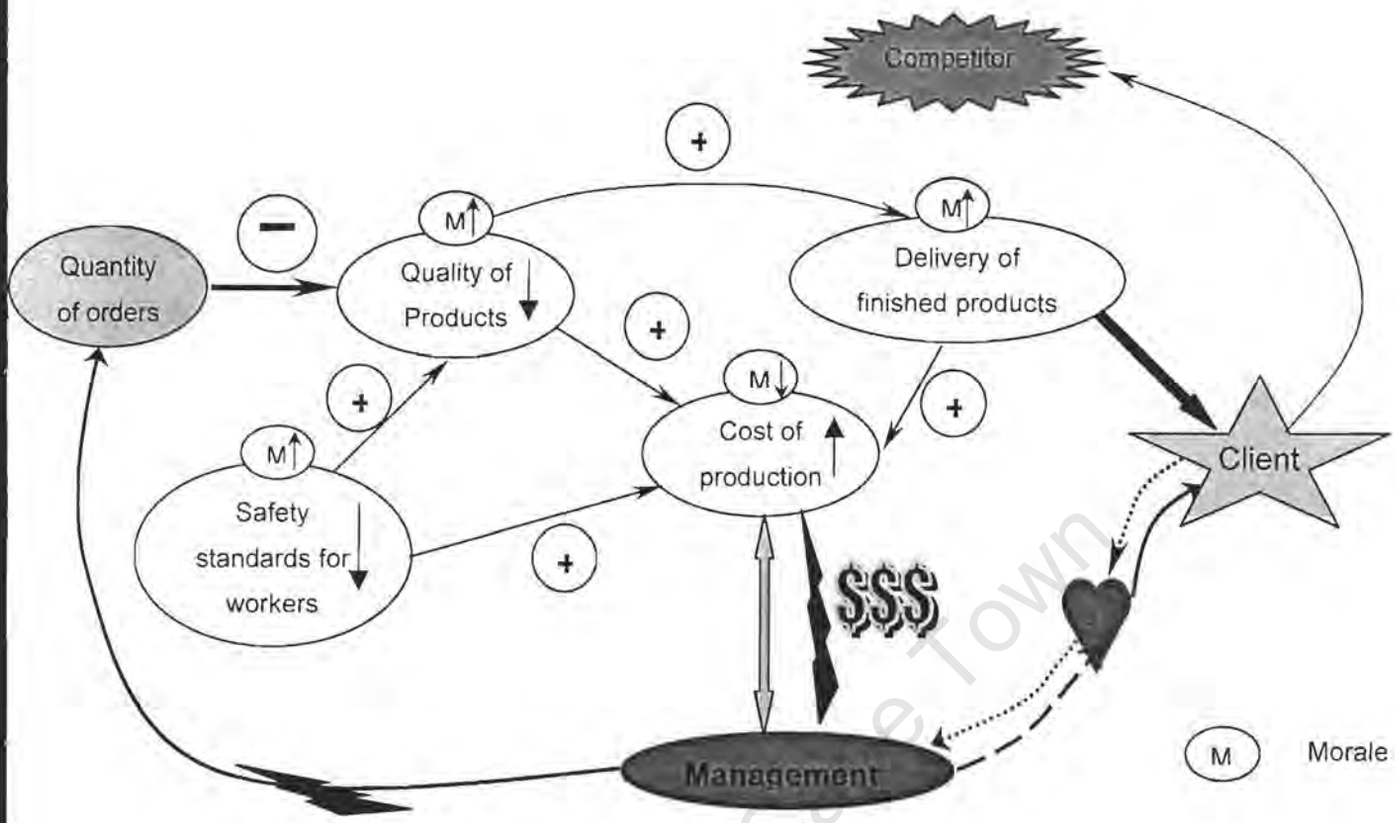


Figure 9.3: Basic Relationships between the different factors

9.5 Using failures as a learning exercise

With a young organisation like *CE* in this new era of World Class Manufacturing, the learning is often made through failures. The initial reaction to failures is the hunt for THE CULPRIT but the definition of failure given in Chapter 5 has provided different meanings to it. Learning from it will vary, depending on the level of failure with type 2 (met target but with unwanted side effects) as the most common one. The aim is therefore to learn from these failures to avoid repeating the same errors. But often, the process of learning is not complete, as the whole problem has not been properly identified. In this section, there will be some examples of recurring failures with no permanent solutions in sight.

9.5.1 The "double edge" effect of monetary returns

Most companies are very cautious about the expenditure of resources and their foreseeable return on their investment. Their obsession on profits sometimes undermines the core values of business practice in the current economic era like sustainability of the business. The drive by *CE* to produce tanks at high volumes is putting pressure on the workers to operate like machines on an automated line. Instead of analysing why they can not produce the theoretical targets set, they reduce the cycle times to produce more. Controlling the level of backlogs seems to be a better way to reduce expenditure rather than trying to increase their productivity.

Not understanding the flaws in their current system is itself a failure in the design of the company's internal structures. The pressure to see positive targets at the end of the week has forced the production department to mass-produce within cycle time and increasing reworks at a later stage. As for the calculation of lost time cycle vs. reworks, management has accepted the latter as the cheaper option. This decision has made the company not part of a quality driven culture. For example, the cost of the company's work order of last year has exceeded their profits, resulting in no bonus for the workers. The main reason for this seems to come from the high amount of overtime paid to the workers and the cost of equipment for reworks also.

The short-term goal of making more money is hurting the company's long term plan of survival especially with the decreasing morale of the employees. There are even rumours of a group of employees creating "work" for overtime as a new way of increasing their income. Providing the workers with the option of overtime, the company has created a "market niche" for specific workers. The very idea of making more money by accepting more orders has also provided a means for some employees to benefit from it. But as for the extent of the group's influence on the general workforce, its impact is unknown.

Removal of incentive scheme for more productive employees seems to be logically wrong, as this is the only motivation that operators need. A bonus based on the overall performance of the company annually has not been well received as the workload increases

dramatically when the financial year ends. If there are continuous check points on a production line, then there must be continuous check points" for monthly performance. Since the company loses about ten per cent of its work orders due to backlog, the company can surely use that margin as the control level. For the moment, the company is functioning with high pressure from top to bottom and not much from bottom to top.

For example, the sales department is driving the production department. This equation can change with production driving sales to continuously look for more customers. The failure of management to see that monetary motivation for the workers at this stage is essential since their immediate needs are still located in the lowest part of Maslow's hierarchy of needs (Figure 1.2). Employees quickly forget any long-term rewards (like the end of the year bonus). They need continuous incentives to perform better and produce more throughout the year. The main problem is the possibility that the company is under too much pressure to try this "high cash" exercise at this stage. But then the next question that arises is the failure of different control mechanisms that should have raised the concern when the problem went over the assigned control limits.

9.5.2 The resistance to learn from managers

The situation in which *CE* lies is the poor results of their actions taken to improve the conditions. This shows that either the problem solvers were provided with flawed data or that the problem solvers were not analysing the data correctly or a combination of both cases. There exists another possibility where the employees of CE do not understand the training provided. Therefore, resistances occur at both management and operators' levels. But improvement can only be achieved by the desire to learn from the practitioners themselves.

Dörner (1989) and Deming mentioned the issue about people with good intentions makes mistakes but being unaware of it. This applies mainly to employees who are in high positions but lacking the specific experience to deal with the problems. When the company's expectations are unrealistic and conflicting, the poor results often prompt a higher level of "surveillance" from senior management (Young, 2000). It is during that time that the stressed

out managers start to interpret the different meanings of the company's new policies in an attempt to preserve one's job. Tampering is normally the reaction from managers just to show that they are very active in their jobs. But it is the worst thing to be doing during crisis time.

Setting up theoretically sound goals and then blaming others when the results are unexpected is one common way of attracting positive attention from top management. Some do that intentionally while others are really overwhelmed by events. This is typical within a traditional organisation like *CE*. Some have still not made the transition from job shop to a production line system. The decisions taken within their departments are often not value adding to the overall performance of the company. In one instance, there were no parts for one type of tanks as the line manager had decided to mass-produce a complete batch and not working with a product mix.

As for providing leaders for the development of young employees, the program is not working also. Young managers lack the practical experience to implement theories. One real life example of this was "demonstrated" to the researcher. During the three months at the company, the buffer zones used to be littered with barrels or incomplete tanks but recently after the appointment of a new line manager, all the buffer zones were empty when that section could not provide tanks for the production line. The company had to switch back to its old methods of product mix and stock building.

