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**The Development of a Systemic
Inquiry Framework and its
Application in Developing New
Understanding Regarding Feedback
and Communication in a
Manufacturing Environment**

A Research Report submitted to the Faculty of Engineering Management,
University of Cape Town, in partial fulfilment of the requirements for the
Degree of
Masters in Industrial Administration

Peter F Bauer

DECLARATION

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements of the degree of Masters in Industrial Administration at the University of Cape Town. It has not been submitted before for any degree or examination in any other University.

University of Cape Town

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ABSTRACT

The context of this report is a manufacturing concern that supplies accessories to the clothing industry. With the opening up of the South African borders and the removal of inherent restrictions it has become an environment that is very competitive and dynamic.

It had become necessary for an analysis to be done of the business and to establish exactly what the restrictions are that are hampering the business from developing and progressing.

It was necessary to develop an inquiry framework that would assist me to assess the situation, as current business practices did not support me in this changing environment.

The development of the inquiry framework represents a two-year learning process culminating in the development of a philosophical inquiry framework. It examines various methodologies available and stimulates a questioning of beliefs to help assess problem situations. The framework is broad so as to be useful at all operational levels, not just in a manufacturing concern. This inquiry framework or guide was then applied in a real situation to test it for application.

In the application phase the framework is taken through two cycles to assess its worth and effectiveness.

The first cycle examines the process of information feedback and why it does not have the desired results. An answer is proposed and implemented and the results tested.

This process took 3 months and involved the following process:

- The current situation was unacceptable to the owners, as employees did not respond to information being presented to them. There was a perception of carelessness amongst staff.
- There was a concern that the business (even with all its processes and measurements) was not performing to standard. This meant that there was a shortcoming and this needed to be identified.

- With the ongoing feedback and information being provided and having been provided for so many years it was necessary to question why the expected results were not apparent?
- A possible answer was that data being fed back had to be changed into relevant information.
- The use of the inquiry framework enabled the strengths and weaknesses of the system to be identified and to test the validity of the possible answer. Applying the methodologies linked with systems thinking allowed for an in-depth analysis of the operational system.
- The change in attitude towards the information being presented and the results spoke for themselves.

In the second cycle a new question arose as to why the learning in the first cycle had not been self-sustaining? The result was only a temporary success and as such needed assessment. In this second cycle the learning or instruction process is questioned and evaluated. This led to an intervention with a predicted result. The outcome brought about change in the organisation, the role players and the facilitator. The process took another three months and involved the following:

- After the implementation of the previous cycle's answer there was an incident that highlighted that learning had not taken place. Even though feedback was now understood, there was disunity.
- A concern was that even though the feedback was being understood there was no synergy.
- It was necessary to question why was it that even though people "understood" the process and the functions within the departments there did not seem to be real understanding and how does one impart understanding and learning in such a way that it remained pertinent?
- The process, which was then followed, was to swap people around in their functions and their roles to provide them with first-hand experience.
- The rationale for this was that the inquiry framework guided the thinking in the sense of questioning all previously held preconceptions.
- On reflection it was apparent that the change in attitude between people and the new understanding that developed, was what made this a success.

The document takes the following format:

Chapter 1 looks at the background of Systems Thinking and various methodologies.

Chapter 2 looks at the environment and the manufacturing process.

Chapter 3 develops and looks at the methodological inquiry framework.

Chapter 4 looks at including the philosophical level to the inquiry framework.

Chapter 5 and 6 describe the two cycles of the application of the inquiry framework.

Chapter 7 is a reflection and evaluation of the application process.

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CHAPTER 1

This chapter looks at the concept of systems thinking and its development through the years.

SYSTEMS THINKING HISTORY

System concepts and methodologies have been developed as a response to the ever-increasing complexity of socio-technical and managerial systems.

Systems' thinking has developed over a number of years and is not a new "Science" as such. Aristotle's statement: "The whole is more than the sum of the parts" is a definition of the basic system problem, which is still valid. (L Robert 1978)

A number of disciplines have emerged in the twentieth century that can be classified under the general heading of "system thinking." These originally separate disciplines include the following:

- The biological philosophy of Ludwig Von Bertalanffy, and his concept of the "Open System"
- Norbert Wiener's formulation of Cybernetics
- W. Ross Ashby's related work on machines that are claimed to think and to learn and, stemming from this work, the concept of feedback and automation.
- Information and Communication Theory, based on the work of Shannon, Weaver, Cherry and others, on the theoretical, mathematical, and linguistic problem involved in the transmission of messages over message-carrying circuits.
- Operation Research, which first emerged fully-fledged in England during the 2nd World War under the leadership of EC Williams.
- The Game Theory of Von Neumann, computer simulating social and environmental process.

Technical and scientific advances in various fields led to the development of new disciplines. Within a given period, the overall framework or point of view of the field remains fixed and stable; scientific work usually consists of applying and elaborating concepts that are taken for granted. New work is done and new discoveries occur without overthrowing the general framework or point of view. But at some point discoveries occur, the implications of which are "revolutionary" in that they suggest the overthrow of the paradigm or general conceptual framework within which scientific work has been done.

The system thinking assumed a revolutionary worldview, i.e. to take the world as:

- Organisation
- Whole
- System

not as in the basic categories of mechanistic and positivistic philosophy in which life was an accidental product of physical processes: the living world appeared as a product of chance (Stephen C. Pepper).

To deal with order or organisation, there were two highly successful principal ideas.

- One was the comparison with man-made machines, the comparison of the make-up of the parts that make up a whole
- Another was to conceive of order as a product of chance, as expressed by the Darwinian's idea of natural selection.

The fight on the concept of organism in the first decades of the twentieth century indicated increasing doubts regarding the "paradigm" of classical science, that is, the explanation of complex phenomena in terms of isolateable elements.

In the late 1920's Von Bertalanffy proposed a concept of "organismic biology" in order to provide a complete explanation of the vital phenomena, which any single part and process cannot provide.

"The property and model of action of higher levels are not explicable by the summation of the properties and modes of action of their components taken in isolation. If, however, we ensemble of the components and relations existing between them, then

the higher levels are derivable from the components”¹. That is, in order to understand an organised whole we must know both the parts and the relationships between them.

Many discussions of reductionism were ill adapted to deal with “relations” in system; they were concerned with one-way causality or relations between two variables. Even though the problems of “system” were ancient and had been known for many centuries, they remained “philosophical” and did not become a “science”. Being a Biologist, Bertalanfy proposed the theory of “open systems”, that is, systems exchanging matter with environment as every living system does (George J Klir 1972).

Inspired by Wiener’s work, the cybernetic movement became ever more influential and the basic model, as feedback and dynamic system interactions, were of wide applicability in many different disciplines.

GENERAL SYSTEMS THEORY

General system theory consists of three parts: Systems science, systems technology and systems philosophy.

System science: that is, scientific exploration and theory of system in various sciences (e.g., physics, biology, psychology, social science), and general systems theory as the doctrine of principles applying to all systems (George J Klir 1972).

In external description, the system is considered as a “black box”; its relations to the environment and other systems are presented graphically in block and flow diagrams. The system description is given in terms of inputs and outputs; their general forms are transfer functions relating input and output. Typically, these are assumed to be linear and are represented by discrete sets of values. In terms of control theory, external description is given in terms of communication (exchange of information between system and environment and within the system) and control of the system’s function with respect to the environment (feedback), to Wiener’s definition of cybernetics.

System technology: The problems arise in modern technology and society, including both hardware (control technology, automation, computerisation, etc.) and software (application of system concept and theory in social, economical etc.) problems.

¹ George J Klir, Trends in General Systems Theory, Wiley Interscience New York, 1972

System Philosophy: the reorganisation of thought and worldview following the introduction of system as a new scientific paradigm. First, we must find out what is meant by "system" and how systems are realised at the various levels of the world of observation. This is systems ontology. What is to be defined and described as system, is not a question with an obvious or trivial answer. It will be readily agreed that a galaxy, a dog, a cell, and an atom are "systems". But in what scenes and what respects can we speak of animal or a human, society, personality, language, mathematics, and so forth as "systems"? Real system which entities perceived in or inferred from observation and existing independently of an observer, conceptual systems which essentially are symbolic constructs, and abstracted system as subclass, that is conceptual systems corresponding with reality. However, the distinction is by no means as sharp as it would appear. For example, when we consider on the interactions of component, a social system is just as real as an animal, or human being. As against reductionism and physicalism, the problems and modes of thought occurring in the biological, behavioural and social sciences require equal consideration, and simple "reduction" to the elementary particles and conventional laws of physics does not appear feasible.

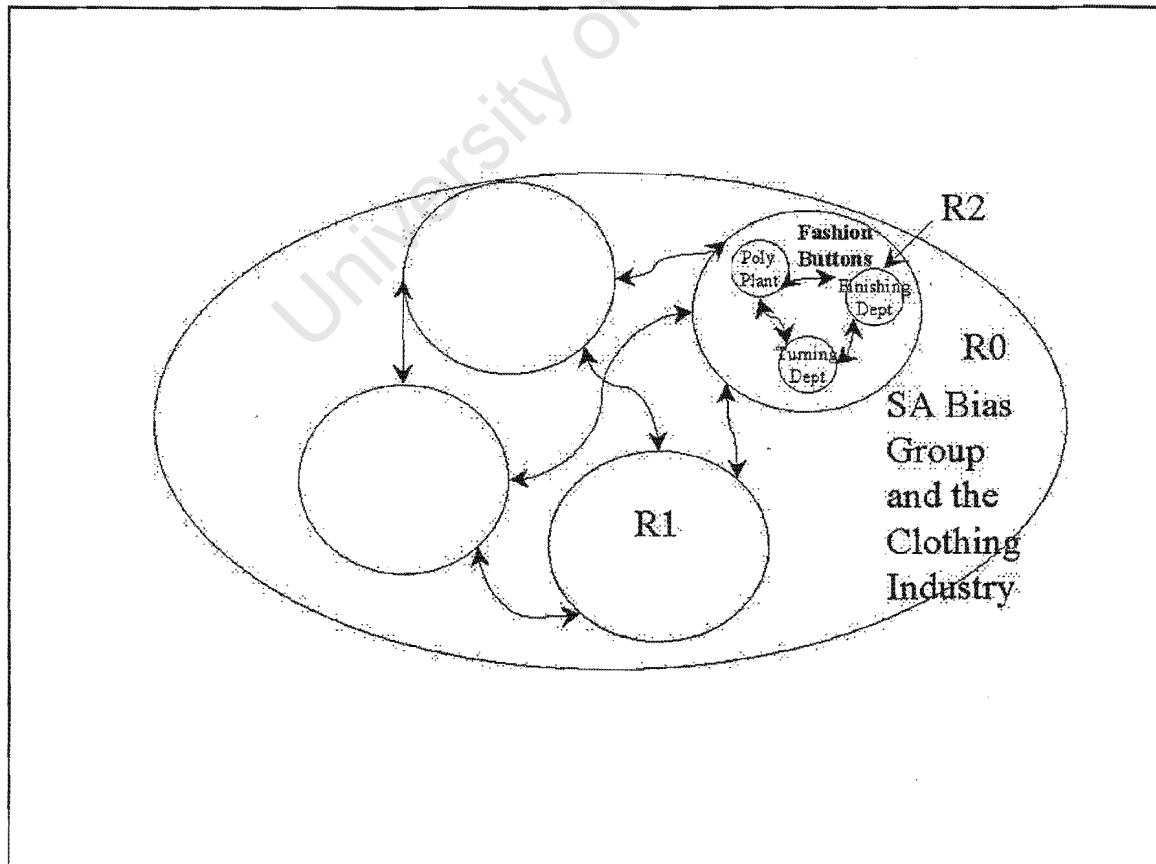


Figure 1 Systems Thinking Theory

In Figure 1, I represent a particular organisation in the classical systems thinking format where:

- R0 - Recursion Level 0, is the containing system or environment
- R1 - Recursion Level 1, is the system in focus
- R2 - Recursion Level 2, is the subsystem or part of recursion level 1.

Many advocate the development of systems thinking - the ability to see the world as a complex system, in which we understand that "you can't just do one thing," that everything is connected to everything else". There are many schools of systems thinking. Some emphasise qualitative methods, others formal modelling. As sources of method and metaphor they draw on fields as diverse as anthropology, biology, engineering, linguistics, psychology, physics etc.

Learning about complex system when you also live in them is difficult (John D. Sterman 1994).

Learning about complex dynamic systems requires tools to articulate and frame issues, elicit knowledge and beliefs and create maps of the feedback structure of an issue from that knowledge. Formal models and simulation methods assist to assess the dynamics of those maps, test new policies and practice new skills methods to sharpen scientific reasoning skills, improve group processes, and overcome defensive routines for individuals and teams.

LEARNING

All learning depends on feedback. George Richardson (1991) shows how beginning in the 1940s leading thinkers in economics, psychology, sociology, anthropology, and other fields recognised that the engineering concept of feedback applied not only to servomechanisms, but to human decision making and social settings as well. Forester, in *Industrial Dynamics* (1961), asserted that all decisions (including learning) take place in the context of feedback loops. Later, Powers (1973,351) wrote:

"Feedback is such an all-pervasive and fundamental aspect of behaviour that it is as invisible as the air that we breathe. Quite literally it is behaviour - we know nothing of our own behaviour but the feedback effects of our own outputs. To behave is to control perception.

- Learning as an iterative cycle of invention, observation, reflection, and action (Schön 1992).
- Learning as an explicit feedback process has appeared in practical management tools such as Total Quality Management.

The single feedback loop describes the most basic type of learning. The loop is a classical negative feedback whereby decision makers compare quantitative and qualitative information about the state of the real world to various goals, perceive discrepancies between desired and actual states, and take actions that (they believe) will cause the real world to move toward the desired state. Even the initial choices of the decision-makers do not close the gaps between desired and actual states; the system might eventually reach the desired state as subsequent decisions are revised in light of the feedback received.

The single feedback loop obscures an important aspect of the learning process. Information feedback about the real world is not the only input to our decisions. Decision is a result of applying a decision rule or policy to information about the world, as we perceive it. The policies are themselves conditioned by institutional structures, organisational structures, and cultural norms. These in turn are governed by the mental models of the real world we hold. As long as the mental models remain unchanged, the feedback loop is what Argyris (1985) calls single-loop learning, a process whereby we learn to reach our current goals in the context of our existing mental models.

Single-loop learning does not result in deep change to our mental models (our understanding, our worldview) of the causal structure of the system. Our world is actively constructed (modelled) by our sensory and cognitive structures. This mental model long ago evolved structures to build these models automatically. Usually we are totally unaware that these mental models even exist.

Argyris (1985) denoted double-loop learning as information feedback about the real world that not only alters our decisions within the context of existing frames and decision rules but also feeds back to alter our mental models. As our mental models change, we create different decision rules and change the strategy and structure of our organisations. The development of systems thinking is a double-loop learning process in which we replace a reductionist, partial, narrow, short-term view of the world with a holistic, broad, long-term, dynamic view and then redesign our policies and institutions

accordingly. Such learning involves new articulations and new decision rules, not just new decisions.

For learning to occur, each link in the two feedback loops must work effectively, and we must be able to cycle around the loops quickly, relative to the rate at which changes in the real world render existing knowledge obsolete.

Much of the literature in psychology and other fields suggests learning proceeds via the simple negative feedback loops.

This leads me to the next chapter in which I describe the current situation that I found myself in and from which the need for an encompassing management tool arose. Systems thinking and the related learning, which occurs, has formed the foundation of the development of a unique inquiry framework which I will develop in Chapter 3.

CHAPTER 2

This Chapter gives you a brief insight into a South African Button Manufacturer. It describes the polyester button manufacturing process. The process flow and the controls within the particular business are described in detail. Sufficient background is provided to give insight into the problem and to highlight the need for the development of a unique inquiry framework, to address the problem.

BACKGROUND

Mr M Girourd who established the original business in Elsiesriver started Fashion Buttons in 1972. Mr Girourds' skills were of a technical nature and in 1986 S A Bias Industries bought him out when the business was in financial difficulties. S A Bias Industries started as S A Bias Binding and was a bias binding supplier to the clothing industry. They expanded by acquiring other businesses related to the clothing industry and are currently the largest accessory supplier to the clothing industry in South Africa.

At the time Fashion Buttons was one of four Polyester Button manufacturers in South Africa. Mr Girourd was kept on as manager of the plant for another three years. Thereafter S A Bias put in their own management team. In 1987 Fashion Buttons moved to its new site in Maitland and currently employs 28 people.

THE CLOTHING INDUSTRY IN RELATION TO THE BUSINESS

The latest figures available for the South African polyester button market peg it at approximately 35 million Rand sales. Fashion Buttons has a 10% market share in the current industry. The small share in the market is mainly due to the fact that Fashion Buttons only provides polyester buttons and not all types of buttons. Sales are also primarily concentrated in the Cape Town market with sales in Kwazulu Natal and Gauteng being incidental i.e. the business is not turned away, but at the same time it is not actively pursued.

The sales force of the sister company is made use of in Kwazulu Natal and Gauteng and the product is sold on the basis of commission being paid to the relevant branch. The product is a hard sell product and very time-consuming to promote. 50000 m of ribbon provides more turnover at 50c per metre than 50 000 shirt buttons at 5c each.

Each order is unique in this make-to-order environment. The colour variations, effect variations and shape combinations make the permutations limitless.

The strength of Fashion Buttons is that:

- It is a small company and therefore fairly versatile and flexible.
- It does not have the limitations of specific length frozen queues that are the case in most other make-to-order environments.
- It has skilled staff that have been with the company for a long period. (This could also possibly be seen as a weakness as it could mean that they are not open to change and are set in their ways).