This can also demonstrate the harsh realities between theory and practice in which either one of them can not operate without the other. Yet, that person has been in the company for quite some years now. He was eventually "rewarded" with a new post as the Head of a crucial Department in the company. The influence of some people within the company has also preserved their "group" to be in the positions of power when they should not be. The training for the employees at these crucial positions is essential when considering the amount of investment made and the impact on the company's resources.

9.5.3 The resistance to training

Companies normally provide training for employees to improve their productivity but often, the results are not as positive as would have been expected. The most common belief is that employees will automatically perform better after training as they are taught to identify company's problems. Learning by training occurs only when the lessons taught are assimilated by the practitioner to develop his own methods. And that rarely happens, as the power to apply that to their work conditions is not given to the full extent. The workers tend to forget the theories taught and management then start losing hope on the training program.

What employees see from training is a worsening of the situation in which new targets are set in the same work conditions. With the new knowledge, some of the operators feel threatened especially if they have exceeded the manager's technical skills and the scrutiny from him is very dangerous for operators who are surviving on the daily wages. Luckier employees will then wait for better opportunities to change companies where they can get a better wage for their newly learnt knowledge.

The results from training the operators have not solved the company's numerous problems on the shop floor as their problem solving skills are not efficient enough. The contents of the training do not bring value to the remaining experienced operators. The techniques taught often clash with operators' previous knowledge and that has resulted in delays in assimilating and translating into productive results. The time allocated for assimilation is not being accounted for and the pressure of cycle time has made workers reject the new techniques taught to produce on time. Operators are then wary of training offered by the company as they are still being measured by their output and not on their new skills. The gradual deterioration of trust between management and operators is increasing. The intention of the company is good but the support for it is very poor.

Communication between operators and managers are very poor in some departments. In some cases, the new strategies have gone against the operators' opinions and now, the company has to counterbalance the investment on the unused equipment or process implemented. All sorts of problems were raised by operators that in the end, it was cheaper

to find another alternative rather than fix it. This communication breakdown in the planning stage of the project between operators and management has resulted in losses in the company's allocated budget and planned return on investment. This type of passive resistance of operators can be very costly especially when the new plan has reached a point of no return. Their documentation of meetings and the technical requirements seem to be lacking in consistency and also quantity of indicators for proper conclusions to be drawn.

9.5.4 Knowledge Management (KM)

All these problems can be blamed on a large part on lack of communication. This has been a major concern for most companies as academics raised the issue on Knowledge Management. In most companies, there is a basic form of knowledge management with recording of output, defects, costs, etc. But the core of the concept is often missing. KM deals with the capturing to tacit knowledge of the company and that applies specifically to the very experienced employees in the company. It is through meetings of problem solving or planning that these crucial information need to be captured and it is from these data that the company can build its knowledge capital to be more productive in quality end products.

But KM does not deal with technical data only but also social issues. Methods of selecting teams and drawing the best of each of the team members is also crucial in the organisation especially in the case of *CE*, where the input of each individual can have huge impact on the outcome of the products. This database can be very useful for the employees to learn from experts in their fields to strengthen their weaknesses. Some employees are very good at technical issues while being very poor at networking for example. Therefore, KM goal is to draw out the knowledge from its employees, *as it is through social interaction that knowledge is created* (McCampbell, Claire & Gitters, 1999). The process is very long term based and if properly performed, it can also create a teamwork environment, which can become the company's core competency.

But KM is mainly targeting managers level as the rewards from this "theory" is to draw out the motivation from workers not based on monetary rewards but on futuristic career

opportunities. In a labour intensive environment, KM will be probably supported by some kind of rewards most probably monetary for the operators. This is to fulfil their most basic needs before reaching for the next level. Therefore, the KM starts with data capturing on the Shop Floor for relevant social interactions to yield that crucial information for the company.

9.6 Conclusion

On a personal note, this thesis has taught the researcher not only the analytical side but also the networking skills required to "blend in" situations under investigation. Starting from a researcher to a friend with the employees has been itself a long and complex process. The continuous breakdown of wariness of employees at different levels of the organisation was also very rich in experience. The learning of participant observation and interviews was put to the test at the company especially when rumours of imminent retrenchment were ripe. The words used in questions had to be continuously verified to avoid creating a false impression of a "witch hunt" in the company. But each employee' reaction is also different depending on their position in *CE*.

Doing in a research in a tensed environment at *CE* was at times very frustrating with the amount of problems coming from all directions. The two different mental models of workers and managers also made the task of finding the common ground difficult as their needs are sometimes separated by several layers when comparing to Maslow's Hierarchy of Needs once again. The seemingly only approach is to prove facts by numbers and logical explanation. But then, the problem of poor data resulted in a new approach to *CE*'s problems. Shop Floor Management instead of Total Quality Control was considered to be a better tool to use to help alleviate the problems.

But to make them accept this new management fad from academics, the details of the model and theories are provided to make them aware of the benefits to their personal growth as well as the company's. Double Learning is then required from them to solve their root cause problems and not the symptoms. This can only be initiated with proper data capturing methods for the learning process to follow. Not only do they need scientific tools (like

Statistical Process Control) but also some communication and human management skills especially for some managers.

Creating links with educational institutions can facilitate the learning process. The use of students at the *CE* can also provide them with the continuous testing phase of their operational plans derived from their strategic plans. Continuous probing of the company's core and tacit assumption will force *CE* to thoroughly understand their own definitions before implementing changes. If those visions can be explained to students, then it can also be translated to simple language for the operators to know them. This can then draw out the creative side of the operators in performing their work more efficiently and with efficacy.

The treatment to the operators on the production lines also needs to be addressed if the implementation of the new plans can be speeded up. Incentive schemes is essential to provide the continuous motivation for the operators and after some time, these schemes can be changed to something else when their needs change too. Having a regular workforce can also reduce the number of defects and reworks at the company but the measurement indices need to be in place and properly understood by them.

With the restructuring of the company's top management, the new framework of Shop Floor Management will hopefully provide them with a new and stronger platform to build the company's future and not the company's downfall.

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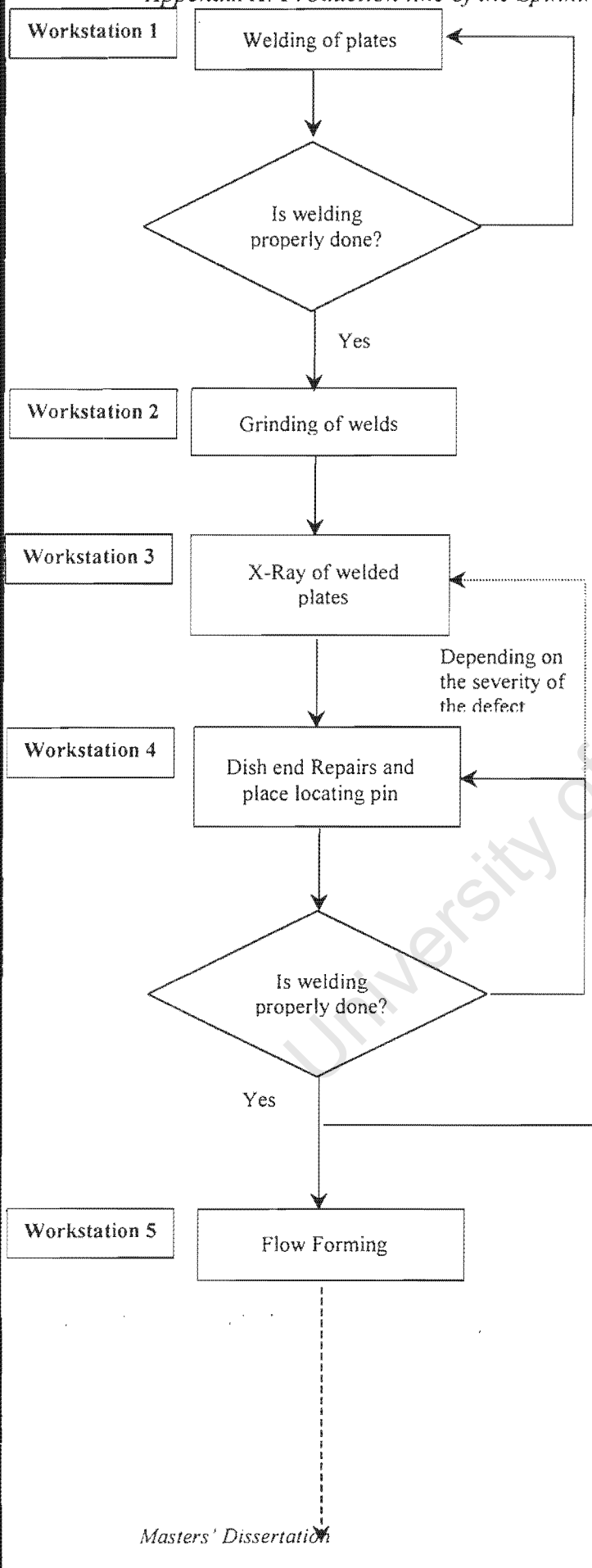
Appendix A: Flow Chart of the Spinning Shop

Appendix A: Production line of the Spinning shop at CE



Workstation 1:
This workstation deals with the welding of semi-circular plates. The welding is done using a TIG plasma welder who welds on the whole length of the

The operator then checks for any irregular welds on the plate. If there are defects, the welder uses a separate welding machine to correct the mistake

Workstation 2:
The long welds are then grinded to have a smooth finish of the interior of the dish ends.

Workstation 3:
The plates are then sent to be x-rayed for gaps that may have been left out when welding or erosion due to too much grinding

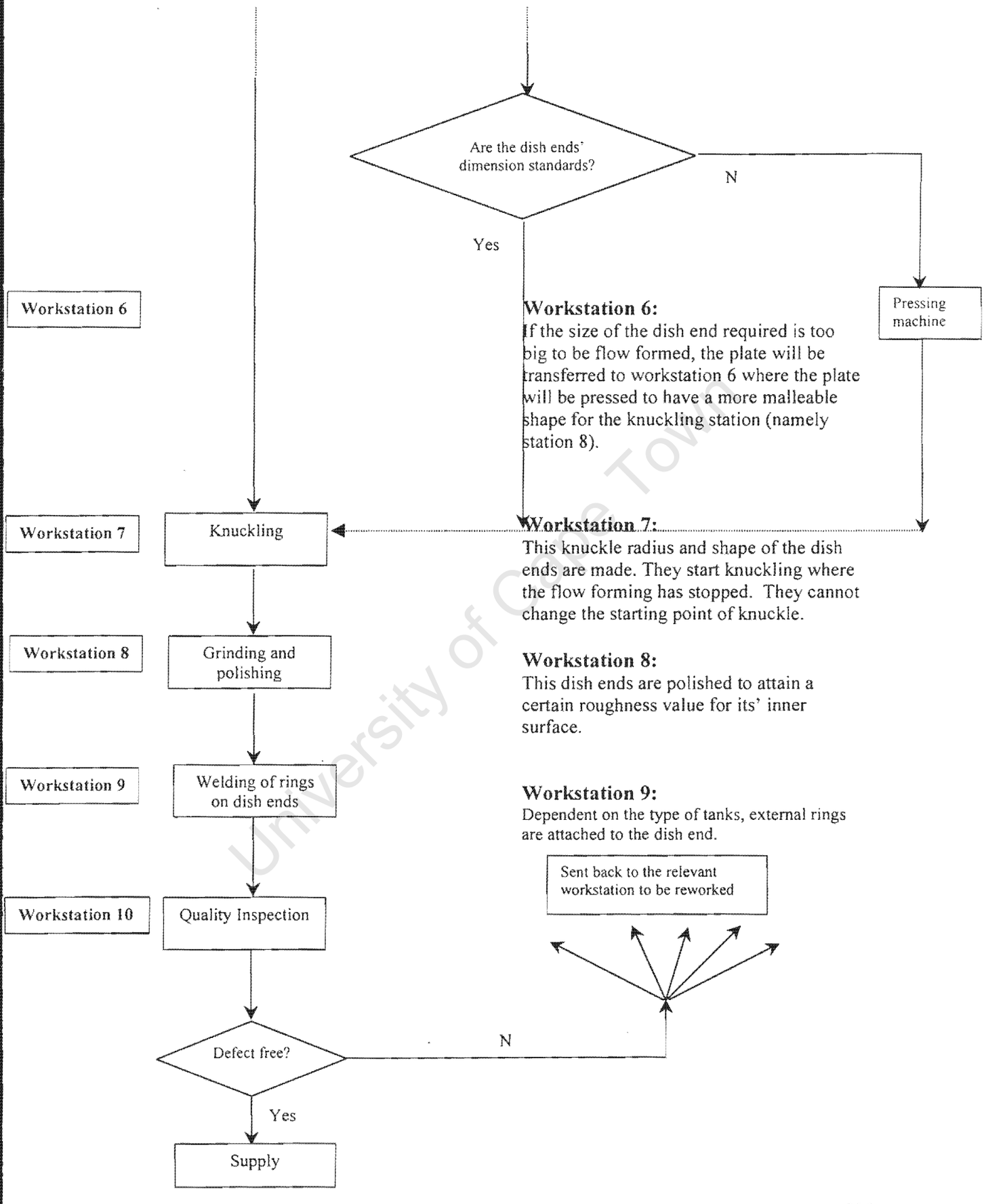
Workstation 4:
Repairs are done to the defective welds and, depending on its severity, the dish end can be sent back to the X-ray workstation again. If the defect is not that severe, immediate correction can be done.

The locating pin is welded in the middle of the metal plate by measuring its radius. This is to provide a point of reference for the coming workstations.

Workstation 5:
The plate is then loaded on the die to be flow-formed according to the dimensions required.

There are 3 die casts that are used to flow form plates for a whole range of sizes of tanks.

Appendix A: Production line of the Spinning shop at CE



Appendix B: Deming's 14 Points of Quality

Appendix B: Deming's 14 point of Quality

1. Create constancy of purpose toward improvement of product and service, with the aim to become competitive and to stay in business, and to provide jobs.

2. Adopt the new philosophy. We are in a new economic age. Western management must awaken to the challenge, must learn their responsibilities, and take on leadership for change.

3. Cease dependence on inspection to achieve quality. Eliminate the need for inspection on a mass basis by building quality into the product in the first place.

4. End the practice of awarding business on the basis of price tag. Instead, minimize total cost. Move toward a single supplier for any one item, on a long-term relationship of loyalty and trust.

5. Improve constantly and forever the system of production and service, to improve quality and productivity, and thus constantly decrease costs.

6. Institute training on the job.

7. Institute leadership. The aim of supervision should be to help people and machines and gadgets to do a better job. Supervision of management is in need of overhaul, as well as supervision of production workers.

8. Drive out fear, so that everyone may work effectively for the company.

9. Break down barriers between departments. People in research, design, sales, and production must work as a team, to foresee problems of production and in use that may be encountered with the product or service.

10. Eliminate slogans, exhortations, and targets for the work force asking for zero defects and new levels of productivity. Such exhortations only create adversarial relationships, as the bulk of the causes of low quality and low productivity belong to the system and thus lie beyond the power of the work force.

- Eliminate work standards (quotas) on the factory floor. Substitute leadership.
- Eliminate management by objective. Eliminate management by numbers, numerical goals. Substitute leadership.