PREMISES AND LOCATION

Fashion Buttons is located in Cape Town, which is considered to be the heart of the clothing industry in South Africa. The Durban clothing market has over the last couple of years become a major force and a natural split developed in the market, with Cape Town clothing manufacturers producing predominately fashion items and Durban clothing manufacturers producing the mass produced, high volume items. The current low cost imports have hit the South African clothing industry rather hard and there have been many retrenchments, cutbacks and downscaling of businesses, this affecting predominantly the larger volume lower margin end of the market which does not have much room for cost-cutting, except to downsize.

Fashion Buttons' strength is that it is located in the Cape Town market where new fashion ideas start. Some of these items eventually develop into bulk consumer goods, which in turn end up being manufactured in Durban. This means that Fashion Buttons is involved at the inception of a new fashion idea.

The existing premises are adequate for the current needs. The premises are rented and belong to the Iscor Pension Fund. Permission has to be granted from the administrators for any alterations to the building structure and the upkeep of the building is the responsibility of the leaseholder.

Figure 2 shows the layout of the plant with the various production areas, which I will describe in more detail when talking about the process.

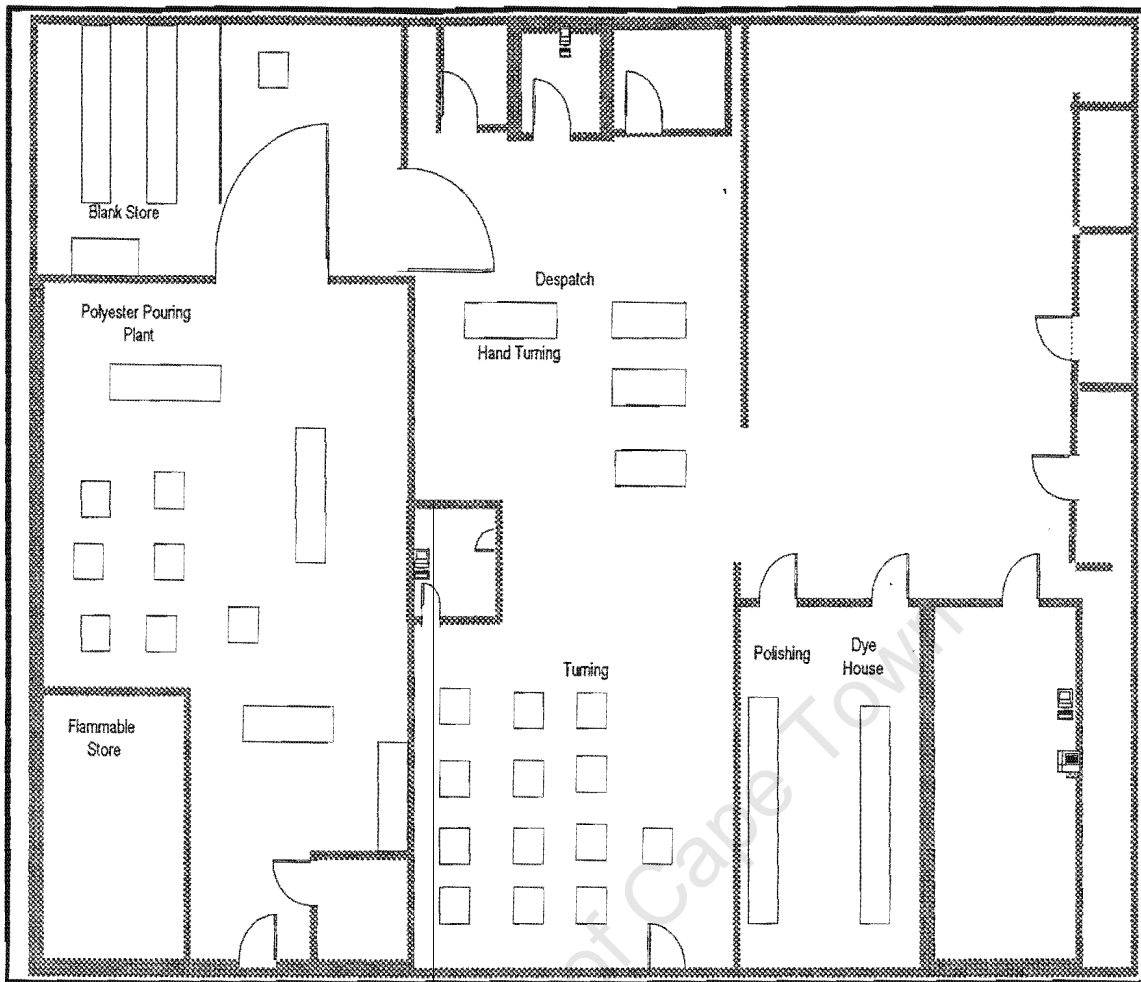


Figure 2 Plant Layout

THE PROCESS

Orders are received from the customer providing an article number that identifies the shape, finish, material and number of holes in the button. The customer specifies the size of button and quantity required. The article number does not identify the colour and either a sample or swatch has to be provided. The order is loaded into the computer system and a jobcard generated. To this jobcard a sample button is attached and that jobcard then stays with the job throughout the process.

Orders are batched to reduce set-up time on the machines. As can be seen from Figure 3, set-up time is a major factor in the manufacturing process and therefore monitored closely.

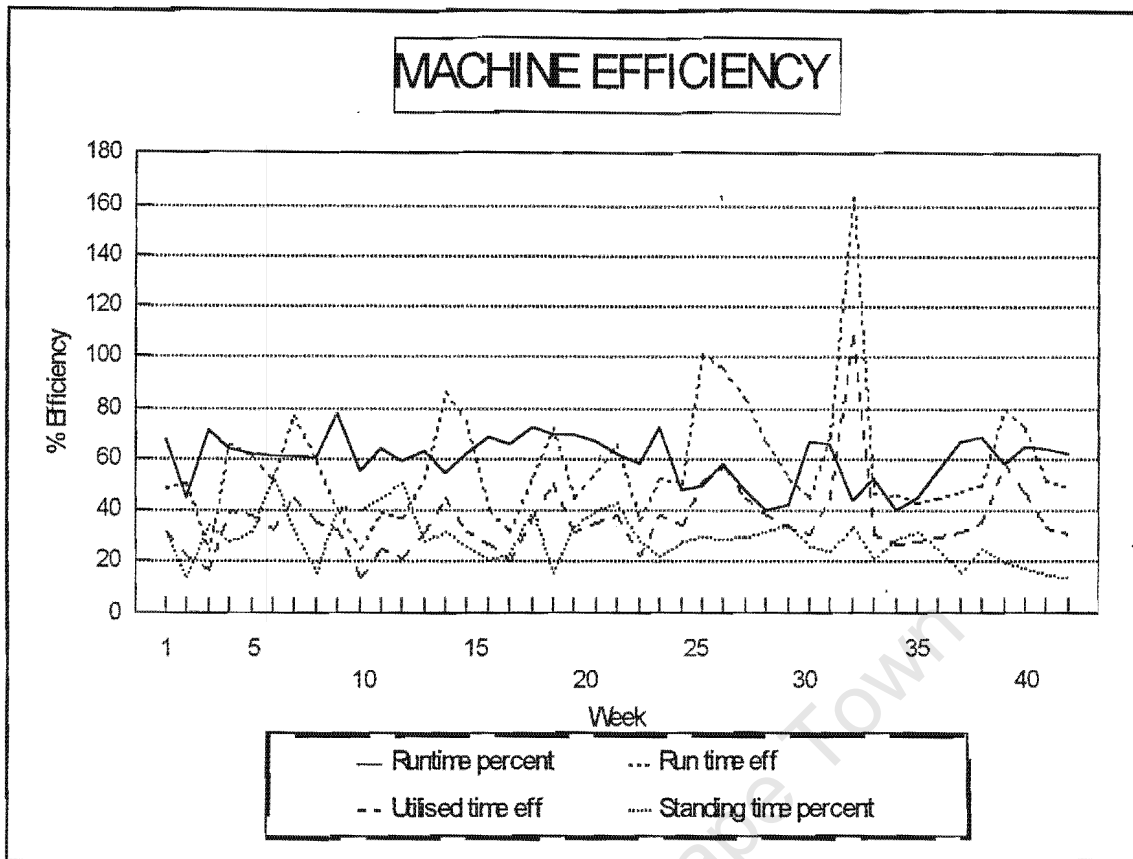


Figure 3 - Machine Efficiency

POLYESTER PLANT

The jobcard is handed to the polyester plant's colour matching kitchen where the recipes are kept on record and is entered on the job-card. The pigments are then mixed into the polyester resin according to the recipe. Shortly before the pouring process the catalyst is added to the resin. Critical factors at this stage are the viscosity of the resin, gelltime and temperature.

The resin is poured into a centrifugal casting drum and once it has hardened into a sheet, this is removed from the centrifugal casting drum. This is referred to the green state, as the resin is still soft and flexible. The sheet is rolled out on a table and left to cure for a little longer until it has reached a shore hardness of 65 (measurement of hardness related to materials such as rubber, polyester etc.). At this point it is put through the blanking machine that cuts out the required disk size as per the order. For different sizes different quantities of blanks are cut out of the sheets i.e. one sheet produces approximately 10700 of 11,5 mm blanks. The blanker is able to automatically cut sizes from 9 mm to 28-mm blanks out of a sheet, just by changing the blanking block.

These blanks are now left in water to dissipate the heat (the addition of the catalyst starts off an exothermic reaction, which hardens the resin). Once they have hardened (usually overnight) they proceed to the turning section.

THE AUTO TURNING SECTION

The turning floor has 11 automatic button turning machines of which six are Single Vikings and five are Double Vikings. Viking is an automatic button-making machine designed and manufactured by Tullio Giusi in Italy. Single Vikings are machines for manufacturing single process (flat back) buttons. Double Vikings produce double process (round back) buttons. The machines are of varying age, the oldest being 26 years old with the two most recently acquired being only two years old. The older machinery requires refurbishment or replacement which would mean capital input into the business (a factor not feasible at this stage).

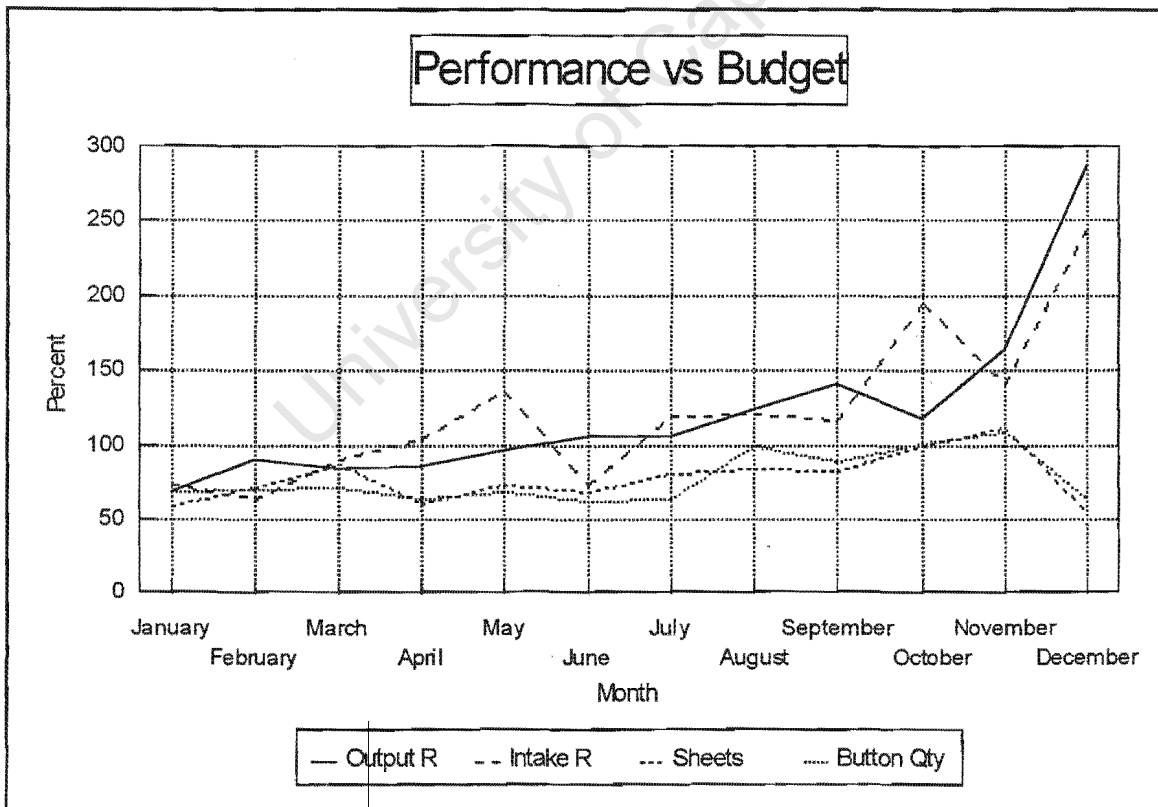


Figure 4 - Plant Output %

The machines have to be set depending on the buttons required. Three setters are allocated to set specific machines and to ensure their effective running. There is one

operator that ensures that the machines are not producing scrap and who also checks for blockages. The speed of the turning machines is anywhere from 160 buttons per minute down to 12 buttons per minute dependant on the profile and shape of the button. Figure 4 shows some additional measurements critical to the business.

THE POLISHING AND DYEING SECTION

Once turned, the buttons go to the polishing process. This is a wet polishing process, where the buttons are put into barrels together with ceramic stones, water, pumice powder and soda ash. They are tumbled in the barrels for 45 minutes for a matt finish and 12 hours for a polished finish. The polished buttons are usually polished overnight and removed the following morning. As there are seven polishing barrels and 11 turning machines various jobs have to be combined in the polishing process. Four different sizes can be put together into one barrel as the automatic separator can separate these.

There is also a dye house where buttons can be over-dyed. This is available to customers that require a small quantity of buttons and where they require a 24-hour delivery. Over-dyed buttons are not colourfast and can only be used in cheaper quality garments. Customers also often make use of this facility to have their own stock dyed to various colours.

FINAL INSPECTION AND FINISHING

From the polishing, the buttons are dried and go on to the sorting tables where a 100% sort is done. The buttons move along a conveyor where one sorter checks them. They then flip over onto another conveyor where they are looked at on the reverse side by the next sorter.

This area is also where any additional finishing is done. Some polyester buttons have a metal ring fitted around them or inserts fitted. This has to be done by hand and is labour intensive.

After sorting quality control does a final check and signs the buttons off before they are packed and despatched to the customer.

CAPACITIES

With the current capacity, Fashion Buttons can produce up to 300 000 buttons per 24 hour shift. This is also dependent on the order quantity and run size. The polyester pouring plant has seven centrifugal pouring drums of which one is water-cooled. This enables the polyester plant to pour an average of 70 sheets per day. With the quantity of buttons dependant on the size of the blank, the polyester plant is able to supply enough blanks for each day's turning.

The finishing plant has 7 wet polishing barrels, which have enough capacity to polish the daily turning output. These machines were built in-house based on the polishing barrels available from Tullio Giusi at the time. The machinery is simple and does not require much maintenance and has little wear and tear.

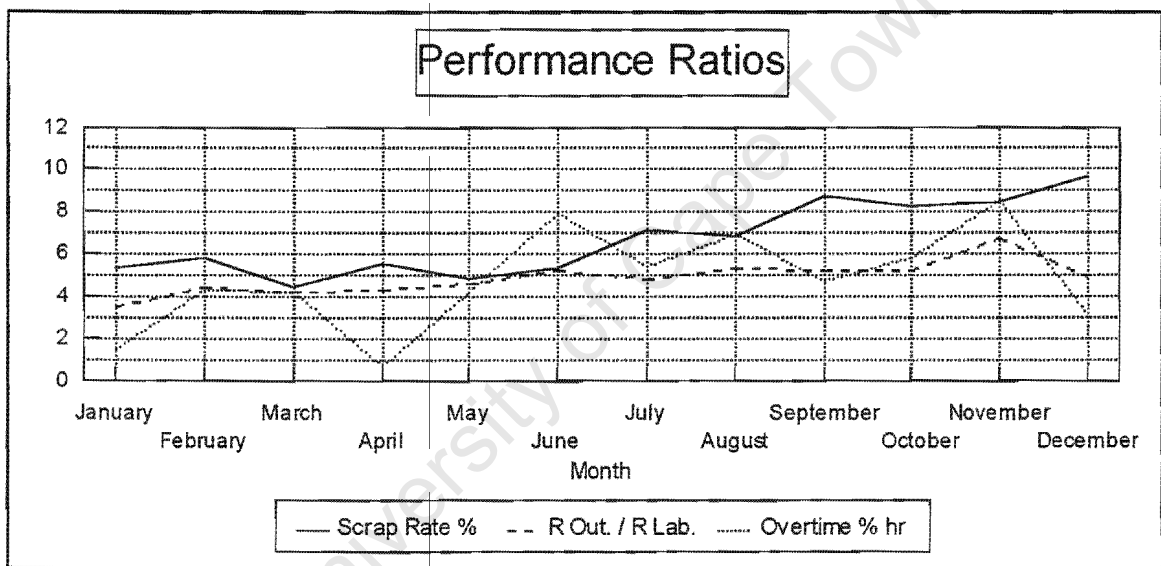


Figure 5 - Analysis Scrap Rate, Output Rand, Overtime

There is one separator that separates the various sizes of buttons that have been put into the polishing barrels. Six operators operate the three sorting tables where the final Quality Assurance is done and from where the buttons are packed and despatched. Figure 5 shows some additional measurements taken and recorded in the business. In this instance it shows the scrap rate that steadily increased to 9,7% from 3,5%, the overtime that fluctuated with the seasonal changes and the Rand output per Rand spent on labour which remained fairly constant.