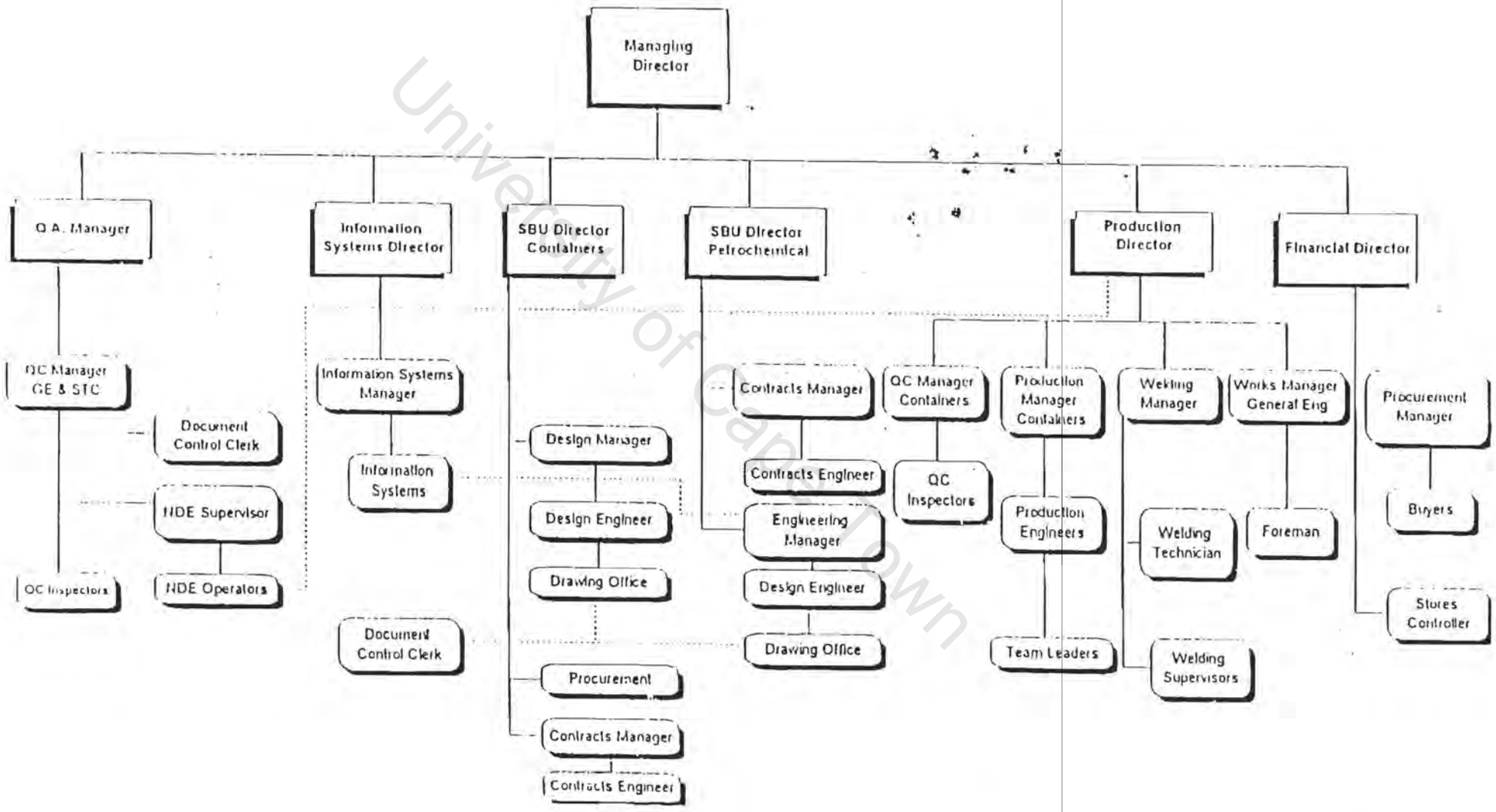
11. Remove barriers that rob the hourly worker of his right to pride of workmanship. The responsibility of supervisors must be changed from sheer numbers to quality.

12. Remove barriers that rob people in management and in engineering of their right to pride of workmanship. This means, inter alia, abolishment of the annual or merit rating and of management by objective.

13. Institute a vigorous program of education and self-improvement.

14. Put everybody in the company to work to accomplish the transformation. The transformation is everybody's job

Appendix C: Organogram of CE



Appendix D: Field Notes

The background information at *CE*

Vision of *CE* (World Leader in Supply of Tank containers)	
GOALS	**VALUES**
- Exceed shareholders criteria for financial performance in all key areas of business	- Excellence (simply the best)
- Continuously strive to meet world class business practice	- Integrity (adherence to code of ethical values)
- To be at the forefront of product & process development through sound engineering designs and practice	- Teamwork (teamwork is greater than the sum of individuals)
- To exceed customer expectations with respect to value for money	- Ownership & Autonomy (supporting policies, decisions & actions of the team)
- Continue to develop partnerships with reliable suppliers	- Maturity (to be responsible & solution driven)
- Improve customer service through quick response & reduced lead times	- Commitment & focus (allowing to agreed parameters)

The current problem that is facing *CE* is to reduce their number of defects and try to successfully implement TQC (Total Quality Control) throughout the company. The implementation part was mostly unsuccessful in the different departments and it is my scope of reserach to find what went wrong and if possible, fix the area of concern. This all form part of the learning process of my action research where qualitative research seems to be the key. Looking at a company where statistics are being used every day, there seems to be little concern for the workers.

Being an international company, holding a 40% market share worldwide, in the manufacture of tankers (for storage of gas, chemicals, food, etc.) they need to be continuously more innovative than their competitors. Their first step is to ensure that their products are to the satisfaction of their customers.

Monday the 20th of March 2000

Reason of failure of the TQC plan:

1) Framework of the workers: personal goal vs. Co' Objectives

The workers think that their job is better than the company and that the standards set by the company is not that good sometimes. It is also an attitude of "throwing the problem over the wall. My problem is the next person's problem now!"

2) Measurements: Unclear QC goals

Even though *CE* proclaims that they implement ISO 9000 series, there still seem to be a lot of defects that arises. Sometimes, the measurements are very vague and the readings taken are not to the norms!

N.B: How does one measure the real effect of a phenomenon? How much overlap is there between the two systems in consideration?

3) Measurement method: What is the correct method?

Dialectic? Trying to verify one piece of information through several sources to either confirm or disprove a theory!

Problems in work environment:

a) Level of noise eliminates communication – Does it bore the workers? Does that lead to boredom which in turn leads to defects?
b) Are the workers happy? Hygiene of work environment seems to be quite bad! (Dust particles are floating around in the workshop)

Wednesday the 22nd of March

Confirmed with the Production Manager people to try to implement TQC all over the different companies. But sudden problem! 6 tanks (worth ZAR 900,000=$140,625) is being returned by customers due to misalignment of parts! (mainly head to shell section). Emergency meeting where the spinning shop is blamed!

Discussion of the main problems facing the Production people:

1. Quality aspects:

(a) Curvature of dome not satisfactory to customers

(b) Supply system is in disarray – Not enough time to prepare for parts. Some stations come to a halt and thus creating bottlenecks. Where does the problem lie? Internal suppliers or external ones' problems?

(c) Defect Rate (according to Production Manager) is 7% but some are little jobs (like waiting for customers' logo) but 7% is mainly for reworks!

(d) There is a need to implement TQC to eliminate all these problems

2. There is a need to change workers framework or way of thinking

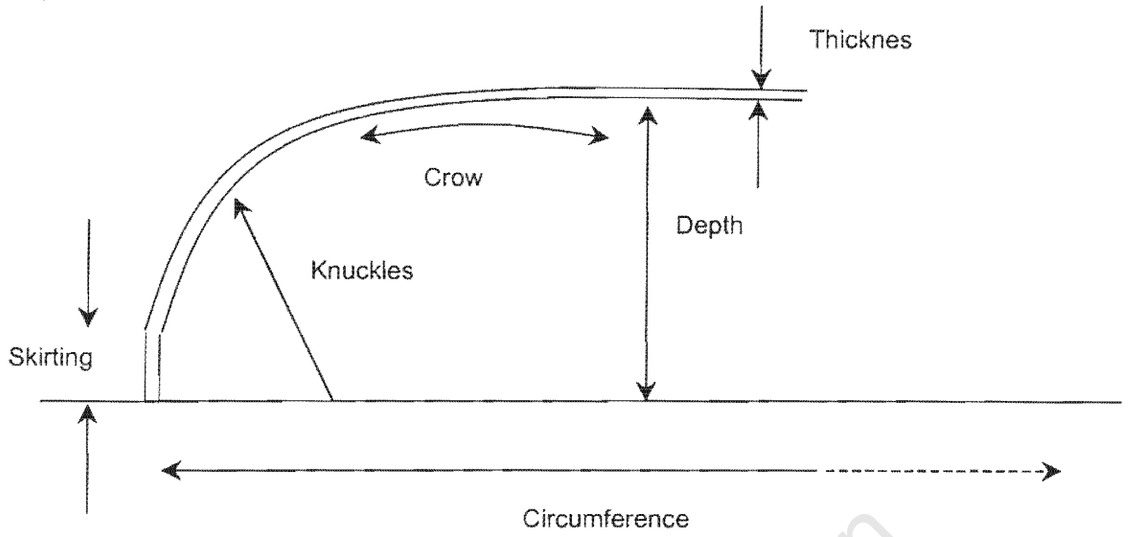
Often do according to their standards and resistant to change.

Fait interessant: Les autres ingenieurs n'ont aucune idee des autres competiteurs dans le monde!

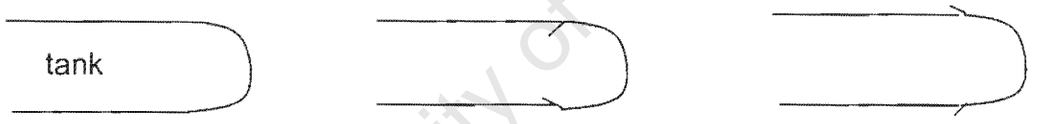
FIRST PROBLEM: Radius of curvature of the cover

- There are 2 machines for making these tanks' covers. And since *CE* has no limits on the different sizes of the tanks, there are too few jigs for the different models of the tanks. There are 2 types of machines that fit the covers on the shell.
- It also seems that the 24,000 litres has the more problem than the rest.

Appendix D: Field Notes



- The shape is more of a combination of all 6 properties but based from Tony (manager of supply shop), it looks like it is the circumference and shape (not measurable = not quantifiable), mainly based on gut feeling but problem arises down the line.
- Continuous banging to make the cover fit but it also distorts more when welding. The cover distorts more and more as the process continues.



Correct **Wrong** : Overknuckled Underknuckled Head

On the standard line

Welding/fitting head to shell

- Measuring the circumference of the tank seems arbitrary especially when the measurements are of the order of mm.
- Time and resource consuming process when the fitting of the "head" is by trial and error. (The welders often perform mathematical calculations to discard the very badly distorted ones)
- The Quality inspectors' work is very badly done as measurements differ. The shop floor has to continuously check the measurements of the works.

- There are 2 "machines" that are used to fit the covers to the shell. Machine A is looked upon as easier to fit covers as there are more uniform pressure to squeeze the covers to the shell whereas machine 2 relies more on the experience of the operator.
- Some delay in the supply of materials in the spinning shop to make the heads
- Main problem is overknuckle rather than underknuckle. Overknuckle cannot be fixed as the characteristics of materials change more as the welding distorts more the material.

On the special line:

- The barrels are not to size. The ends differ, as it seems that there are different factors that affect the bending of the metal sheets.
- Supply shop always give them 1 extra cover as they expect that one out of seven will not fit the barrel.
- The special line thinks that the standard line is only doing their job to get rid of them of their "special" job.
- Quality of the covers depends on the operator's experience. The defect rate is periodical (about every 3 weeks)
- New way of welding? Less heat generated implies less distortion?
- Misalignment of plates
- Storage problems that causes the barrels to be scattered all over the yard. More prone to damages
- Double clips are used to ensure that the measurement of the barrels is done accurately.
- Welding of plates differ on the thickness of plates
- No communication between shell and head section? Only when there is HUGE differences?
- Slight implementation of accountability of the operators?

Pas d'ordinateur pour les mecs sur les machines?

Summary of week 20th of March to the 23rd of March

There seems to be problems on the dish ends and that is causing major problems on the production line. The main problem seems to come from the customers' complaints of misalignment of dish ends to head to shell. This has generated a lot of concern from the management at the moment.

Fault is not being picked up by operators as they have the tendency to "pass" the problem to the next station. The thinking is that they can fix my problem.

Parts missing for spinning shop to make dish ends. Then head to shell is left stranded which in turn affects the production line. *CE* produces a lot of tanks of different sizes. The dimensions are quite huge on certain models but they have only 3 dies to make the initial templates for all of them.

Monday the 27th of March

Standard line

- Welding of plates is done unidirectional. Cause of distortion? Defect of the barrel forming station?
- The welders trust the sizes of the plate dimensions.
- The metal sheets are measured individually ensuring a defect free product.
- Machine 2 is more successful in putting heads to shells.
- Greenfield meetings are within each department everyday. No cross-departmental meetings!
- Different end sizes are the result of bad alignment and welding.
- Trust (or laziness) of the operators on what the quality inspectors write on the barrels.

Some results in the interview with Late Johann Smit, production manager of standard line

- Quality inspectors not suited for jobs. Unaware of technical details that is sometimes essential to the correct inspection. Hired in the Dept. at "random".
- Better control with workers as less trouble with unions. Also better in off-peak season.
- Seems that quality inspection at the entrance is quite bad.

- Also quality reports always late. They are of no value adding!
- "New" JIT system. Need a buffer zone to deal with unexpected orders.
- Maintenance department not very effective. Appears only when there is breakdown.
- Not possible to mix inter departmental meetings as the mentality of workers are very different.
- QC collects the daily data but feedback is very slow.

28th of March 2000

Spinning shop

- Quality inspector checks only at the end of the production line
- Every 2 weeks, the workers are transferred to night shift and vice versa. This is to prevent to them from getting bored.
- Knuckling Machine 1 (big one) is easier to take measurements than machine 2 which is higher up on the ground. Problematic to lower it down to perform measurements.
- Small machine (no.2) under-thickness (2/10) Small production
  Big Machine (no.1) knuckling (4/10) Big Production
  Complete opposite from what the operator says
- Flow forming bad.
- No regular maintenance
- Use of template but knuckling gap still cannot be removed

Maintenance dept contains only 1 technician??? (Highly unlikely)
Excess workload on spinning shop?
No paperwork to track down faulty workstation? Seems that verbal agreement is the norm.

29th of March 2000

The knuckling problem has been fixed. The problem was a small gap between the pressure knuckles that wobbles when the machine 1 (the big one) starts to knuckle. Was fixed on the 24th of March

Asked to check if the tolerances of the dish ends lie within the lower limit or the upper limit? And also the barrels' limit of tolerance?

4th of April 2000

- 10 dish ends returned from the special line as it was of wrong sizes. The spinning shop was blamed for it.
  Standard claim that their barrels' end was according to specifications and tolerances.
- Unhappy about the new management as the new ideas of production will be imposed on the operators. Operators and some line managers tend to think of these "new innovative ideas" as just a waste of time. Analogy to a baby that can walk has now gone back to crawl.

5th of April 2000

Spinning shop

- What are the dimensions that have the most problems?
- Frequency of defects?
- What are the main causes? Dish ends or barrels?
- What operators are on duty? Day or night shift?
- Comparison of existing knowledge to that of the engineering drawing
- Why quality inspector failed to notice the problem?
- Also, why has so many Q.I failed to notice the 10 rejected tanks?
- Why is the defect rate fluctuating? Synchronize the work order to increase in defects?

11th of April 2000

- Out of 10 dish ends don't fit with their barrels. (Wrong dimensions)

Work order 9327

(1) 6277	6281 mm	(+4)
(2) 6276	6280 mm	(+4)
(3) 6276	6279 mm	(+3)
(4) 6278	6283 mm	(+5)

- Need to investigate on the "hospital"
- *CE* interested in quantity not quality
- Different cultural background affects control or leadership
- Supposedly, "colored" people have problems obeying people of same color, like a line supervisor with his operators.
- Line of production designed for 12? But trying to pump 22?
- Competitor coming in soon. Rumors of Chinese company coming in the market!
- Rumeur d'une prise de contrôle par la Chine compagnie
- Production line loads different types of tanks because of different work orders
- Spinning shop has a buffer of about 3 work orders
- Huge amount of tanks lying outside in the yard

Johann Fourie, line manager of Head to Shell

- Planning and scheduling of work badly done. Not helping production
- Suppliers problem, mainly internal – lack of accountability
- Should have no problem with the different size in barrels. Last plate is machined off.
- Buffer of at least one week's work in the yard (about 60 tanks outside not one week's work order)
- Still think that the measurements of the metal sheets are recorded.
- Doing some admin work, just to ensure that accountability of work
- Marche sur la ligne de production – rouleur publique bon?
- Contract dept not talking to production line

Michael Heynes Master Schedule

Fritz Procurement

12th of April 2000

- Precision tolerance +0, -2mm
- Clamping pressure not uniform when welding.
- Possibility of getting some German engineers to fix the flow forming machine due to problems?

Shifts (day)

Monday – Thursday	07 00 – 16 45 (50min official break + 60min)	4.52 tanks
Friday	07 00 – 13 00 (20min official break + 60min)	2.95 tanks
Saturday – Sunday	07 30 – 16 45 (40min official break + 60min)	4.90 tanks

Shifts (night)

Monday – Thursday	19 00 – 06 15 (50 min. official break + 60min)	6.43 tanks
Friday	19 00 – 06 15 (50min official break + 60min)	6.43 tanks
Sunday	19 00 – 06 15 (50min official break + 60min)	6.43 tanks

TOTAL = (4.52*4) +2.95+(4.9*2)+(6.43*4)+6.43+6.43 = 69.41

Theoretically, they should produce 69 tanks but 60 tanks should be good enough per line. Running two lines for day and night shift, they should produce 120 tanks per week but they are only producing 64 tanks per week. (53% productivity)

13th of April 2000

- Interview with Marks, the liaison "officer" between Competitive Dynamics and *CE*
- Aim of competitive dynamics: share the same vision and have the "correct" environment to be work. Quality work is the key word.
- Properly received? Not really. Operators are very clueless about what that was.
- Key aspects looked at on the production floor are Speed, quality and cost.
- While at a higher level, there is a drive to produce a mini business goal/idea to make them aware of what are the possible current situations.
- September – October is the time where the company functions on skeleton staff to reduce overheads.
- Workers are difficult to motivate.
- Most of the time, Fridays are quite bad as they get paid on Thursdays and they tend to get drunk and then fight for more pay.
- MDT1 (line supervisors) have daily meetings while MDT2 (line managers) holds meeting weekly.
- Possible cause du probleme de la Co. Tous les torts sont mis sur le defunt. Il ne donnait pas de plan pour la production.