The average lead time (days to delivery from receipt of order) across all the products is six days. The fastest cycle time for the manufacturing process is three days but curing the blanks in hot water can reduce this by one day.

PROBLEM STATEMENT

From this arises the problem situation: as can be seen the manufacturing process is a make-to-order process, as opposed to a make to stock process, where the variables affecting the products are limitless. At each stage of the process there are decisions to be made which have to be left to the various department heads. As such the checks and balances have to be rigidly enforced and followed through to prevent potential problems early on in the process. Measurements are taken throughout the process and the results (Figure 3, 4 and 5) fed back to the various role-players to assist in their decision making. Even with all this information there is a perception of apathy on the part of the department heads regarding the business. It is this situation that I need to explore further in order to establish a possible solution. In chapter 3, I will look at various techniques and methodologies to assist in trying to analyse this problem.

CHAPTER 3

This Chapter looks at the development of a framework of inquiry. In particular I will look at techniques and methodologies and their particular application. Figure 11 summarises the development of the framework for this level.

DEVELOPMENT OF THE INQUIRY FRAMEWORK

Different approaches to problem solving have found favour in different situations and have their own strengths and limitations. The task of designing or electing a methodology for a particular problem situation is becoming more difficult with an ever-increasing choice. There are various attempts to expand systems thinking, for example Bertalanffy's General System Theory; Ackoff's Idealised Interactive Planning; Checkland's Soft Systems Methodology all serve as learning paradigms. Checkland² states that in developing a particular systems methodology for tackling unstructured problems it is hoped to fall between precise technique and vague philosophy or what Boguslaw (1965) refers to as handbook truths and unbridled intuition. With SSM one cannot hope to achieve a precise repeatable result but at best to answer the question: was the problem solved?

I have chosen to combine various techniques and methodologies into a framework, as I found that there were aspects lacking in individual options and as such they were difficult to apply to my requirements. The research thus performed has to be rigorous and relevant in order to enhance the knowledge of the situation being dealt with.

²Peter Checkland, *Systems Thinking, Systems Practice*, John Wiley & Sons, 1981, pg 192

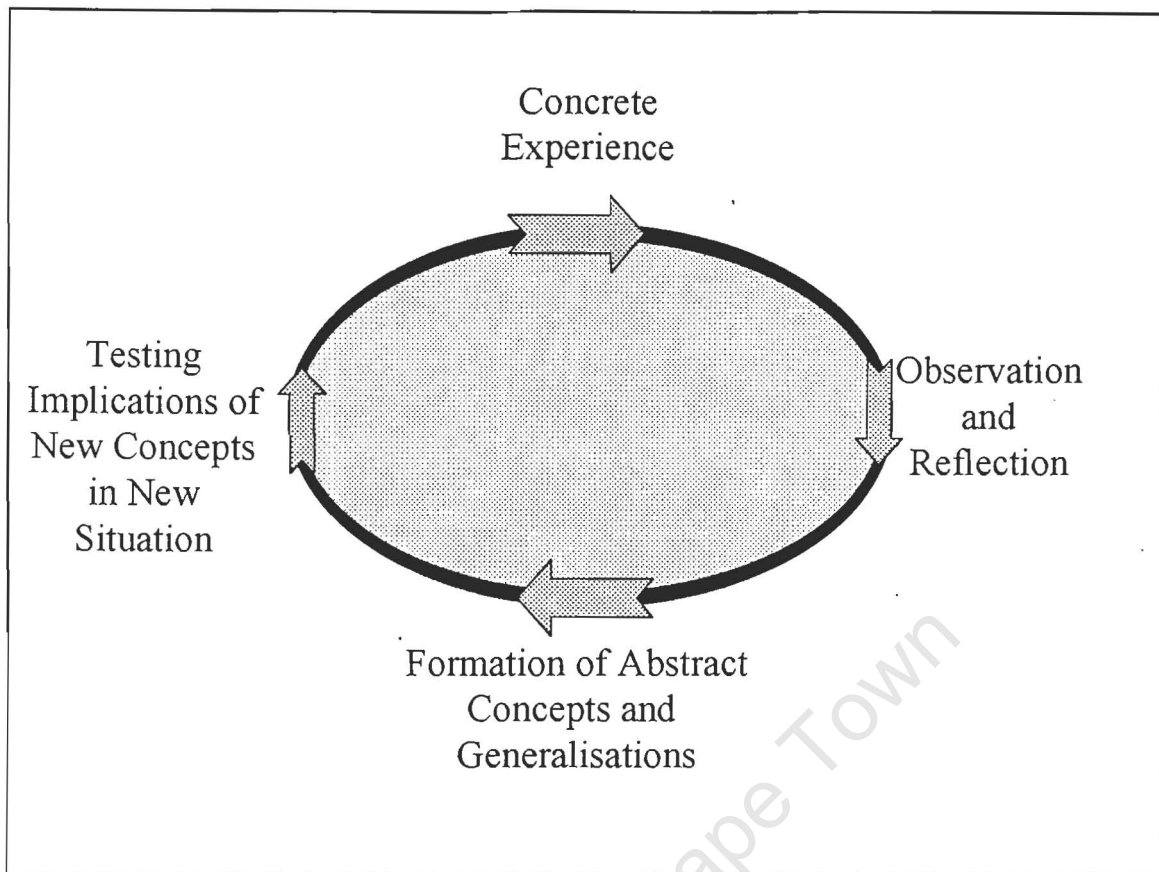


Figure 6 Kolb Learning Cycle

The research into these various techniques and methodologies started two years ago by looking at learning cycles and learning processes. These are cyclic in nature, as shown by Kolb's learning Cycle in Figure 6, as the process is a continuous and dynamic one. The final inquiry framework is an expanded learning cycle that is systemic in nature. The idea being that it guides and does not restrict the thinking, evaluation and learning.

In the next few paragraphs I will provide some insight into various techniques that I researched and that I applied in developing my Inquiry Framework.

VIABLE SYSTEMS MODEL (VSM)

This is a technique developed by Stafford Beer³ (1959) to expose and improve organisational problems pertaining to structure and function.

³ Dr Barry Clemson, Phd, Cybernetics: A New Management Tool, Abacus Press, 1984, pgs 96-143

The twentieth century with its new degrees of complexity, rate of change and interdependency of social systems requires an increasing amount of learning on the part of individuals and organisations. Organisations have to be able to learn and adapt rapidly in order to meet the needs of their clients on a continuous basis.

In order to achieve this a model was devised which acts as a nervous system for an organisation, allowing it to learn and adapt and in so doing improve its overall effectiveness.

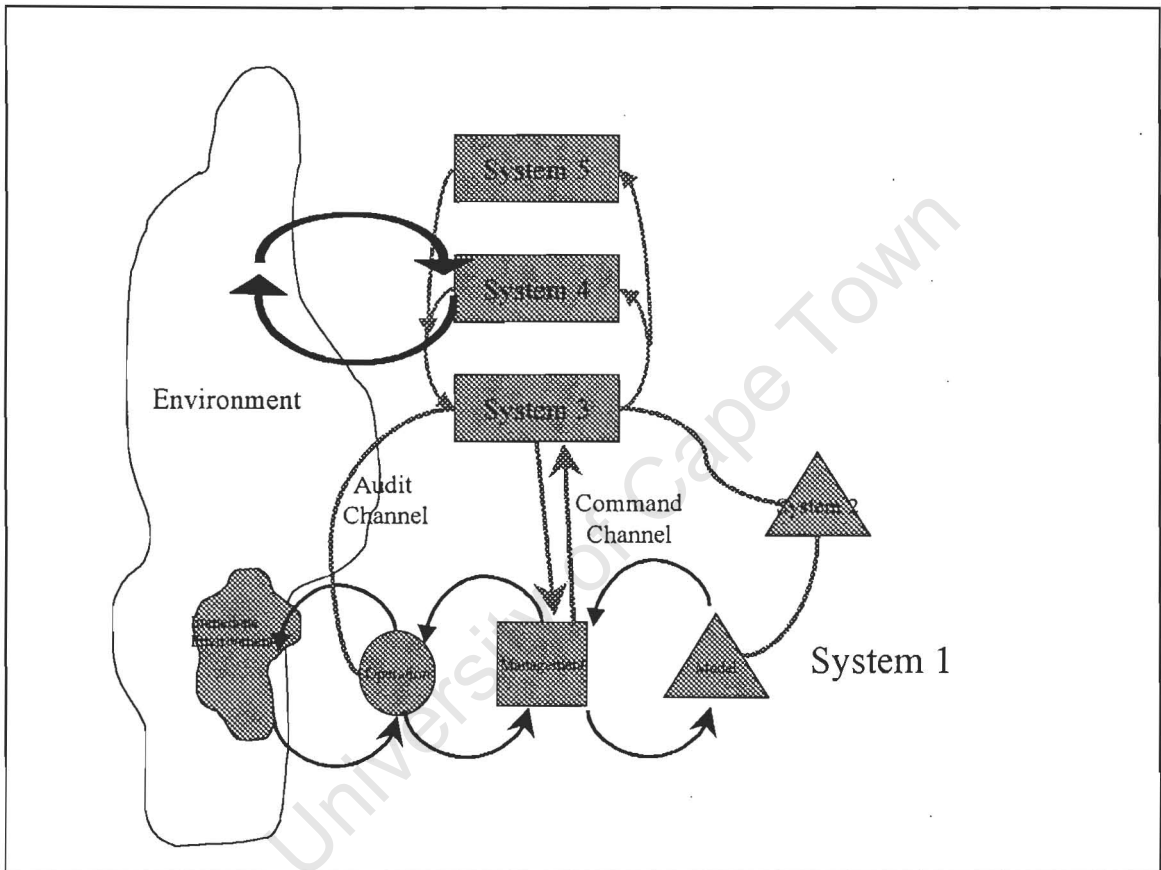


Figure 7 Viable Systems Model

In this model, a set of functions are distinguished, which ensure the viability of any living system, - organisations in particular. These functions and their interrelationships are specified in a comprehensive theory, the propositions of which can be summarised as follows:

An enterprise is viable, if and only if (a technique is specific), it disposes of a set of management functions with a specific set of the interrelationships, identified and formalised in the model:

System 1: Viable System made up of environment, operations, management and mindset

System 2: Co-ordination System that co-ordinates activities via information and communication and thus controls attenuation and amplification to dampen oscillations

System 3: Control system e.g. via resource bargaining

System 3*: Auditing System by investigating and validating information in Systems 1-3 and Systems 1-2-3 via auditing/ monitoring activities

System 4: Intelligence System, dealing with short and long term patterns in the internal and external environment

System 5: Policy System, which balances the interaction of System 3 and System 4 and embodies supreme rules and norms.

This model is diagrammatically represented in Figure 7. More detail on the VSM is provided in Appendix A.

FACTORY PHYSICS⁴

This is a large body of knowledge concerning the operational environment. This relates mainly to the 'hard', factual issues involved in all production environments and how these are influenced by variability. This is generally easy to measure, as it is hard, factual and empirical data that is easily gathered and measured.

The technicalities of production will create variety on the production line. It must be accepted that some form of lack of control must exist. Using factory physics we can identify those aspects that determine the success rate of an operation. The identification of technical variety is tempered by the fact that the laws of factory physics determine the parameters within which issues can be corrected. For instance, in a steady state, all plants will release work at an average rate that is strictly less than the average capacity.

WORK SYSTEMS⁵

As opposed to factory physics, work systems looks at the human activity system and looks specifically at the interrelationship between humans and the activities they have to perform.

⁴ Ray Wild, Production and Operation Management, Cassell, 1971, Wallace J Hopp, Mark C Spearman, Factory Physics, Foundation of Manufacturing Management, Mc Graw-Hill, 1995

⁵ Luc Hoebeke, Making Work Systems Better, John Willy & Sons New York, 1994

The human input to the manufacturing process is the second dimension of variety that impacts on the production process. Management methods, workers perceptions, etc. are the factors that will determine if the operational process will be viable, i.e. value adding.

A work system represents the co-operative relationship between activities and people with the objective of transforming specific inputs to specific outputs. All other systems within the whole are matched to the work process. A work system displays the characteristics of a social system; it has an input, an output, undergoes a transformation and has a purpose, consists of humans who are the actors, owners and customers, and operates in an environment. The development of a work system allows us to understand why people collaborate and compete with one another.

There is no resemblance between work system boundaries and organisational structures. Work systems refer to a system of meaningful activities, which can vary in size and can be networked, or loosely coupled to create a large enterprise.

CYBERNETICS

The word Cybernetics is derived from the Greek noun, Kubernetes, which has an association, to pilot, or rudder. Norbert Wiener defines cybernetics as "the science of effective communication and control in man and the machine". Stafford Beer defined it more clearly as "the science of effective organisation". This is clearer when systems are seen as complex, dynamic, probabilistic, integral and open.

As such, cybernetics looks at the difference between effective and ineffective means of interaction within organisations, or any system. The three basic laws guiding cybernetic thinking state that complex systems organise themselves, that the output is dominated by the feedback and that the system is limited by the variety and complexity that the regulator can cope with.

SOFT SYSTEMS METHODOLOGY⁶

This deals with 'softer' issues in situations that are often problematic, but the problems or symptoms are not blatantly obvious. SSM attempts to uncover these unseen issues and offers techniques for instituting change.

SSM arose and was developed in a 20-year program of action research in real-world problem situations.

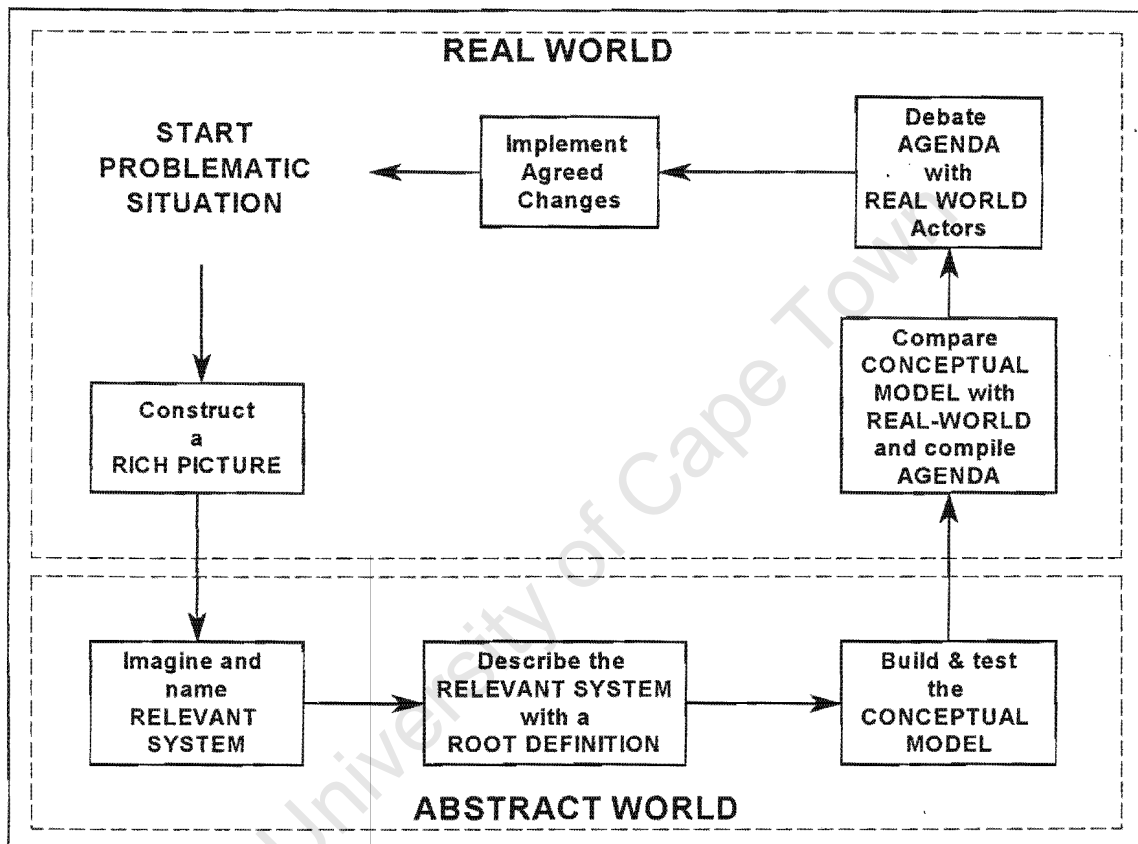


Figure 8 Soft Systems Methodology

SSM is a methodology (Figure 8) that aims to bring about improvement in areas of social concern by activating in the people involved in the situation, a learning cycle which is ideally never-ending. The learning takes place through the iterative process of using systems concepts to reflect upon and debate perceptions of the real world, taking action in the real world, and again reflecting on events using systems concepts. The

⁶ Peter Checkland, *Systems Thinking, Systems Practice*, John Wiley & Sons, 1981, pg 149
The Soft System Approach, *Soft Systems Analysis: An Introductory Guide*, The Open University Press 1984

reflection and debate is structured by a number of systemic models. It is taken as given that no objective and complete account of a problem situation can be provided.

ACTION RESEARCH / LEARNING⁷

The framework that I am proposing is primarily based on Action Research.

Action research strives to combine rigour and relevance to achieve improved performance by initiating meaningful action. This action requires relevant and useful information, which in turn requires research. And this leads us to developing our framework around how best to conduct this research in order to achieve the required meaningful action.

The Action Research Framework has been chosen because the research looks at real issues of mutual concern to the researcher and the organisation being researched. More importantly people in the organisation (to be looked at) will be involved, especially in interpreting the data collected and reaching conclusions, taking action or implementing solutions arrived at by a group of people in conjunction with the researcher. The main stages of Action Research (not to be confused with the stages of SSM) are illustrated in Figure 9 below.