- Sudden change of plate thickness from 6.7mm to 5.8mm. (harder to mould)
- The problem in the spinning shop is due to "racial" problems? Some people' mistakes are covered?

18th of April 2000

- Looking at day shift only, they should produce 23 tanks per line per week = 46 tanks per day shift per week
- But in real life, they only produce 27 tanks per week.
- Friday the 14th, another meeting with the new production manager and the workers. Hope that this time, things was better and that there has been no swearing.
- Rumors of firing of a whole night shift. Putting pressure on the day shift people.
- Spinning shop has a buffer of 46+15= 61 dish ends
- No motivation for workers. Only appears in crisis and it comes in forms of threats.
- Bad S2 – Attitude dominateur du chef de chantier
- Current values – No will to learn. Obsede par l'argent, aucune chance de promotion.
- Blanc gagne 28 par heure alors que colores gagnent 18 per heure alors qu'ils sont meme niveau
- Production of dish ends = 14 if ok, 12 if some problems depending on severity of problem. For Big knuckling machine.
- Pas ouvert aux suggestions, il sait tout savoir (2eme mention)
- Possibility of wrong centering of lug – bad flow forming – bad knuckling
- Machine 2 (knuckling) has less power and therefore takes more time to finish 1 dish end.
- New engineering drawings (those with supposedly improvements) sometimes different from old ones even when that part was not improved.
- Clamping function of the welding machine in Spinning shop is not 100%. Use of cloth to compensate for loss of pressure.
- Probleme sociale d'Afrique du Sud
- HEAD TO SHELL : A guy walks around the yard and writes down the different work order that is lying outside. Continuous update of the tanks out there for contingencies
- Seam welders broke down for about 1.5hrs, then broke down again for 4 hrs. (at least 3 cycle times lost)

19th of April 2000

- Flow Forming
- Done twice. 1st time to get the shape & the 2nd time to get a more accurate dimensions.
- Cannot measure the center of lug. May cause problem to flow forming and knuckling stations.
- Damaged die due to particles found on the plate after splatter of welds of lug. Huge flow forming head then grinds on the die.
- PROBLEM: Dish ends' depth not to standard. (506mm instead of 510mm) Regular problem but there is still no solutions.
- Weld splatter on lug prevents the plate from being loaded on the Flow Form machine.
- FF machine has "copy" function but it has never been used nor fixed for the past 10 years the least.
- Maintenance is quite bad. Fix something, breaks down the next day.
- Bogey tracks laid down last December but never used.
- No meeting with managers for the past 10 yrs.
- No Quality, Speed, Cost, Morale (QSCM)
- 5th of May, another meeting with Alan Caldwell, the newly promoted production manager.
- 4weeks ago, there was a rush of orders but now things seem to have calmed down.
- Rumors of being sold out
- Small knuckling machine' grinding tool get stuck often. Been a regular problem.
- Wooden stick used to "test" if the plate has properly stuck to the die based on its "resonance".
- Suggestion box is in manager's office. No lock on box.
- Some guys who are involved with the problem don't even know the dimensions of the problem.
- One worker is at a station for 6 yrs but never moved. Why? Merit increase of 0.75cts from the Company after 6yrs! Or a 0.5cts increase after 4yrs as in another case!

20th of April 2000

- New target for production line is 50 tanks per week. Working under pressure soon.

- Les represailles du patron sont [illegible]. Il bousille le travailleur le lendemain d'une querelle.
- The queue of workers in front of *CE* has decreased dramatically. WEIRD!!!!
- End of the year bonus non existent. Not a fixed % like I thought. Workers have to bring in unions to fight for bonus.
- Just a day's notice if you are fired. Most often, the worker will know if he is fired when he checks his pay slip.
- Le mec du machine K1 est mar[illegible] du mec de FF
- There seems to be a closer control to have products made according to final engineering diagrams.
- Knuckling machine 2 is less powerful. More time to knuckle and not enough strength to lengthen the thickness.

2nd of May 2000

- Only have 3 dies (21K, 24K, 26K capacities).
- Rumors of whole night shift being fired.
- 2.5yrs ago, *CE* shifted from 6.7mm to 5.8mm (In the 6.7mm, the thickness goes down to 6.2mm while the 5.8mm goes down to 5.0mm). Quality goes down but price goes up.
- Wrong dimensions sent to the 2 departments. (spinning shop and head to shell section)
- Big knuckling machine was stripped for maintenance during the long Easter holidays. Only the lower hydraulics part (the loading of the plate section) was done.
- Under depth as a result of bad flow forming?
- Change of shift: 3 guys from previous shift remain unchanged. Why?
- No scale on grinder of knuckling machine.

HEAD TO SHELL

- 4 dish ends returned. Dish end too big. (+6mm)

Work order 2254: 7326 and 7332. Waiting for outstanding dish end: 3 of them.

- End of June, > 30% of workforce will be retrenched. Target is now 46 tanks/week

Recruiting of workers in August again. (1) Possibility of a raise So fired people in advance (2) Dip in work order.

- Promotion not based on experience but outsource.

- Difference de salaires pour tara vailleurs de couleurs
- If dish end does not fit, call QC of spinning shop to verify the dish ends. But QC lies to protect himself.

QUALTY DEPARTMENT

- 56% of finished products are reworks. Not really differentiated in major rework or just menial jobs
- 140 (out of 310) defects are as a result of poor workmanship, 49 on client details and 37 not in stock.
- Lack of proper training (5 year apprentice is now reduced to 6 months)
- R 25,000 paid as salaries for the people in the hospital section. Extra costs are overheads like rental of equipment, cost of materials, etc.
- Night shift finished at 04 45 instead of 06 25. More than enough time to finish allocated work.

3rd of May

- About 50 (53%) tanks per week for whole day shift only. But only 8 tanks are produced daily, resulting in only 44 tanks per week. They are supposed to have 94 tanks!
- Elimination of Saturdays and Sundays except in emergencies.
- Reworks per month

  January = 336
  February = 1044
  March = 2345
  April = 2935
  May = 182 (after 2 days)
- Percy Crocker, the Quality manager is a specialist in welding. He had given courses in welding at *CE*.

4th of May

- Why Part Number 25257, Work order 2249 fault was reported twice? 7 minute difference?

- Why is NCR (non-conformance Report) never properly filled up? Line manager should have filled it up!
- Over-knuckle – outside the size. Better than under-knuckle. Impossible to work on it if too small. Distortion when correcting mistake.
- 30 Million saved by firing 3 directors and when the other sections like pressure, food and beverage, bulk tanks are sold off, money is also saved. 38% of workforce fired by end of June.
- 18 out of 22 (81%)
- 8/10 (day shift) and 10/12 (night shift) but a lot more incomplete. Night shifts quotas also impact on the day shift.
- Past 3 yrs, profit of at least of 25 Million rands. Tremendous growth of market has occurred over past 5 years. But so is the volatility of the market, 3 months change.
- Management structure unclear. S3 going into S1.
- Pressing may reduce the errors of knuckling but it is more time consuming than flow forming.

DISH ENDS

- Depth ± 2mm
- Inside circumference +0, -2 mm
- Alan Caldwell had a meeting with the employees yesterday instead of tomorrow. No advanced warning. Whole spinning shop didn't go!
- QC cannot have standards for knuckling because operators don't give it to them. All dish ends are made according to the experience of the operators.
- Possibility of increase in damaged tanks as uncertainty of jobs is also increasing.

8th of May

- Spinning shop coming to a stand still as they are not supplied with plates. Monty, the line manager of spinning is also the manager of supplier side. S2 break down even though production is fully booked till end of June.

- Monty was before (today) concentrating 90% spinning, 10% supply shop. Now, it is the other way around.
- Double productivity in 98 but no merit.
    - *CE*'s salaries are better than other companies.
- Maintenance department have about 25 people (including engineers)
- Only lower part of knuckle machine 'maintained' and top part will take more than 4 weeks.
- Main maintenance problem is spinning shop with huge machines. Mainly mechanical parts that is quite complex.
- Knuckle gap is dependent on % of tank size.
- Only 1maintenance guy for nightshift. All works are transferred to the day shift & production suffers. Also 1 manager for the whole plant at night shift.
- Social dance set up by *CE*.
- 28% of world market at the beginning of year 2000. Best level was 32%.
- Always have to work overtime to supply both production lines at night.
- Meeting by Alan Caldwell for one shift only. Twice the same shift!
- FROM Maintenance guy: Trencor has only work till end of June.
- Threat of a national strike on Wednesday 10/05.