The approach to be adopted in each stage of the framework will include:

1. Input - this refers to what goes into the stage.
2. Transformation Process - this involves the interaction of the parts to effect changes in the input within a particular stage. The relevance of the methodologies chosen for the analysis of the transformation process.
3. Output - this refers to the changed input as a result of the transformation process.

Note that the output of one stage becomes the input of the subsequent stage as illustrated by single-ended arrows and that the flow from one stage to any other stage is iterative.

⁷ Roger Bennett and Jim Oliver, How to Get the Best from Action Research - A Guidbook, MCB University Press Limited, 1988

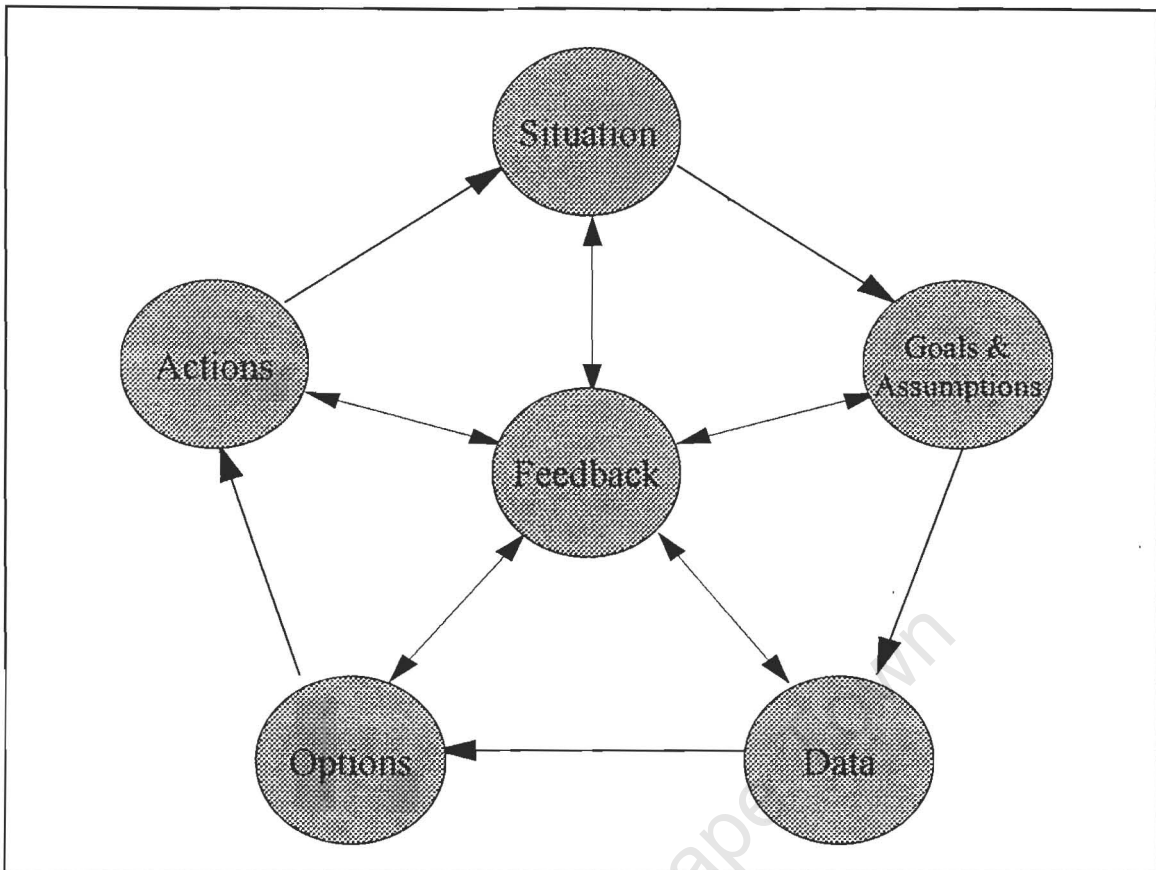


Figure 9: The Main Stages of Action Research.

All learning depends on feedback. George Richardson (1991) shows how beginning in the 1940s leading thinkers in economics, psychology, sociology, anthropology, and other fields recognised that the engineering concept of feedback applied not only to servomechanisms, but to human decision making and social settings as well. Forester, in *Industrial Dynamics* (1961), asserted that all decisions (including learning) take place in the context of feedback loops. Later, Powers (1973,351) wrote:

"Feedback is such an all-pervasive and fundamental aspect of behaviour that it is as invisible as the air that we breathe."

WHY ACTION RESEARCH / LEARNING?

All too often in large organisations one sees decisions being made without the decision makers understanding all of the complexities of the situation. One person alone is generally not able to handle the requisite variety. On the other hand one all too often sees ongoing debates, workshops and discussions taking place without the necessary action taking place.

Action Research can be broken down into various stages

STAGE 1 SITUATION

The situation refers to an issue, problem or opportunity, to be looked at in the system. To analyse the situation we incorporate the Soft Systems Methodology (SSM) and get an overview of the situation.

STAGE 2 GOALS AND ASSUMPTIONS

These are goals and assumptions made by the working group about the structured situation in stage 1, which has been agreed upon by the researcher and the feedback group.

This involves defining what the researcher and the Feedback group want to achieve from the inquiry/research. The setting of such objectives must be accompanied by a clear definition of what assumptions are made. These objectives and assumptions are debated and discussed between the researcher and the feedback group.

The setting of goals requires the identification of problems, which can be done using the SSM methodology (root definition, relevant systems etc.). The assumptions derive from the relevant systems and root definitions used in SSM. In Operations Management the relevant systems and root definitions are derived mainly from Factory Physics, Work Systems and the Viable Systems Model.

STAGE 3 DATA

The objective of collecting data is to help verify what the real issues or problems (amongst the issues previously identified) are and what opportunities may exist or what possible solutions and actions exist.

The nature of the data to be collected depends on:

1. Goals and Assumptions of the project
2. Time available for the project

The transformation of raw data to relevant information is carried out first by deciding how the data is going to be used (with reference to the goals and assumptions). This decision is arrived at through consultation with the feedback group and revisiting the goals and objectives of the inquiry. Methodologies such as VSM, Cybernetics, Factory

Physics and Work Systems are employed, depending on the nature of the data collected, to process it.

STAGE 4 OPTIONS

The purpose of generating options is to bring about meaningful and valid action (to both the researcher and feedback group) in order to improve the undesirable structured situation.

The researcher, together with the feedback group analyses the low, middle and high roads of the information. The disadvantages and advantages of different options are discussed and debated.

Once we have collected the data the model of the situation can be refined using SSM once again. The model has to be tested in real life (which is known as verification). At this stage it is useful to test the model against the data collected (validation). To address this point Systems Dynamic Modelling can be used. This is running the possibilities through computer models designed to simulate the real situation. In case of discrepancies between the data collected and the result of the simulation, the assumptions will have to be revised and the model developed further in order to provide a more accurate simulation of the reality. Once the model is a sufficient approximation of the reality, it will be used within the SSM methodology to forecast the expected result of the various options (for this purpose the model may need to be altered). The result of SSM and the different options then forms an agenda of issues to be addressed. It is our responsibility to assign priorities surrounding these issues in accordance with the goals and strategies of the company.

STAGE 5 ACTION

The changes suggested by the viable option are implemented by the feedback group, particularly the client or owner. This also involves the monitoring and evaluation of the performance of the action implemented. The action phase should by no means be overlooked. It is during the action phase that one can see whether the assumptions were indeed reasonable assumptions.

Action Research is expanded on in Appendix D. Fitting the techniques into the methodologies gives me a framework as represented in Figure 10.

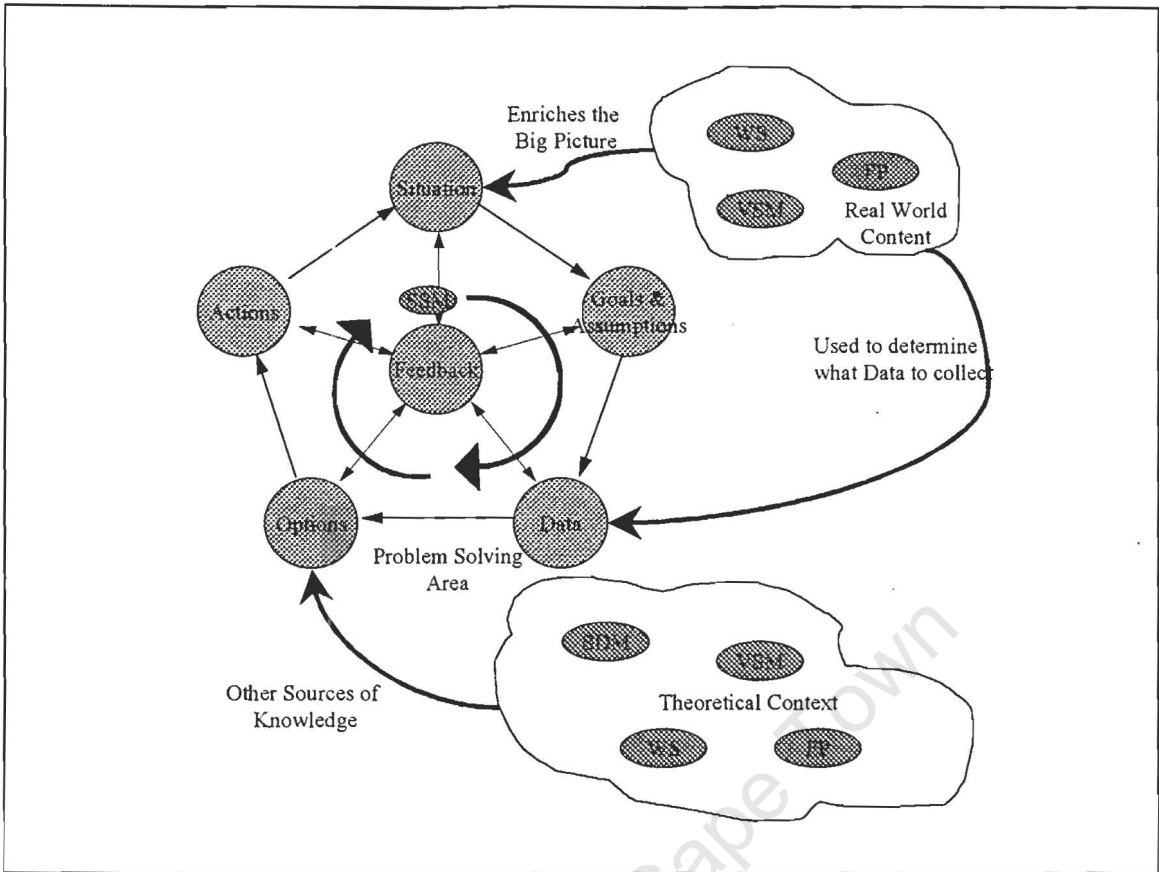


Figure 10 Inquiry Framework

What I have at this stage is a framework that provides me with Techniques and Methodologies to investigate a situation. It lets me assess the situation reasonably analytically. What it does not do is look at current beliefs, worldviews and understanding, both my own and others. For this purpose I need to research philosophy and the understanding of reality. In Figure 11 I have represented diagrammatically how far I have progressed with the framework. At the base of the triangle I have the techniques, Factory Physics, Work Systems and Viable Systems Model and above that the methodologies, Soft Systems Methodology and Action Learning.

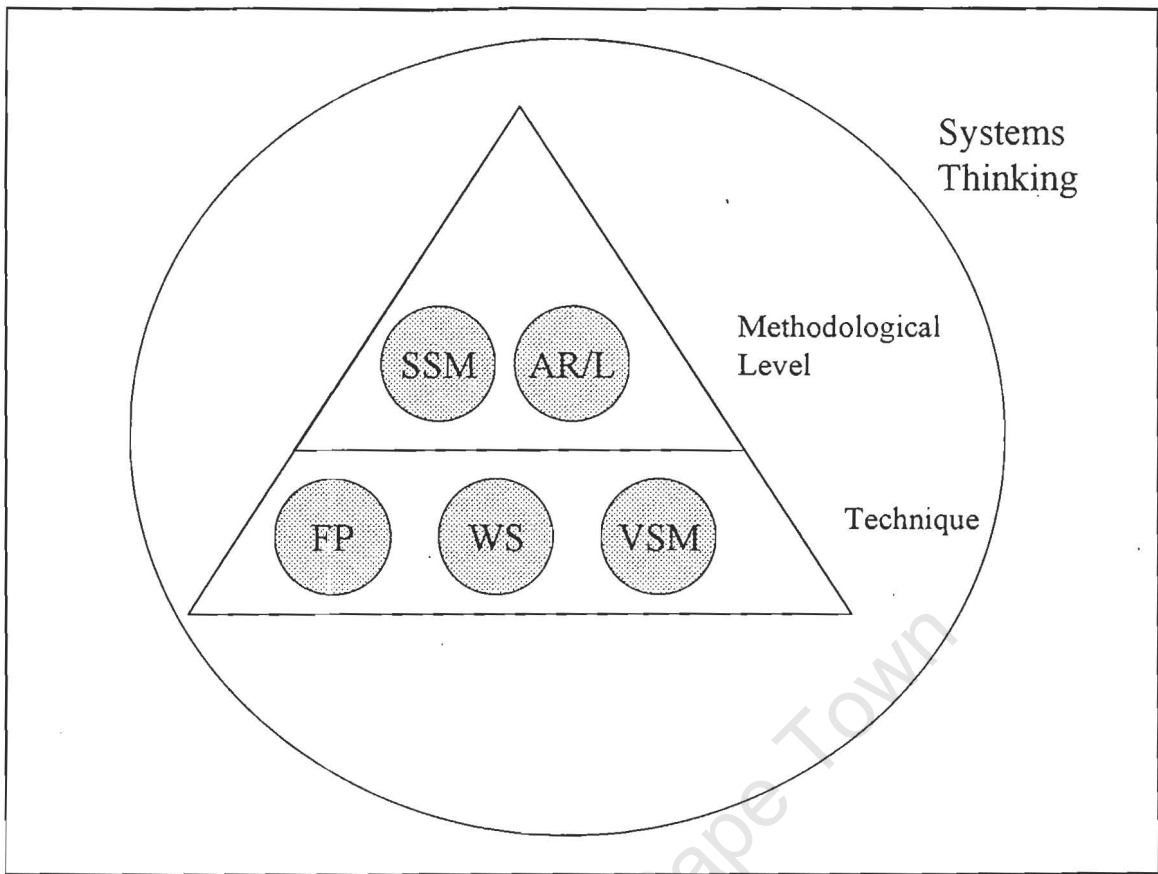


Figure 11 Methodology and Technique

In Chapter 4 I will incorporate the philosophical level into the Inquiry Framework.

CHAPTER 4

This Chapter looks at the Philosophy of reality, knowledge and value. It compares the similarities and differences between philosophy and science, art, education and religion. It describes why I follow a pragmatic cycle of truth development. It develops an argument around the Scientific Method and its relevance. Various aspects are discussed surrounding how this process is fundamental to the practice of management. Ultimately it completes the Philosophical Inquiry Framework. Figure 21 completes the summary of the development of the Framework started in Chapter 3.

PURPOSE OF PHILOSOPHY

Philosophy aims to answer the questions of life, the eternal questions of mankind, i.e. those related to reality, knowledge and value. Philosophy is interested in truth. It falls into the fields of inquiry and investigation and, through these, seeks the ultimate truth. The meaning of facts, as applied to life, is what makes philosophy significant.

Philosophy operates within the realm of interpretation and explanation in terms of ultimate relations and meaning. It interprets reality, knowledge and value through taking multiple views of experience. Experience is related to aesthetic, moral, social and political aspects of life. Experience is analysed to determine what constitutes the experience. Beliefs and rules are examined. Philosophy is concerned with the nature of the self; it questions whether it is physical, social or spiritual. It is ultimately concerned with value.

Philosophy is a theoretical and speculative subject, therefore not necessarily practical. This is why I primarily am interested in following the philosophical pathway of Epistemology, Pragmatism and the Scientific Method. These will be discussed in more detail later in this chapter.

It is in this context that attempted links are made between philosophy and the practice of management. A question that is often asked is "Is management a science or an art?" Philosophy provides some insights through its relation to the fields of science and art.

ASPECTS OF PHILOSOPHY⁸

When investigating the aspects of philosophy we need to question the basis of our knowledge and understanding so as to get insight into its basis. Too often we unquestioningly take ideas and knowledge that we have attained for granted without checking their context.

A philosophical framework needs to aid us in the description of our values, reality and knowledge and to give us an understanding of them and where they originate.

The understanding, or processing of experiences and phenomena, involves the use of our senses and thought processes which, in turn, are guided by our underlying assumptions. These assumptions are underpinned by and based upon the beliefs we hold of the world we live in. These belief systems are our answers to the basic problems with which humans' struggle, those related to reality, knowledge and value. These problems embrace the subjects of religion, art, science, education and philosophy to varying degrees. I will describe the relationships briefly as they shape our thinking.

PHILOSOPHY AND SCIENCE⁹

The main commonality is that both Philosophy and Science are interested in knowledge and truth, both are fields of inquiry and investigation. Knowledge is the end to which both strive. The main difference is the kind of knowledge that they seek. Science is looking for knowledge of facts and philosophy it seeks ultimate knowledge.

The methods of science are observation, experimentation, description and explanation of the relationships of the facts. The method of philosophy involves the interpretation and explanation of the ultimate relationships and meanings of facts. The philosopher's method tends to be more inclusive, by taking facts, pointing to their relationships to the totality of our experiences and suggesting their meaning to life. The philosopher tends to infer from the facts of human experience, the nature of the universe, the meanings and purposes of living, whereas the method of the scientist is descriptive and observational and the method used is interpretative.

⁸ W H Newton-Smith, *The Rationality of Science*, Routledge & Kegan Paul Ltd, 1981

⁹ Francis E Reilly, *Charles Peirce's Theory of Scientific Method*, Fordham University Press, 1970, pg 20

PHILOSOPHY AND EDUCATION

The main difference between the two is that philosophy is theoretical and speculative and education is practical. Philosophy asks questions, examining factors of reality and experience, many of which are involved in the education process, whereas education is the active process of dealing with these factors.

Philosophy yields a comprehensive understanding of reality, a worldview, that when applied to educational practice lends direction and methodology. The experience of the educator in nurturing the young, places him in touch with phases of reality, which are considered in making philosophic judgements. Those who are actively involved in educating can advise philosophers about certain matters of fact.

PHILOSOPHY AND ART

Art and philosophy share the common interest of interpreting experience. Their chief concern is to interpret, appreciate and enjoy the meaning of facts.

The artist interprets the aesthetic qualities of experiences with which they deal. They seek to catch these feelings and reproduce them in a visual form inviting others to experience them and feel as they experience them.

The philosopher is concerned with interpreting the various phases of experience and is concerned with other values, with reality, with knowledge and the kind of action which results from life. The artists' treatment of beauty is real; the philosopher intellectualises aesthetic experience.

PHILOSOPHY AND RELIGION

Religion, as science and philosophy is interested in truth. Religion does not tend to be purely intellectual as science and philosophy, but calls for personal commitment and the practice of a way of life. Philosophy is not a religion, nor does it commonly take the place of religion.

There are at least three essentials, which might be described as constituting religion, the experience of religion, the community of believers and the constructive program of service by the religious group.

Philosophy examines the basis of belief upon which religion is founded. It seeks to examine all beliefs and determine those whose foundations are firm and secure. Since religion like science is a realm of experience in which the experiencing subject is related to reality greater than and beyond the individual, philosophy can scarcely ignore this area of human experience as one of the sources of data with which its interpretative activity must begin. One contribution which philosophy makes to religion is to offer help in understanding the receptacle into which divine truth and life come. Philosophy may also refine religious belief and the help it can offer in understanding the thought processes of people.

PHILOSOPHY AND ITS BRANCHES

Why do we focus on philosophy? It provides us with a basis for dealing with the complexities which the realm of work presents to us. We look to it to provide a theory of knowledge, meaning and value to guide our inquiry process in grappling with the problems of management.

As stated previously, philosophy is a theoretical and speculative subject, thus not necessarily practical. Rupert C Lodge states that philosophy is "Life at the reflective level". We come to that level of experience after maturing influences such as crises, earnest inquiry and purpose.

The philosopher and, more specifically in this case, the inquirer, has to be highly conscious of themselves and has to factor their own experience in. They must know that they are part of their own worldview and this influences their interpretation of experience. Therefore the philosopher and the inquirer must be interested in pure truth for the sake of truth only.

For theories to be acceptable they must possess a content of truth, and for truth to exist the aspects of Axiology (Value), Ontology (Reality) and Epistemology (Knowledge) must be present.

Three primary branches of philosophy, which deal with the problems of reality, knowledge and value, are commonly recognised. A high level view describes these components as:

Truth Component	Relates to	Indicative Questions
Ontology	Reality	What is the nature of the universe in which we live? What is real?
Epistemology	Knowledge	How does a man know what is real? How do we come by our knowledge? How do we know that it is true, error or illusion? How do we relate ideas (science of logic)?
Axiology	Value	What are important values to be desired in living? Are these values rooted in reality?

This is diagrammatically represented in Figure 12

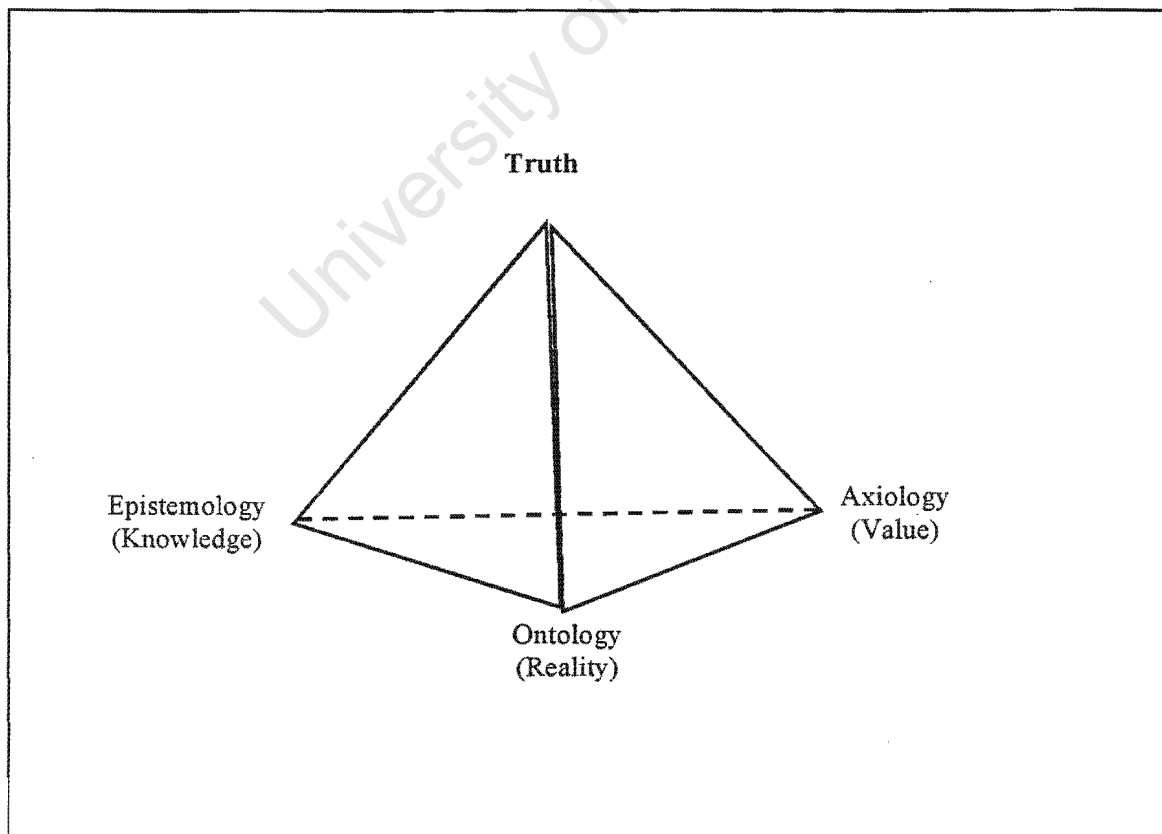


Figure 12 Components of Truth

THE FOUR SCHOOLS OF PHILOSOPHY

There are four primary schools of thought, which attempt to explain the questions raised by Ontology, Epistemology and Axiology. These are represented in contemporary thought as:

- **Naturalism¹⁰**: The world of nature is regarded as the entire reality. The physical universe is all there is
- **Idealism¹¹**: The same substances as ideas, minds or senses constitute reality. Idealism can also be referred to as "ideaism", "mentalism" or "spiritualism"
- **Realism¹²**: Gives distinctive difference to the problems of knowledge. Objectives of the external world are real in themselves and not dependent upon the mind for their existence
- **Pragmatism¹³**: The use of things is more important than the knowledge of things. Utility is of prime importance and must be capable of realisation. Pragmatism springs from idealism. Reality is viewed as many, with the individual capable of making a difference.

In terms of the pathway followed by the Inquiry Framework, the main school of interest is that of Epistemology and Pragmatism. I have taken a pragmatic approach in the development of the framework.

PRAGMATISM

Charles Peirce founded pragmatism. In a letter to William James (1902), Peirce writes, "Pragmatism is correct doctrine only in so far as at is required that material action is the mere husk of ideas. The brute element exists, and must not be explained away.... But the end of thought is action only in so far as the end of action is another thought. Far better to abandon the word "thought" and talk of "representation" and then define what kind of representation it is that constitutes consciousness"¹⁴. Peirce was concerned with learning. Material action and its consequences must not be explained

¹⁰ CJ Misak, Truth and the End of Inquiry, A Peircean Account of Truth, Clarendon Press Oxford, 1991 Pg 58

¹¹ CJ Misak, Truth and the End of Inquiry, 1991 Pg 84

¹² CJ Misak, Truth and the End of Inquiry, 1991 Pg 68

¹³ CJ Misak, Truth and the End of Inquiry, 1991 Pg 3

¹⁴ Francis E Reilly, Charles Peirce's Theory of Scientific Method, Fordham University Press, 1970, pg 19

away, but ought to give rise to another thought, which encourages the inquirer into another cycle of inquiry.

- Pragmatism's central insight is that there is a connection between knowing the meaning of a hypothesis and knowing what experiential consequences to expect if the hypothesis is true.
- Pragmatists deal with matters with regard to their practical requirements and consequences, treating facts with reference to their practical lessons.
- Pragmatism offers a practical and rigorous philosophy with which to guide the formulation of a scientific method of inquiry to problems experienced in an organisation.

It differs from other schools of thought in that it is mainly concerned with the consequences of thoughts and actions and with improving conduct in future situations. It depends upon reliable methods, reason, logic and experience in order to arrive at new beliefs. The advantages of pragmatism are:

- it provides a rational context for inquiry;
- it makes sense of the practice of inquiry;
- It justifies and provides a method of inquiry.

A diagrammatic overview of Pragmatism, as represented by Peirce¹⁵, is illustrated in Figure 13.

¹⁵ Francis E Reilly, Charles Peirce's Theory of Scientific Method, Fordham University Press, 1970, pg 14

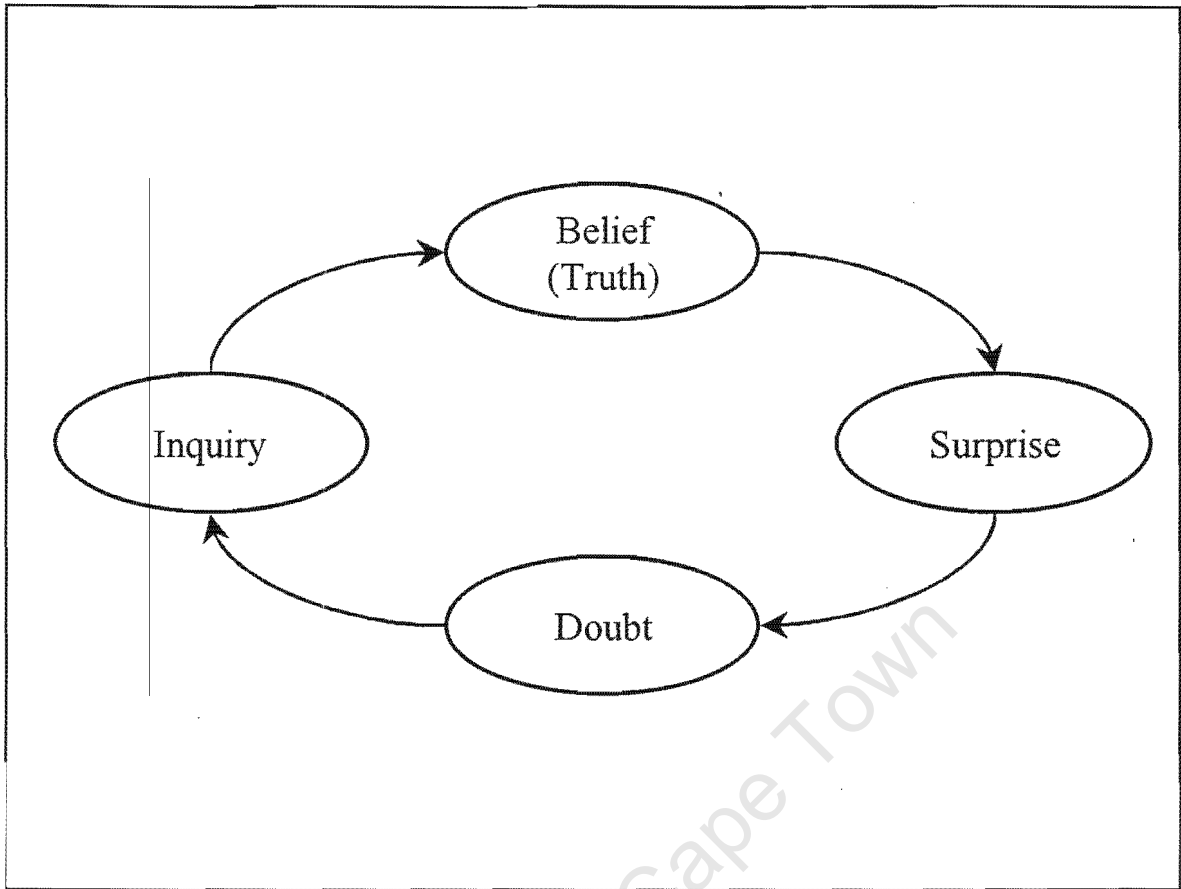


Figure 13 - Pragmatism

The aim of inquiry is to settle belief. In other words, it is to prove something true or false and in the process of doing so, derive some knowledge. The inquiry process starts with an observation, a perceptual judgement that is based on experience. This generates desire and/or doubt, which at this point is beyond the control of reason, to find out how we would act if the doubt was resolved. This is an admission that we do not know something, the implicit desire to know it and an effort to discover what the truth really is.

BELIEF

Belief is simply theories held to be true based on one's experience, knowledge, and value, and thus it is of use only to the individual, providing both structure and order, amidst an ever changing world. By its very being this belief or truth can be and usually is of a temporary nature.

SURPRISE

Surprise is the confrontation of unexpected results which do not fit our currently held beliefs and may be either negative or positive. However, it is only this confrontation of surprise which promotes progress, for once faced with surprise (which impacts on treasured beliefs) an extremely uncomfortable state is experienced and escape is desired.

DOUBT

In the Pragmatic Cycle of Truth Development, the state or aspect of doubt should not only be a result or consequence of surprise, but should also be a result of Critical Thinking¹⁶. Critical Thinking is a technique that encourages critical analysis of all "facts". Table 1 gives a brief summary of critical thinking. Critical Thinking should be used as a mechanism of evaluation and refutation of beliefs to establish their truth content or increase the truth content. This involves examination of the underlying assumptions of others and our beliefs and spurring us towards actions of thinking and acting differently on the basis of our Critical Thinking. This Critical Thinking should also take the form of reflection on the existing and the contemplation of alternatives to the existing.

INQUIRY

This is simply the process of reinforcement or establishing a new belief, through the process of research, hypothesis, testing, and reflection. This is supported by the basic methodology of inquiry i.e. the Scientific Method, and the technique of Critical Thinking and analysis of problems and results which are faced.

This framework does not debate or argue pragmatic philosophy but simply uses a pragmatic philosophy as described by Peirce. This can also be described differently as aspiring to different levels of understanding.

The pragmatists put themselves in the position of an inquirer, adapting themselves to modify a changing world. The validity of using a pragmatic approach in this philosophical framework is described by the pragmatist's view of reality and knowledge. Its view of reality stresses the uncertainty and precariousness of our world. With regard to knowledge, pragmatism elevates the use of things above the knowledge of things.

¹⁶ Stephen D Brookfield, *Developing Critical Thinkers*, Jossey-Bass Publishers, 1987

Table 1 Critical Thinking

Characteristics of Critical Thinking

A productive and positive activity	Critical thinkers are innovators, creative and see the future as open and malleable. They have a realisation of the diversity of values in the world.
A process not an outcome	A continual process of questioning assumptions and critical scepticism of accepted world truths
Manifestations of critical thinking vary according to the contexts in which it occurs	Can be totally internal or can be external. i.e. workers who change their workplace to be non hierarchical have exhibited critical thinking externally
Triggered by positive as well as negative events	Negative events can promote thoughts of how to prevent a reoccurrence, while a positive event may activate thoughts of how to repeat the occurrence.
Emotive and rational	Emotions are central to critical thinking, asking questions about our accepted assumptions are disturbing. When we abandon assumptions that we have been inhibited by, we feel liberated

In the Pragmatism model we are concerned with the practical approach to the development of a philosophical aspect required for research or inquiry and the consequential development of beliefs or theories.

The essence of concern here is the Pragmatic approach to the development or the uncovering of the truth. As the truth is unattainable we resolve ourselves to the development or uncovering of a greater truthfulness, an ever closer approach to the truth, or the ever increasing of truth content in whatever Theories or Hypothesis are postulated.

Peirce describes observation, and the meaning or understanding that these give, by linking observations to signs. He infers that understanding is increased if the

interpreter can accurately define terms and use the term to make accurate predictions. In order to apply a sign, the interpreter must know what qualities and attributes a sign connotes. There must be rationale and, to make a connotation, there must be interpretation.

Experience is described to be anything that is forced upon one. Anything that is compelling, surprising, brute or impinging that happens without dealing with reason can be described as experience, including perception. Peirce states that experience comes from two sources, namely the inner, or ideal, and the outer, or real. These can be described as:

1. Inner, or ideal experiences, uses the world of mathematics, logic and reasoning and inquire into the truth by inward experimentation and observation
2. Outer, or real experience, is a clash between the senses and our experience and inquires into the facts by experimentation and observation.

Furthermore he states that interpretation occurs in three ways. It occurs immediately and depends on the fitness of a sign to be understood in a particular way. It occurs dynamically by affecting the interpreter and sparking off a chain of thought. Lastly a final interpretation is made when an interpretation is believed to be correct.