09 May 2000

- No support by company to do further studies. Encouraged to take loans at banks because leaving company afterwards.
- 10 years ago, 40 % of market share. Now, 22-18%? (Based on Marks)
- No allocation of budgets – autocratic rule
- Previous production director was out looking for customers. This adds up to the existing production schedule. Promises of slack time to workers not held.
- 16 tanks "lagging" off at head to shell and 50 at the final fit (34 tanks missing on the line)
- Input ≠Output. How did this happen with all the cycle meetings?
- Putting up green area equipment at special line.

11th of May 2000

- Hier, avec un etudiamt de Tom. Il m'a dit qu'il vend des programmes au department de maintien. Un nouveau "upgrade" du produit sur la relevance des programes du maintien.
- Green area meeting is still on hold to be built in spinning shop. Due to restructuring of lay-out, no area was allocated for it.
- Tracks laid down in spinning shop unsuccessful due to small gap between the grinding stations (no. 2) and the wall.
- Notice of retrenchment shown on the day of strike (?)
- When welding, the fit is known only when 3//4 of the whole dish end is welded. But before that, the welder measures the barrels & circumference of dish ends. If difference is 4mm bigger, then dish end is rejected. If difference is < 4mm, there is an attempt to squeeze it in.
- The welder teaches his helper his welding techniques. Informal training.
- Saturdays & Sundays. Not all lines are running. Only the bottleneck areas are cleared. So my calculations are skewed.
- Had a laxer discipline but did not work. Had to do some tight control.
- La competition avait 3 usines mais 2 ont fermes depuis 1999. Seulement un seul est ouvert.

15th of May

- Unclear of who falls under what department. Spinning shop returns to who?
- Rumors of about 400 workers being retrenched from a 1,200 workforce.
- Most problems seem to be barrel sizes and no dish ends.
- No feedback from reports about barrel sizes.
- Monty does not attend cycle meetings. Rumors of him being retrenched.
- Target boards set up in spinning shop. Looking for reasons to fire people?
- Updated status: Head to shell = -17 and final -39
- Supply system seems to be in disarray
- Cycle time of about 35minutes for BIG K and 55min for small k. Grinding and polishing takes about 35 minutes also.
- Workers slaving for their place with rumors of retrenchment.

- Before the 19th of May, workers have to decide whether to accept the severance package. Rumors of people above 55 are going to be fired.

16th of May 2000

- Faits troublants: Plusieurs managers n'ont reçu qu'une education primaire!!
- Poor workmanship not penalized. HR probably don't have records.
- Human resources should be accounted for warnings & not production people. Human resources are specialists in that field. (193 out of 480)
- Team leaders take a lot of punishment from management before resigning. This has happened when fellow members elected a "pal" to be in their team leader.
- External people come in & take high-end jobs. Blocking promotion chances to team leaders.
- Commitment must come from top management and NOT the other way around.
- Number of tanks in yard and work available in company
- Cultural differences make *CE* difficult to manage.
- Feeling of more complaints but data reveals less.
- Mafia elitism

17th Of May 2000

- Promotion done based on preferences
- Head to shell –22 and Final fit –35 (33days left). Deadline 24th of June
- Day shift provides supplies to night shift. Set up, etc.
- No freedom of how team leaders manage. Especially from top management
- Positions created not from merit. Maybe retrenchment is good.
- People unaware of toll free line complaints
- Misinterpretation of eng. Diagrams. Barrels rolled up the wrong way?
- SA law: Must retrench all the contract workers before firing permanent workers
- Why is head to shell being split? New manager created to supervise that position
- In the past, they once had a record of 111 tanks/week because of a promise of 5 week bonus. But it was never paid out as the director of production was fired.
- TQC failed. Why?

- Continuous shifting of workers at some station. Threat of warnings but never followed upon!
- Cycle meetings are a waste of time (according to Ray)

18th of May

- Building an info system. Corrective action taken later decided by Quality managers and managers
- Quality inspectors are ISO coded!
- Continuous changes in order. How aware are they of business trends, e.g. chemicals in Russia, etc.?

23rd of May

- Target boards in spinning shop to monitor production. Why not used throughout the year?
- Head to shell: -20 & -29 (28 days left). Last week's production 80 tanks. Never achieved before?
- Absenteeism still about 20 per day (total of 304 people) 6.57 %
- Need to clean the company due to visits of new customers. 4S need to be implemented.
- During the past 4 years, 2 directors promised bonuses but they did not hold on to their promises.
- 5 million Rands fine last year due to late delivery. But no fine for customers.
- Rumors of 40 gas tanks per week.
- Welding Manager got fired on Friday the 19th during a meeting.
- Flow forming head cracked. Ordered for a new head!
- Smaller budget for QC for next year
- Blaming the other shifts for low productivity
- Competitive dynamics not really bought in. Lot of impractical theories
- Accepting all orders before. Things are changing with "new guy in town"
- Profit will be shared
- Suggestion box at team leaders
- Permanent staff lazier. Contract workers are keener to work. Retrenchment is not that bad as most of the staff will be transferred to special line and gas tanks

- Maintenance is unhappy with the other departments. Blaming production for breaking machines and Production blaming maintenance for not fixing machines properly

29th of May

- 5 days, 6 times out of order on new machine that *CE* has paid for R60,000
- 4 QC absent out of 13 in day shift and 12 at night shift
- Usage of abrasives increased dramatically. In some stations, the extra cost has increased to about R1000 per tank. DON'T CARE ATTITUDE
- No decent control of raw materials, e.g. the abrasives for tanks are not classified into parts (e.g. food tanks, chemicals, etc.) Stock taking very difficult to make. The figures in the stock and the sales are different. 3M is helping *CE* to sort out their sales.
- 2 years ago Ian Price came in and took all the privileges away (like milk, hot soup)
- Also NUMSA has "come in" 2 years ago. Decided to have the wages discussed externally but other unions are trying to have it done internally
- Supplier 3M tries to keep *CE*'s expenditure on abrasive according to their theoretical target. If the number increases, they try to find the problem to solve it. This is to reduce the risk of *CE* going to other competitors in an attempt to reduce costs.

5th of June

NOT BEEN TO *CE*. Worked on campus

6th of June

- Prototypes on line are creating huge gaps. This was supposedly a week to try to push out backlogged tanks but by putting a new prototype on the line, this has decreased the total output of the tanks at the end of the week

7th of June

- Figures on tank output vs. total available productive time is sometimes wrong because night shift people do not work on 2 lines but one. Industrial engineers do not know about this problem unless being told by team leaders. Calculations are then wrong.

- Problems happening in frame shop concerning the new tank HO3. Problem in manufacturing the parts
- New tanks running on the line full capacity with no pre-trial run
- *CE* has supplied hot soup before but removed that about 2 years ago.
- Lotus notes are used to keep a detailed report on defects but system failed because simply there was not enough PC for the team leaders and line managers to fill in the forms. There is still a lot of paperwork that is used to transfer data.
- Supervisors "lose" their workers if they lend it to others.
- No proper planning from engineering to production. Thickness of plates reduced from 4.6 to 4.4 mm.

Meeting with new production manager

- 2nd week in position. Captured problem areas. Aware of production needs, different attitudes to production line
- Availability of forklifts (from coordinating department). Push supplies to us and not us pulling supplies. Use of kits to solve problems of parts missing?
- Sole responsibility – (means accountability)
- Maintenance – work until problem is fixed
- Planning – on time

12th of June

- Alan Caldwell is setting up a list of complaints daily, compiled it weekly and then send it to relevant managers. Done that for 4 weeks but only got reply from 1 guy.
- Circumference main control of knuckling of dish ends
- Problem of circumference mainly for special line

Interview with Manager of Supplies

- No planning schedule and communication among department
- 10 days of lead time prior to head to shell
- 15 days for special line lead time for cutting list
- 80% productivity overall

- main concern – Peaks of variation
  Absenteism
  New machine breaks down
- HO1 problem tank
- Customers control peaks – change customers needs
- Accountability based on throughput and not activity based
- Overtime – Raw materials not on time
- Prefer labor brokers – attendance better
- Things that are not tolerable are (1) Quality (2) time (3) Interdepartmental communication

14th of June

- Introduction of automated machines will make the post of 15 grinders redundant
- 15% of market share before – now it is 25%
- Production line initially designed for 12 tanks per day. Now ideally targeting 22 a day but making about 18 tanks a day
- Graphs for days lost on sick or unauthorized leave for May was printed out and given to team leaders.
- Stan, the night manager got slapped last Thursday and that has prompted a search for alcohol, as some workers seemed to be under the influence of alcohol. Search resulted in nothing.
- The MD called industrial engineer for prompt installation of new grinding machine for July, as the production line's new budget has not taken into account the workers. Nobody knows where the new machine should go with the leave of Jaro.
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Interview of sales manager

- Initially, the sales people take orders from customers. Then ask for design engineers to decide if the customers needs' can be made on the line. Then he decided whether the tank could be manufactured on the standard line or special line. The next stage is acceptance of work and cutting list is drawn out and given to the respective departments. There is a lead-time of 10 days for standard line and 15 days for special line. There is a

preempt engineer who tries to solve the problems that the operators can experience and tries to reduce them.