Peirce's "cycle of pragmatism" is supported by authors like Handy, Mumford, Revans and Argyris, specifically in the context of it being a learning cycle. The pragmatic pathway, therefore, represents a cycle of learning and inquiry that is dynamic and adapts to a changing environment.

PRAGMATISM AND METAPHYSICS

Metaphysics for Peirce meant:

The results of accepting the logical principles as valid of being, and not only as regulative, but as a extrapolation of these principles to form a general theory of the structure of the real¹⁷.

¹⁷ CJ Misak, Truth and the End of Inquiry, A Peircean Account of Truth, Clarendon Press Oxford, 1991 Pg 29-35

Peirce saw metaphysical issues as extrapolations or 'guesses' rooted in science and logical analysis with regard to the intrinsic character of nature and the mind.

Pragmatists are known to hold the ontological (meaning of existence) position that existence as a category is not valid because everything is in flux or change and there is nothing which fits into the category of existence in any ultimate sense.

PRAGMATISM AND EPISTEMOLOGY

Pragmatism elevates the use of things above the knowledge of things, utility being capable of prime importance and capable of realisation, whereas knowledge of ultimate truth is impossible and of little practical value.

Pragmatism allows us to connect the knowledge of the meaning of a hypothesis with knowing what experiential consequences to expect if the hypothesis is true. Peirce characterises the path of inquiry as follows: belief - surprise - doubt - inquiry - belief, which is presented as a continuous process cycle.

Peirce's pragmatism is intended not as a theory of truth but of meaning. Peirce allows that both false and true beliefs have meaning.

Peirce distinguished doubt from belief in the following ways:

There is dissimilarity between the sensations that characteristically accompanies doubting (wishing to ask a question), and the one that characteristically accompanies coming to believe (wishing to pronounce a judgement).

The feeling of believing is a more or less sure indication, of there being established in our nature some habit which will determine our actions. Doubt never has such an effect. Doubt has an uneasy and dissatisfied state from which we struggle to free ourselves and pass into the state of belief; while the latter to a calm and satisfactory state which we do not wish to avoid or to change a belief into anything else. (Murphy J.P. 1990, 22). Peirce calls the struggle to turn doubt into belief (or disbelief) inquiry and says that one cannot summon up real doubt at will. A body of beliefs have to be presupposed for the operation of inquiry in that there has to be something settled for surprise to stir up. Inquiry is that which aims at truth, and truth is that which would be the product of inquiry.

HOW DOES THIS ALL FIT INTO KNOWLEDGE?

To give the hypothesis any value, consequences must be deduced from it which can be tested by observation, according to the scientific method. This process must depend upon a method of deducing the characters of law which would gradually evolve through the action of habit-formation on chance occurrences, and on a method of learning, through observation, whether or not the predicted characters belong to the actual laws of nature.

This now leads to the question of if we have a new knowledge or truth, how do we confirm this as valid? For this we refer back to Peirce again and the Scientific Method

THE SCIENTIFIC METHOD

The first question we have to answer is why the scientific method? According to Peirce there are just four methods for stabilising one's opinions¹⁸. These are the:

- method of tenacity
- method of authority
- apriori method
- method of science

Peirce adopts the latter with the reasoning that it sets a public standard of truth, and that it is free from dependencies of individual fancies and caprices. The scientific method has been the single most contributing factor to current human progress and based on experience, it has been the most efficient and effective way of approaching and uncovering the concept that we humans have termed the 'truth'. It has aided mankind as no other method has in his continuous quest for knowledge and truth. Further it has provided a means for the settlement of belief which as we have discussed above, is the aim of the inquiry. We can however take this reasoning further with a view specifically linked to the pragmatic consequences of the scientific method.

¹⁸ Francis E Reilly, Charles Peirce's Theory of Scientific Method, Fordham University Press, 1970, pg 23-25

Charles Peirce's theory of Scientific Method can be summarised as a process consisting of observation, doubt, a process of inquiry and a system of belief. The spirit of pragmatism encompasses the consequences and meaning of a hypothesis, and in this case, the explanatory hypothesis. The Scientific Method ought to be pursued dynamically, and is based upon the fundamental premise that the search for knowledge must be done for its own sake, for the pure sake of truth.

Observation must be based on experience and must have the ability to influence the observers' perceptual judgement. Essentially the word observation can be explained as the right fact, observed by a mind, furnished with the appropriate ideas that are highly probable. It is a surprising event that is new and that generates desire and doubt that is beyond the control of reason in its formation.

Observation, combined with experience, can give rise to doubt. When developing an explanatory hypothesis, which is our attempt to solve a doubt, we are trying to find out how we would act, not how we will act. Our thoughts apply to conceived action; this is our admission that we do not know something, the implicit desire to know it and our effort to discover what the truth really is.

We enter into a process of inquiry to settle belief or to rid ourselves of doubt. The method of inquiry that we adopt ought to fix real belief, not start with the answer in hand and remain responsive to future argument and evidence. Furthermore the process ought to ensure that the end of the inquiry leads to further thought and inquiry.

Also the scientific method encompasses double loop learning (as described in chapter 1). Graphically this is illustrated in Figure 14.

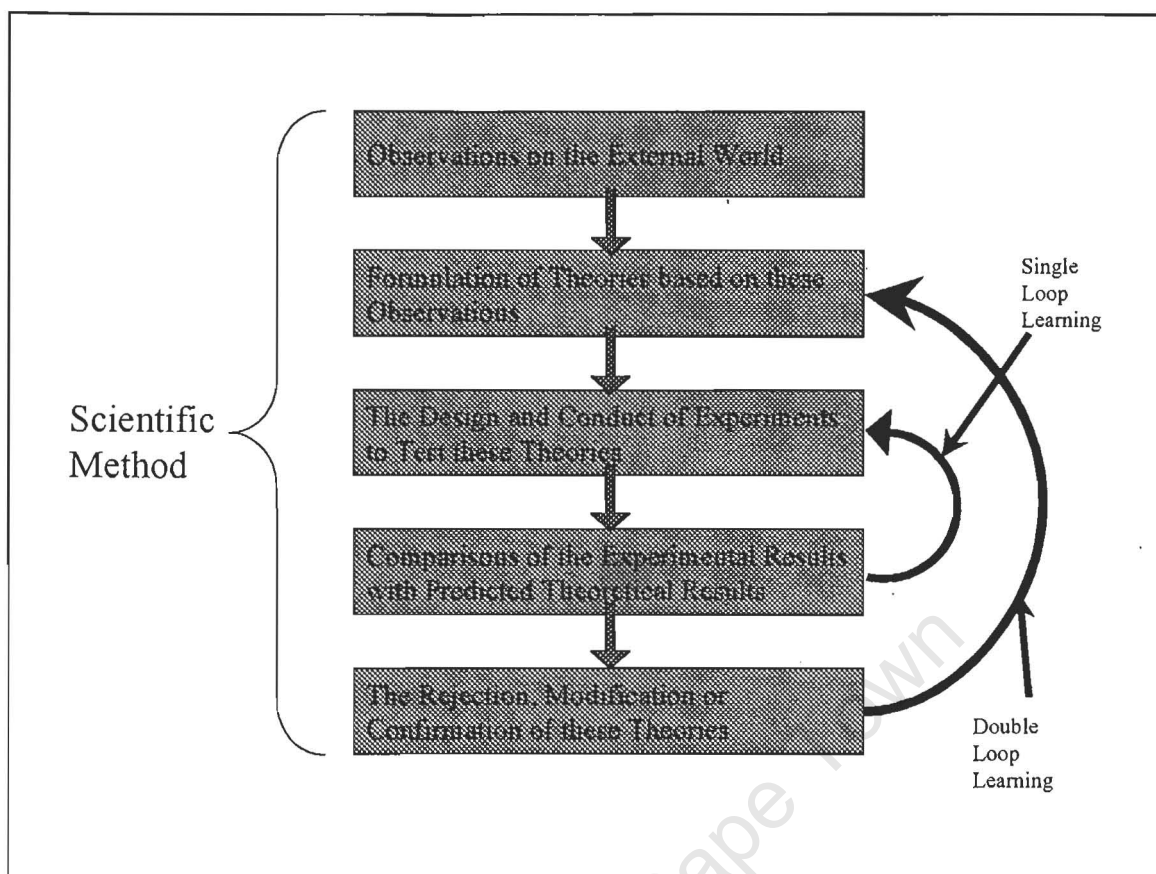


Figure 14 Scientific Method

If we are to move from our pragmatic cycle embedded within our model and the conviction that the aim of inquiry is the settlement of belief, more attention has to be given to the inquiry process. For it is through the inquiry process and the direct result of conclusions, observations or findings that we learn. We adjust and broaden our knowledge, and ultimately we attain new beliefs or reinforce our old ones.

For this reason, our inquiry process has to be rigorous and rational. A means to this end is the scientific method, which is seen as a generator of 'the logic of justification'. The function of the scientific method is two fold:

1. the production of theories for true explanatory purposes or making predictions;
2. Specified principles for comparing theories against a given evidential background.

The method in itself is very powerful because it is based on observation, which is founded in experience and which is compulsive. Inquirers aim for settled belief, but this is equivalent to belief that responds to and coheres with experience and/or consensus. The aim is to get beliefs, which would always stand up to experience.

The scientific method of inquiry follows a process of Abduction, Deduction and Induction. In each case the inquirer makes an inference. These inferences lead from stable premises to stable conclusions.

As a whole the testing of a hypothesis, whether successful or not, aids the process of science and, in this case management, in two ways.

1. The new experiences gained in the testing phase become the basis for new, more accurate hypothesis.
2. The inquirer becomes more qualified to select a better hypothesis.

Peirce states in a letter to W. James (1902): "To give the hypothesis any value, consequences must be deduced from it which can be tested by observation, according to the scientific method. This process must depend upon a method of deducing the characters of law which would gradually evolve through the action of habit-formation on chance occurrences, and on a method of learning, through observation, whether or not the predicted characters belong to the actual laws of nature."¹⁹

We thus use the scientific method as an inquiry tool, which leads us closer to the truth'. We do however explicitly realise the fact that 'truth' is not absolute and in accordance with the scientific method, we thus adopt the Thesis of Verisimilitude whereby our aim is to increase the verisimilitude of our theories i.e. the degree to which they approximate the truth. Through the constant application of the cycle described above, we thus move closer to the 'truth' or what we consider to be the truth. This is graphically represented in Figure 15.

¹⁹ CJ Misak, Truth and the End of Inquiry, A Peircean Account of Truth, Clarendon Press Oxford, 1991

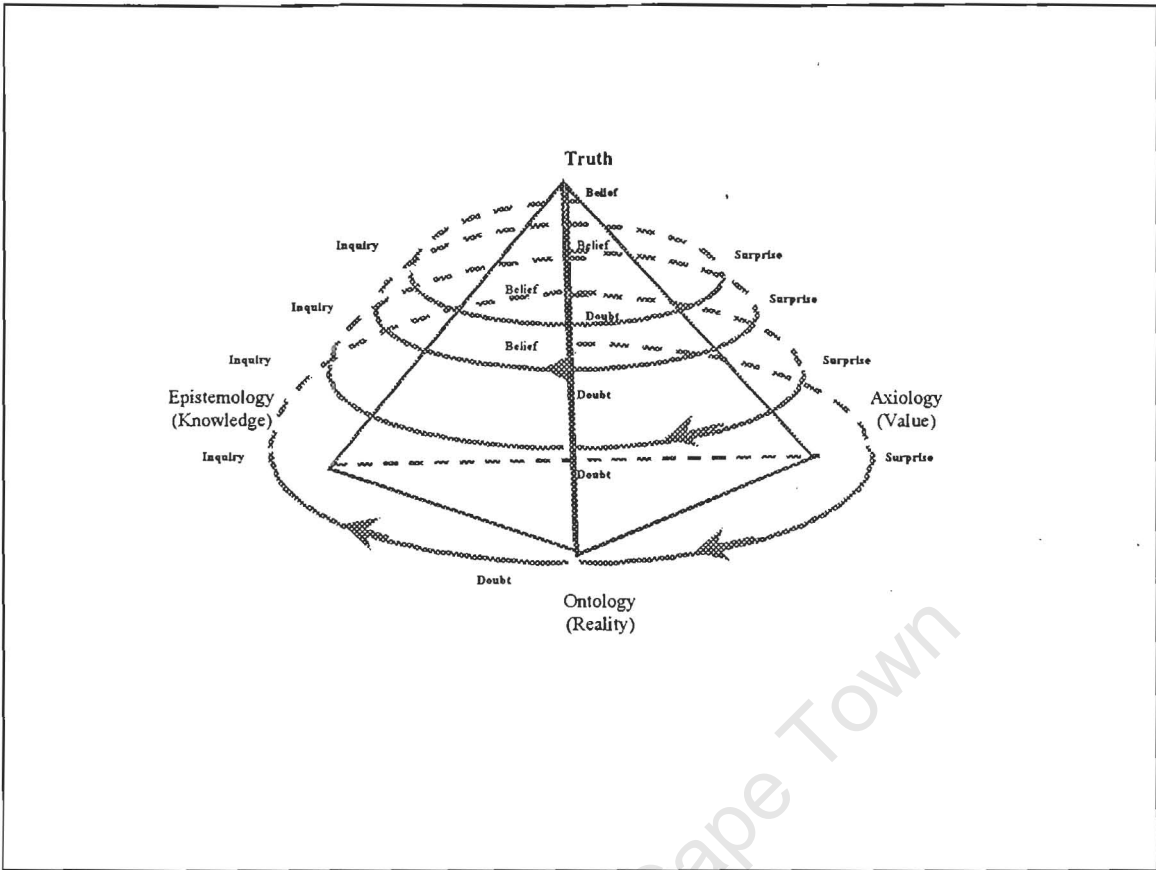


Figure 15 Pragmatic Cycles of Truth development

There are three fundamental inquiry processes, abduction, deduction and induction, that we utilise within the framework of the scientific method²⁰. Depending on where we are in the inquiry process, we would apply any one in particular. I will now describe each in more detail

ABDUCTION

Typically, and especially within a managerial context, this process would start with the abductive phase, where the manager is faced with an unsatisfactory result. From this observed result, and based on his current knowledge or rules, a set or single hypothesis or case explaining the unsatisfactory result is then postulated. This is shown in Figure 16.

²⁰ CJ Misak, Truth and the End of Inquiry, A Peircean Account of Truth, Clarendon Press Oxford, 1991 Pg 91-100

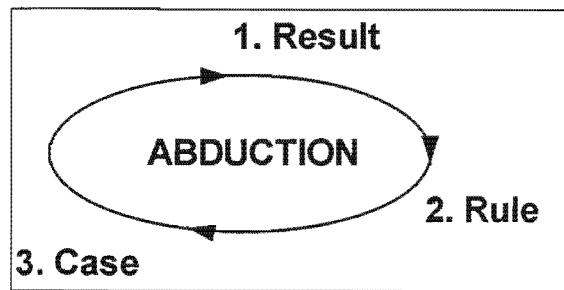


Figure 16 The Abduction Phase

In a broader context this is also how we modify or adjust our belief. Through the above described inquiry process, we undergo double loop learning, which broadens or develops our knowledge basis, questions our reality and adjusts our values.

Abduction is the process of developing a plausible conjecture or explanatory hypothesis. The inquirer aims to infer a case by proceeding from observing an undesirable situation, or result, investigating the cause of the situation, or rule, and inferring, or creating, an explanatory hypothesis.

Practically, Peirce advises that any hypothesis must be verifiable experimentally, must be economic in terms of time and money, take into account the effect of other scientific projects and add value by ensuring that research is based upon intelligent, structured questions.

The inquirer must be able to break the hypothesis down into its smallest components, yet the statement or question as a whole must be broad and inclusive. The function of an "explanatory hypothesis" is to supply a proposition, which if it had been known to be true before the idea or phenomenon presented itself, would render the hypothesis true. Therefore the hypothesis serves to explain and interpret the observed facts. More than one hypothesis is possible, however the simpler hypothesis should be preferred, the one that makes lesser assumptions - remember we perceive what we are conditioned to perceive, therefore we must be open to change our point of view

Lastly the inquirer needs to be aware that the hypothesis is by nature a general statement or question, as perceptual judgement is a way of gaining general knowledge of the world.

DEDUCTION

Thereafter the manager moves into the deductive phase where these hypotheses are used to predict a result or consequences. Usually this process is followed in the hope that the postulated hypothesis will alleviate the unsatisfactory situation and therefore the resolving consequences are deduced. Thus in the deductive phase, rules are used and applied to the given case (the unsatisfactory or desired situation) and the results predicted (Figure 17).

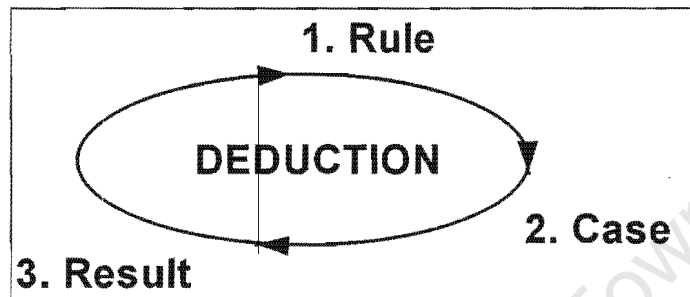


Figure 17 The Deductive Phase

Peirce argues that virtual prediction is an experiential consequence, deduced from the hypothesis, and selected as a consequence independent of whether or not the inquirer knows the truth. It is a process of testing the value of the hypothesis. The inquirer must realise that this process is only a tentative explanation and therefore the process is posed as a question or a plausible suggestion.

The outcome of deduction, or in another term "the truth of the result" is reached, not by reasoning, but by experience and this must generate observable predications.

INDUCTION

Once this phase has been completed, the process moves into the inductive phase where the predictions are tested. Typically some action is initiated (forming the case) and the result observed. Based on these observations and whether the unsatisfactory situation has been alleviated or not, certain rules may be derived (Figure 18).

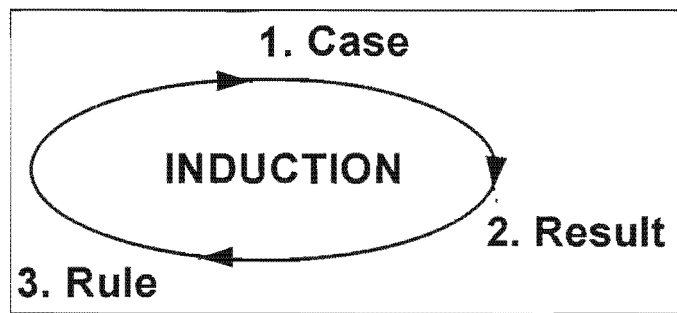


Figure 18 The Inductive Phase

It is a quantitative investigation that investigates what proportion of the consequences generated by the hypothesis will be verified. It may result in new theory, and as such, is a generalising and evaluating process.

The characteristics of the object or events that you are testing must be pre-designated and the observable qualities must be named. The process of reasoning, the consequence of theory, must be ascertained after the inductive process. This ensures that the inquirer does not match the process to suit the reasoning.

In the inductive phase the inquirer classifies general ideas that are attached to objects of experience. A quantitative counting of occurrences and if required, qualitative estimation of the importance of the characteristics obtained is completed. In addition the inquirer appraises the probation singly, then combined and passes final judgement.

In conjunction with the Scientific Method the process can be Diagrammatically represented as in Figure 19.

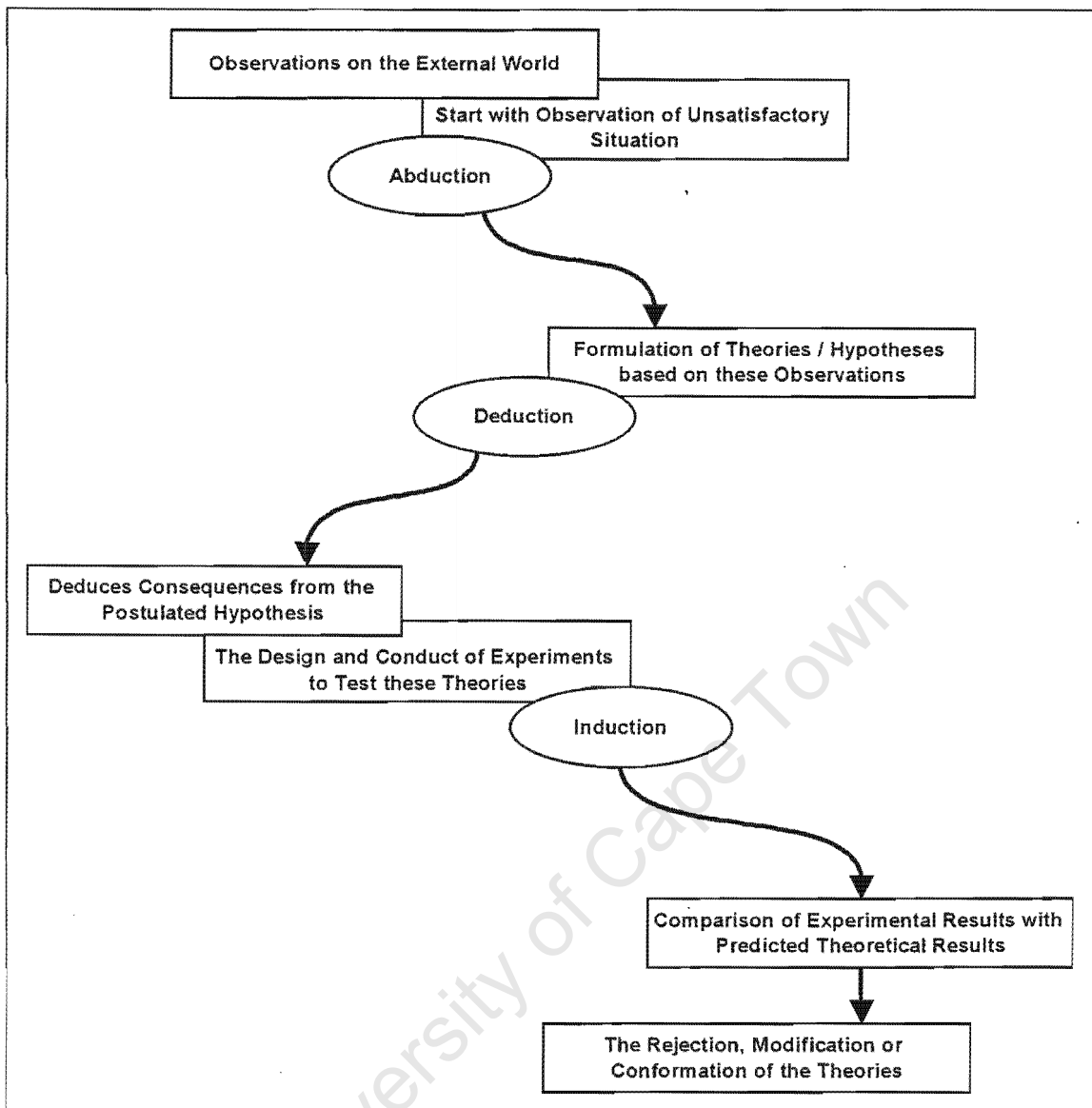


Figure 19 Scientific Method incorporating Abduction, Deduction and Induction

THE QUEST FOR METHOD²¹

There has been progress in science and this progress, is best understood as an improvement in the verisimilitude of our theories. We have evolved evidential or epistemic procedures of some success which can be referred to as the scientific method.

²¹ W H Newton-Smith, *The Rationality of Science*, Routledge & Kegan Paul Ltd, 1981, pg. 208

THE RUPTURE WITH REFINED COMMON SENSE²²

Some practising scientists have described the Scientific Method as nothing more than refined common sense. Pre-scientific common-sense procedures include the discovery of correlations between observables. Unless we possessed this faculty the human race would never have survived. The discovery of correlations between observables is an important part of scientific activity. The search for regularities involves a refinement of common sense both in the fact that the observables may be more precisely specified and in the fact that there will be a search for correlations that are not so evident.

The procedures of common sense involve not only noting repeated conjunctions of observables but also conjecturing hypotheses on the basis of hunches and putting them to the test.

Scientific Method as currently constituted is more aptly described as involving a rupture with the procedures of common sense. For the discovery of correlations between observables, far from being the end of science, is but its beginning.

METHOD IN MATHEMATICS²³

Whether there is general progress in science towards greater verisimilitude is a matter of controversy. Mathematics provides an interesting and enlightening foil for our investigation of the Scientific Method because in mathematics this sort of controversy is almost non-existent. Results, once established, remain in the repertoire of the mathematical community. Proofs in mathematics are just that – proofs.

If by method in mathematics one has in mind the procedure for checking the acceptability of proofs, then that method is characterisable.

The heart of interesting mathematics involves thinking of interesting structures to investigate and thinking of lines of argument that will turn out to give valid proofs in systems that are not complete. No philosopher of mathematics has ever offered rules to be followed in thinking of what to investigate or in thinking of how to come up with proofs. Thus if mathematics, the results of which are largely accumulative, lacks such

²² W H Newton-Smith, *The Rationality of Science*, Routledge & Kegan Paul Ltd, 1981, pg. 210

²³ W H Newton-Smith, 1981, pg. 212

guiding principles we should not be surprised to find that the methods of science cannot be specified in an exhaustive set of guiding principles.

PROBABILITY AND CONFIRMATION²⁴

For the greater part of the time during which the institution of science has existed, the goal was seen to be the discovery of necessary truths. The development of the modern conception of science as a search for contingent, empirical explanatory theories was, accompanied by the development of the quantitative concept of probability. It was natural to explore the possibility that the theory of probability could be invoked in representing the process of theory choice. For instance, given rival theories T1 and T2 and total available evidence E, one looks to see which theory E renders more probable.

The first aspect of probability is that of objective chance and the second is that of guarded assertion. There is no possibility of using the first notion of probability in representing theory choice. Probability construed as guarded assertion fares no better than probability construed as objective chance in representing theory choice. Probability as guarded assertion can give us no guidance.

Since truth eludes our grasp at the level of theories we must employ instead the notion of being approximately true. In science we ought to be interested in support for claims that a theory is approximately true or is more approximately true than another theory, and not in support for claims that a theory is true. We have already seen that the probability calculus fails if we shift from a concern with truth to a concern with verisimilitude.

It may be that some non-probabilistic theory of support or confirmation can be devised to deal with support for claims of approximation to the truth.

THE EVOLUTION OF METHOD²⁵

We continually make discoveries in science, and there is every reason to suppose that we make discoveries in the area of methodology as well.

²⁴ W H Newton-Smith, 1981, pg. 215

²⁵ W H Newton-Smith, 1981, pg 221

If we knew more about the world we should discover variables, the determination of the values of which would enable us to make non-probabilistic predictions of the outcome of measurements.

THE ULTIMATE TEST²⁶

What we aim at in science is the discovery of explanatory truths. Explanatory power comes from theories; but since there is no hope of having grand theories that are strictly speaking true, we should see ourselves as aiming at theories which have an ever-increasing degree of verisimilitude. The ultimate test as to whether one theory has more successfully latched on to a facet of the world than another theory is their relative observational success.

In the long run, then, the ultimate test of the superiority of one theory over another is observational success. If we can locate factors that have guided scientists in making theory choices which turned out to be correct on the ultimate test, we shall have inductive grounds for operating within the constraints of these particular inductive factors.

The factors relevant to theory choice in science are not constitutive of a good theory. The goodness of theories is constituted by their degree of verisimilitude.

THE ROLE OF JUDGEMENT²⁷

A practising scientist is continually making judgements for which he can provide no justification beyond saying that that is how things strike him. Just as our success in dealing with the world in everyday life reinforces justifiably our faith in our perceptual judgements, the scientist's success gives him justified grounds for relying on his judgement.

COUNTING THE COSTS²⁸

If I am being rational in my decision making I shall try to arrive at an assessment of the relative probabilities of each course of action leading to the goal. There may be costs involved, which differ with the courses of action. The courses of action may, even if successful, give me a different degree of realisation of the goal. If we multiply the

²⁶ W H Newton-Smith, 1981, pg 223

²⁷ W H Newton-Smith, 1981, pg 232

²⁸ W H Newton-Smith, 1981, pg 235

chances of the benefit by the probability of getting it, we have what is called the expected utility of that course of action.

This begs the questions, should decision making in science take into account costs and expected utilities? Surely we should opt for the theory that seems less likely to be the better? This serves to remind us of what is often overlooked in discussions of the rationality of science, namely, costs and expected utilities.

A situation which is not so absurd if we imagine ourselves in a management position where we have to decide how a limited budget should be spent.

THE RATIONALITY OF SCIENCE

Scientists are perceived as maintaining the essence of rationality and the methods adopted to prove or disprove theories, serve to bolster this image. A superior face is put on science as a result of past successes and the mystery that surrounds the techniques used in scientific work.

However the mere fact that a theory is scientifically proven does not mean that it will never be disproved or modified by scientific inquiry. This situation can be explained in terms of rational and non-rational models.

PHILOSOPHY AND MANAGEMENT

When considering the significance between management and philosophy we need to step back and consider why we have developed a philosophical framework. In developing a philosophical framework we initially set out to make explicit our underlying assumptions and beliefs in aid of attaining a level of understanding over and above dealing with problem solving at an operational and methodological level. From a management perspective this can be taken a step further where our aim is not only to exhume our personal beliefs and assumptions but more importantly those governing a problem situation. In doing this, we are especially concerned with the consequences of these underlying issues.

MANAGEMENT AND KNOWLEDGE

Management, like science and philosophy, is interested in knowledge. As stated before management is however more interested in the consequences of knowledge or the lack thereof, whereas philosophy is concerned more with absolute knowledge.

According to Ashby's Darkness Principle, knowledge of any situation cannot be complete and as managers we are often required to effectively manage these situations without full knowledge. By consciously questioning the underlying philosophies, assumptions and beliefs of a given problem situation and the consequences thereof, management will be in a better position to understand and control the situation.

Further in conjunction with Godel's Incompleteness Theorem, each organisation or organisational unit develops its own framework, including a more or less specialised vocabulary, set of assumptions, and a general outlook on the world and itself. Godel's theorem shows that irreconcilable propositions will arise within this framework. In order to resolve these, it is required to move to a meta-level to deal with the irreconcilable issues.

Also, according to the Law of Requisite Variety, if management is to control the infinite variety that influences and possible causes of problematic situations, it needs to amplify the variety in the regulator or attenuate the variety of the regulator. Because the real world proliferates so much variety, models must be made which reduce this variety and present the decision-maker with the appropriate information. Our grasp of the philosophical influences is a fundamental means to this end.

MANAGEMENT AND VALUES

The value systems of those who are involved in any given situation, i.e. the actors, customers or owners of the situation, determine to a large extent the behaviour of the individuals. Being aware of and questioning these values will bring to the fore deeper insight into why people act in the manner that they do. In gaining this understanding we as managers will be more competent in eliciting the desired responses required from them in order to control and alleviate the situation. Specifically such an awareness deals with the following typical questions:

- What personal life goals do individuals have?
- Which underlying forces/influences do they experience which they need to obey?

- What are their social constraints or expectations?
- What differences of values exist between the different stakeholders?
- How are these differences resolved/settled/accommodated?
- What consequences do these differences have?

MANAGEMENT AND REALITY

This aspect deals specifically with the consequences of underlying beliefs and values. A manager at the end of the day must achieve his desired objective, be it to improve/solve a conflicting situation or to alleviate any other problem. His actions and those he elicits from the various stakeholders are, in reality, all that count and no theory alone will stand without the desired achievement of results. It is therefore crucial for us in view of developing a useful framework that we are aware of the reality of the situation and that it must deliver the desired results.

MANAGEMENT AND THE SCIENTIFIC METHOD

In accordance with Revans's 'Management and the Scientific Method' we utilise the scientific method of inquiry to develop the most effective management strategies. This process should follow the phases of abduction, deduction and induction as discussed previously. Revans identified the following five major steps:

1. Survey: observation of problem situation within the environment.
2. Production of Policy: the formulation of hypotheses or theories based upon these observations. (Abductive phase)
3. Forming of operations: the designing and conducting of experiments to test these theories. (Deductive phase)
4. Audit and Inspection: the comparison of experimental/observational results with those predicted by the hypothesis. (Inductive phase)
5. The rejection, modification or confirmation of these hypotheses in accordance with the results of these comparisons.

This completes the cycle of the scientific methodology and reinforces double loop learning.

CRITICAL THINKING AND PRAGMATISM

Critical thinking allows us to assess our habits or assumptions when embarking on an inquiry process. As a means of reflective learning it can be described as “the process of internally examining and exploring an issue of concern, triggered by an experience, which creates and clarifies meaning in terms of self, and which results in a changed conceptual perspective.” (Boyd and Fales 1983, 100).

Peirce considers pragmatism to be more involved with the external world of fact and experience than with the inner world of the mind and emotions and the progression from doubt to belief is meant to pass through a process of formal inquiry. The area of overlap between pragmatism and critical thinking is the production of doubt. Critical thinking and pragmatism supports the notion of an experience, trigger or unexpected activity (surprise) which initiates doubt.

Critical thinking ties in with the BELIEF - SURPRISE - DOUBT - INQUIRY cycle at the point of creating DOUBT and of supporting BELIEF. Because critical thinking involves the recognition of assumptions underlying beliefs and behaviours, it means that we can give justifications for ideas and actions, which are subject to reflective scepticism (testing universal applicability and validity against each individuals experiences). The departure with pragmatism rests with the support by Peirce for the scientific method of inquiry whereas critical thinking supports a mental generation of a structure of possibilities extending beyond the empirically known world.

The process of critical thinking can be applied throughout the process of inquiry to assess and challenge assumptions within the context of inquiry.

PHILOSOPHICAL INQUIRY

In developing a philosophical inquiry framework I am effectively aiming to make explicit my underlying assumptions and beliefs that are ingrained upon myself and upon which I act. I thereby hope to attain a level of understanding including and dealing with problem solving incorporating the methodological level.

This is in accordance with Ashby's Darkness Principle and Godel's Incompleteness Theorem, whereby complete knowledge of any situation cannot be attained, and in

order to effectively understand the situation I need to transcend the circumstances and stand outside them (also referred to as Helicopter view) in order to provide closure.

Thus in dealing with problems at an operational level the inquiry framework was adequate, however when faced with problems within the methodological level I need to extend the framework. When the methodologies fail or we fail to understand them, we need to question the fundamental underlying assumptions and beliefs that have generated these methodologies.

Also, according to the Conant-Ashby Theorem, management is able to regulate only those aspects of a situation, which it has in some sense modelled. Thus in order to question the underlying beliefs or assumption in any given situation, I need to develop a philosophical inquiry framework.

INQUIRY

Using Peirce scientific method, abduction, deduction and induction as the basis for the inquiry, I need to analyse the doubt created by the unsatisfactory situation. This will be done using some of the methodologies shown in the Inquiry Framework. I have left all the methodologies in the framework for completeness (Figure 20), but not all are relevant to all situations. Overlaying and influencing the entire process is the technique of Critical Thinking.