- Huge diversity of products is not that bad. About 6 tanks with different sizes. Variation of sizes but not model.
- Forecasting is based on previous' years data and also on pre-booked orders. Still have a couple of fixed tank orders from regular customers.
- There is a certain drive for more complex tanks as it is more expensive and that will bring more $$$ to the company. But profit sharing is across the board.
- Defects are mainly production problems: welding, buffing, cladding.
- Regular meeting with other departments seemed to be held but no discussion of real important issues
- 2 major international forums per year, one in the US, one in the Netherlands. Gradual increase of market share. 25 – 30%
- HO2 tanks were designed according to the customers' needs but the customers rejected it when it was made. Tank has been scrapped!
- Prototyping of HO3 tank took 8 months from design to manufacturing. New tanks will take time to be made as operators have a steep learning curve to undergo.
- This year's order rate was very bad.
- Scheduling is done based on (1) Budget of production lines (2) Production capacity (3) Delivery
- Having taken decisions on certain aspects in the past. Now have to stick with it and ride out the storm.
- Regulatory systems to try to reduce their number of orders are not really possible as the customers dictate the work orders.

20th of June

- Spinning shop was redesigned 3 months ago to improve process time saving and process flow.
- Continuous juggling with quality and quantity
- Buffer is good to have in cases of emergencies

- Huge buffer being built at spinning shop as overtime (Saturdays and Sundays) are being eliminated.
- Marketing strategy boasting the strength of *CE* as competitors are closing down.
- Huge disciplinary action looming due to rumors of drunkenness, drugs, corruption (kickback from suppliers, team leaders and labor brokers)
- Last Thursday, Stan the night manager got slapped for wanting to fire a drunken guy (suspected it) and a contractor got stabbed and beaten up. Canteen also got broken in and chickens were stolen.
- Metal detector broken and not being repaired for the past 3 months.

Interview of Premept Engineer

- Big Boss places order with contract engineer who then sends the order to draftsmen. After completion, it is sent to the process engineer who checks the cutting list, drawings, etc. The whole process takes about 3 days. The planning is done based on a Materials Requirement Planning (MRP) system.
- Component shop does not like to work according to drawings.
- Mix of tanks important as design of production is done for one specific tank
- No huge difference for more complex tanks. Workforce is paid for 80 tanks/week no matter what quantity they produce.
- Next target for production is 80 tanks
- EIR (engineering incidence report). Afraid of giving it out. Fear of reprisal
- If same mistake is made twice, then PUNISHMENT otherwise, it is fine provided that there was some learning behind it.
- 4 people (draftsmen, pre-empt, process + boss) discuss tanks with modifications.
- Only 1 pre-empt person is left out of 3. Now, he is concentrating on the cutting list only as this is where most faults occur. (The drawings should be more concentrated for less specialized persons! Engineering drawings are given to operators who might not have been taught how to read these diagrams.
- Multiple perspectives from all for new tanks.
- There is no specific time on design of new container tanks for the two international shows.

- No time for small changes in the tanks to be monitored. Only completely new tanks will be monitored. Any change on tanks will be run and checked as production goes on real time.
- Notes are made on the designs & cutting lists when sent to other people. The design engineer goes to cycle meetings to warn them about it.
- Use of lotus notes fully to pre-empt mistakes
- *CE* tanks are competitive as they can supply the number of tanks ordered as well as on time delivery.

21st of June

Interview with Maintenance Engineer

- Maintenance engineers do all the technical aspects in *CE* from basic maintenance to designs and implementation of jigs.
- Staff reduced from 48 to 32. (Thinks that there is a distribution of workers to the numerous departments)
- Maintenance program deals with recording only, not much flexibility to do preemptive maintenance.
- Wrong people at certain key positions. (1) Not qualified to do some jobs. (2) Buying machines from unknown company. Wrong specifications given out?
- Maintenance is easy. Change of lubricants, filters, etc. every December. But problems are mainly bad usage of machinery from operators, not understanding of costs involved for repairs, etc.
- No coordination among departments for achieving targets. Maintenance could have solved problems cheaper.
- Badly trained operators
- Production line capacity has been exceeded. Cannot sustain for long periods of production. 12-14 tanks per day on initial design but with modifications, production is supposedly able to produce 14-16 on the long run. Now, the target set is 22 tanks a day. Strains workforce as well as machines.
- No self-organizing structure! No regular meetings after departure of Ian Price.
- Cost cutting (based on retrenchment and cut in budgets) will make each department more aware of cost involved and be innovative to reduce costs.

- Extra work is passed on to maintenance dept.'s budget to install machines, etc.
- Competitive dynamics concepts logical but not worth the money paid to them.

22nd of June

Interview with planning Engineer

In 1995, 11 days are needed for 1 tank to be completely manufactured.

- Head to shell area, create a buffer of 2 days.
- Control is the ability to communicate to others
- World Class product with low cost equipment?
- Proactive approach maintenance. Pre-checklist before shifts start
- Distinct lack of supervision and enforcing of discipline at shop level.
- Should have partnership relationship among workers and supervisors
- No planning for 22 tanks from other departments
- Sales department (sales program) gives planning department the work for the next batch
- Fairly inflexible manufacture side (product mix). Fixed machine, certain amount of capacity (unknown)
- 3 weeks ago, Production of HO3 tanks. No prototyping
- No government subsidy
- Human problems as one main problem in supply. Resistant to change
- Start the use of Lotus notes again
- Workforce (contract) not really qualified. De-skilling the work just to fit the workforce
- Use of a Prof. from UCT to try to look at the market trends but somehow the plan did not go through.

Interview with pre-empt engineer

- Standardize all parts so as to reduce the chances of errors from operators
- Outsourcing of certain departments
- Delivery time, Quality and cost are the main factors that makes *CE* competitive
- Mix on line strains supply. (This requires co-ordination and communication among departments)

- Non-mix does not support supply. (Certain workshops are not designed to produce a certain product at high volume. It survives on product mix)
- Design of workers' work area
- Weight is one important aspect that sales department can use to have a huge market share
- Not a lot of breakdowns
- No re-assessment of work conditions nor work areas and modifications of new parts on tanks
- No regular meetings of maintenance (3 years ago). Andre Kritzinger held these meetings before
- Public notes of problems have started to reduce the problems. More keen to save one's name from being tarnished
- Cape Town's productivity is low. Lot of whining from workers. Example is the worker is being fixated on one position!

27th of June Interview of Line manager

- HO3 tanks are designed from dish ends. If DE are not accurate, the problems for standard production line.
- 10 days of prototyping but 11 days for 1 tank to be finished completely.
- Told everyone (& everyone knows that the DE are not good enough)
- Night shift always more defects. Lack of supervision.
- Promise by De Freitas to give 100% defect free DE
- Range of tolerance for DE too big.
- Not enough skilled workers.

Spinning

- Lots of pinholes on dish end. Possible area of problem is welding of lug. Not enough spray of anti-splatter.

29th of June

QC department

Appendix D: Field Notes

- NCR problem raised. 3 problems in 3 months. But no real increase in defects
- Change of settings to speed up, especially for night shift.
- Not 1 single case won on court. So, lose trust to the "warning" system.
- Lots of tip-offs from Deloitte and Touche on *CE*.
- Prompted investigation. Example is the use of personnel to do personal job but still paid by *CE*.
- Yes, involved with Design department. Easier to do as compared to HO1
- Absenteeism plays a major role in delays of production.
- New line manager not capable of work.
- No multi-skilling. So, there is no capable person to do the job. 22nd of May, batch of 25 HO1 tanks, then 24 more.
- No replication of cycle meeting in supply shop or any other working system in production
- Computerised system to monitor production/supply lines
- SA companies use 2.2% last year for training as compared to 1998 they spend 1.7% only. (DIE BURGER 29/06)
- Competitive Dynamics fall through!