To complete the triangle in Figure 11 at the end of chapter 3, I have now included in Figure 21 the philosophical component. It now incorporates Critical Thinking, the Scientific Method and Pragmatism. The idea is that the techniques support the methodologies that support the philosophy. This is consistent with systems thinking philosophy in that all the parts interact and have utility within the whole as is also supported by Peter Checkland²⁹.

Before I start with the application of the Inquiry Process there are different forms of rigour that I need to clarify. The Longmans Dictionary of the English Language (1985) defines it as harsh inflexibility of opinion. This is too narrow a definition and Drew E Hinderer³⁰ (1992) warns against such dictionary or lexical definitions. I am going to focus on the rigour of the usage of terminology and in the application of the process.

²⁹ Peter Checkland, *Systems Thinking, Systems Practice*, John Wiley & Sons, 1981, pg 8

³⁰ Drew E Hinderer, *Building Arguments*, Wadsworth Publishing Company, 1992, pg 62

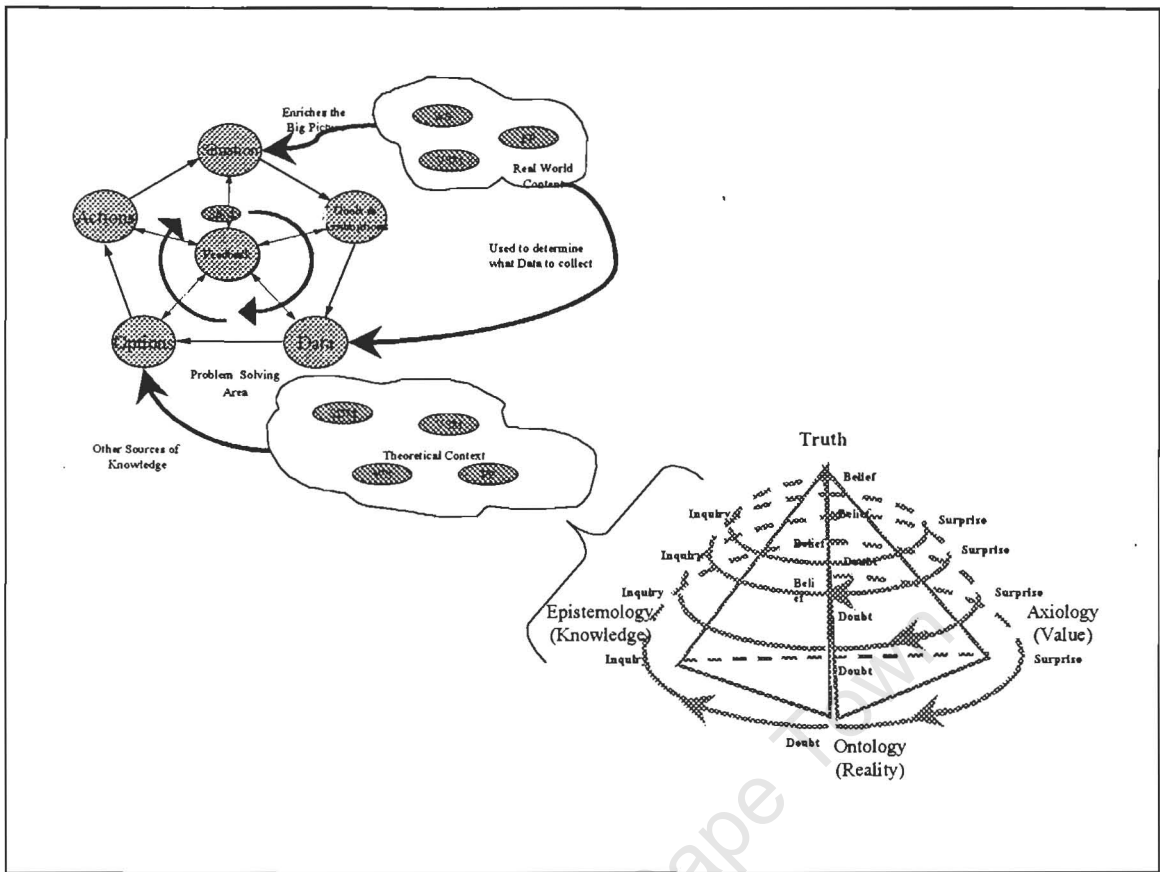


Figure 20 Philosophical Inquiry Framework

Rigour will also be applied in the collection of imperical data for providing proof of problems or outcomes of results. Academic rigour will not necessarily be used as my framework needs to have application in a real world with so called previously disadvantaged people, i.e. the terminology used needs to be relevant and have application.

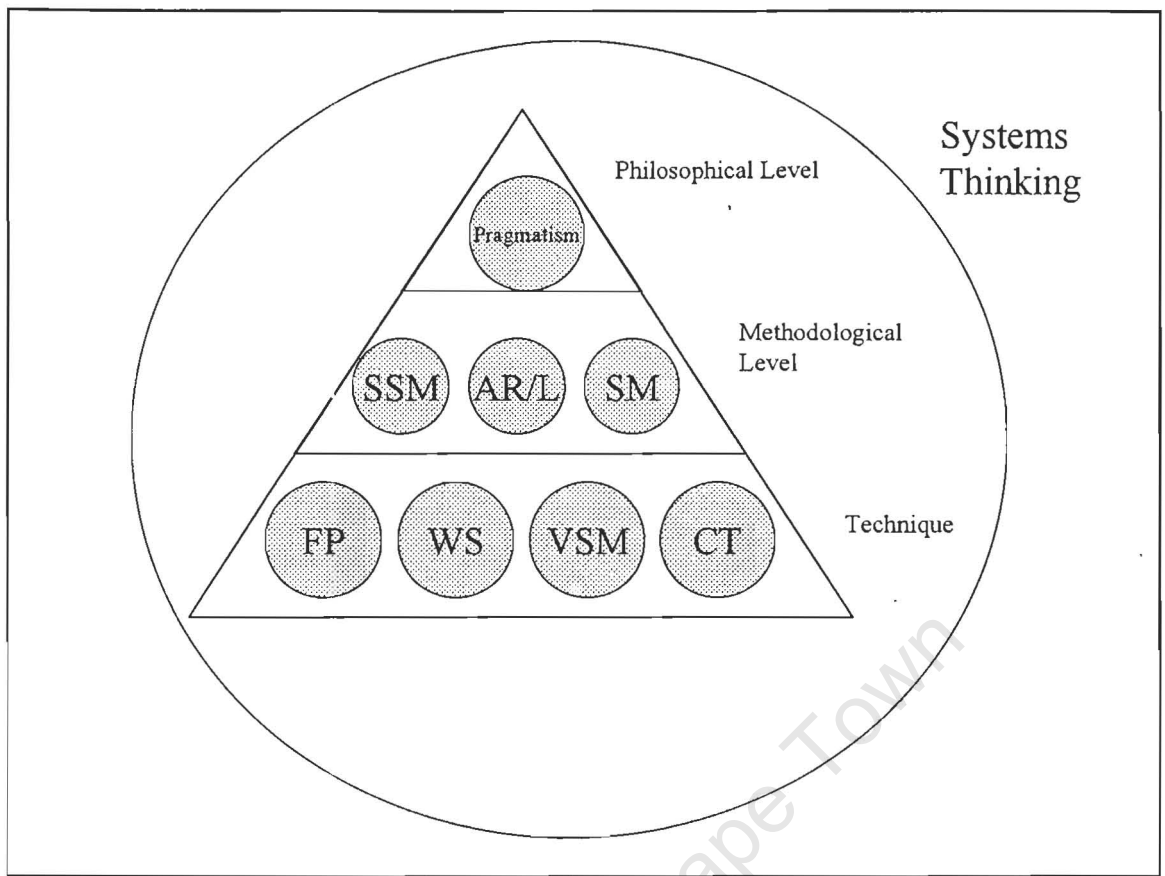


Figure 21 Philosophical Inquiry

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CHAPTER 5

In this chapter the Inquiry Framework is applied and the results achieved are reported on. It recaps the currently unacceptable situation and reports on the process. I look at the format of information transmittal and do an analysis of how the information is received. This leads me to the discovery that the information is not relevant in its current format and a solution is proposed. The results of this implementation are subsequently reported.

OUTCOME CYCLE 1

SITUATION

As detailed in Chapter 2 Fashion Buttons have various control mechanisms in place to ensure effective and efficient running. Throughout the process there are measuring mechanisms which are discussed with and fed back to the various role-players. These have been implemented over the last seven years and every effort has been made to display these in the form of charts, tables and graphs on the noticeboards. From the graphs represented in Chapter 2 (Figures 3, 4 and 5) the type of information recorded can be seen. Typically sheets poured, resin used, resin converted to buttons, scrap rates, machine outputs, machine efficiencies, utilised time efficiencies, standing time, setting time, absenteeism, Rand output etc. are measured.

All along the idea was to develop a climate for the staff, that would encourage self-development. It was hoped that with feedback of information the staff would be suitably motivated to improve outputs, efficiencies, scrap rates etc., but the actual results were disappointing and generally the motivation had to come from the production manager.

The clothing industry has been in a downward spiral since 1992, with 1995 and 1996 being particularly bad years. Fashion Buttons was definitely not a profitable or viable concern. During 1996 the staff were informed and updated regularly regarding the situation and it was made quite clear that the Directors (with pressure from the shareholders) were considering closing down or selling the business.

In June 1996 the General Manager started a monthly meeting with all the staff where he presented the income statement to them. This had never been done before within the group and was only really possible due to the fact that the business was not unionised. It took quite some time before people started realising that these were

factual figures and not fabricated. They had for the last five years been threatened with closures and staff reduction and they had assumed that this was just another "ploy" by management to, as one department head put it, "sweet-talk them".

Applying SSM principles the key personnel consists of the production manager, process facilitator, polyester plant department head, turning floor foreman and sample department head together with their respective staff. These are the actors within the process. The clients are the customers that are hopefully satisfied with the output produced by the role-players collectively. The owners are the directors and shareholders who in the current environment considered selling or closing the business.

At the end of 1996 this became a partial reality when Fashion Buttons went through a restructuring and downscaling and the staff was cut down from 53 to 28 people, floor space was reduced to 2/3 the previous size, old machinery was removed and disassembled for spares. This jolted many people who now realised the seriousness of the situation and 1997 started off with renewed effort from everyone. The information processed is still fed back to the relevant people and the process of presenting the expenditures, started in June 1996, is being continued.

VSM

In applying the Inquiry Framework I will firstly apply the VSM in order to gain insight into the operation and ensure that from an operational level the system is viable.

- System 1, Viable System, this refers directly to the operational level that I (System 3) manage. The input on my part is generally dependant on external influences, be they market related (sales, customers etc), people related (resource requirement, industrial relations etc), raw materials, machinery or finances.
- System 2, Co-ordination System, here a MIS department and an accounts department provide the information to which my staff and I react. This system provides data as information to the operational level via the audit channel, in this instance through regular production meetings, graphs, tables and reports.
- System 3, Control System, this is the control system, which receives input from system 1 via system 2. This immediately indicates a time lag problem. This means that reaction to information from system 1 will only occur after the fact. At the same time environmental influences (i.e. market related trends etc) can be proactive as long as the information is received timorously from system 4.

- System 4, Intelligence system, here there is a lack of input as environmental information generally has to be gathered by myself as it relates to the marketplace. There is no direct marketing function within the organisation. This unfortunately will not be something that will be addressed in the near future.
- System 5, Policy System, this generally is strong as there is direct input to system 3 from head office and policies are clearly spelt out.

In looking at the VSM there seems to be two areas of contention, the first being system 4 and the second being via the audit channel, i.e. the data being fed back to system 1 and the lack of response from this.

CONCERN

The concern is that the displayed graphs and information did not have the desired effect of spurring on the staff to greater efforts or to be forthcoming with suggestions as to improving the business.

QUESTION

Why is the feedback process not having the desired effect and what can be done about it?

ANSWER

Applying the systemic framework of inquiry the following is proposed:

- The data must be changed to relevant information

RATIONALE

SSM RICH PICTURE

In talking to various people in the business and using the SSM methodology I have drawn a rich picture based on the Fashion Buttons situation (Figure 22). The primary concern here is that a lot of supposed feedback was and is being provided to the personnel but there seemed to still be a lack of understanding of the business or, as perceived by senior management, a lack of commitment.

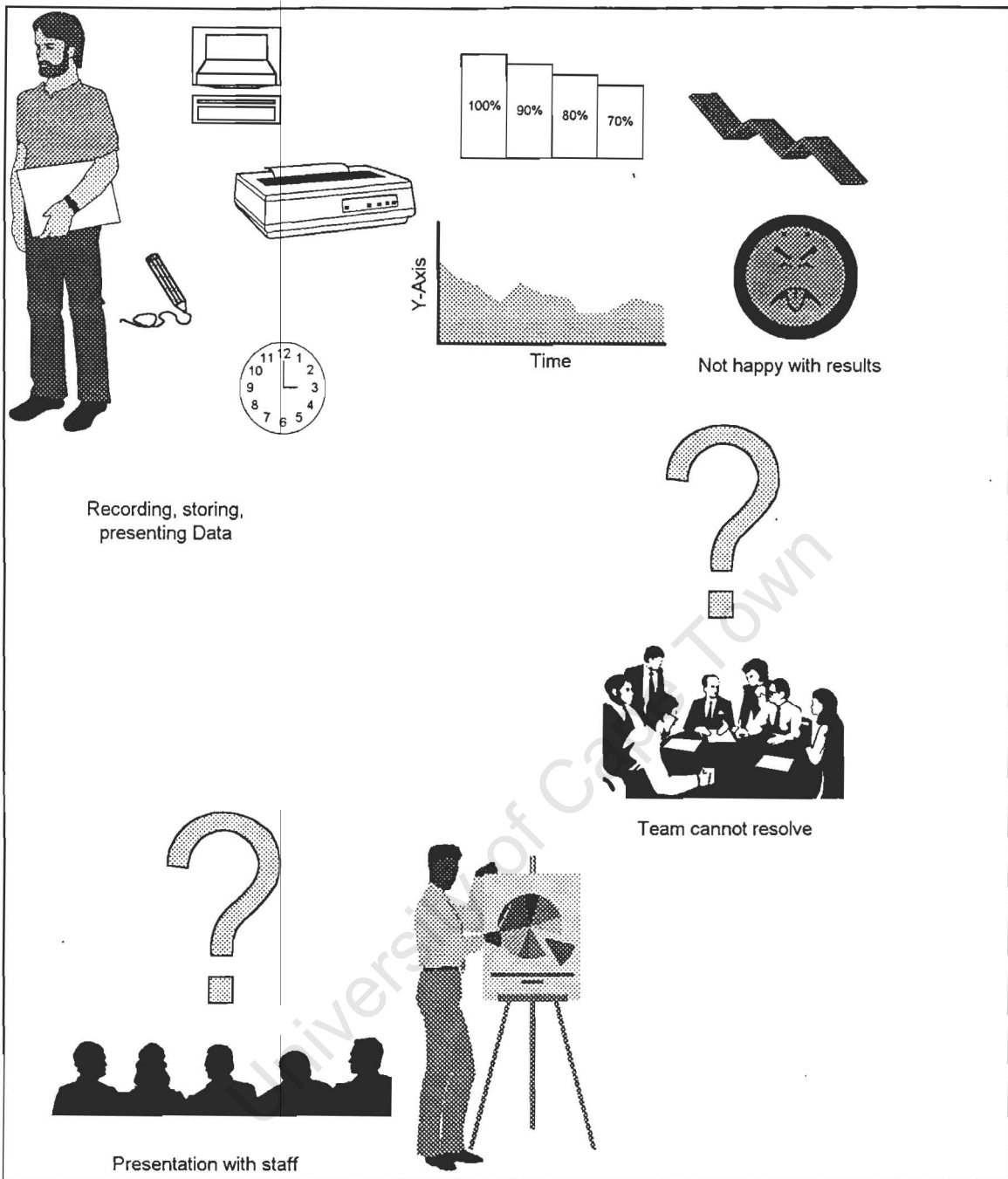


Figure 22 SSM Rich Picture of Situation

RELEVANT SYSTEM

From this Rich Picture the Relevant Systems are the recording of data within the Fashion Buttons context and then the presenting of information as feedback either as graphs or in formal feedback sessions.

The Relevant System that I am going to focus on in this instance is the feedback loop that does not have the desired effect within this situation.

The Root Definition is as follows:

A System that provides relevant and useable information, from data collected, regarding performance of the plant to the relevant department heads and sections such that it motivates the respective sections to take corrective action.

In doing a CATWOE analysis of the root definition I will check the root definition so as to ensure that all aspects are covered by the definition.

- Customers: these are the people within the system who are to benefit from the feedback and in this instance would represent Fashion Buttons and all its role players. They can be seen as beneficiaries if they are able to react to the information to the benefit of themselves and the organisation and could be the victims if they are not able to interpret the information correctly.
- Actors: these are the people that do the actual recording of the data and represent it as information in the various formats, i.e. management reports, graphs etc.
- Transformation process: this is the changing of the collected data to relevant and understandable information for the role players.
- Worldview: this makes this system relevant in that the information provided must be of such a nature that it motivates the role players. Up until now the information provided has not done that for the organisation.
- Owners: these are also the role players as they are imperative to the system. If they are not interested in buying into the system and owning it their recording methods will not be of any use to anybody.
- Environment: the constraint in this system is that a lot of the data gathered and inputted into the respective computer system is not really understood by the people doing the collecting of data but taken for granted as being correct as it was implemented by "higher powers".

CONCEPTUAL MODEL

The Conceptual Model that flows from this Root Definition is a data collecting process that then transforms this data to information that is understandable to all levels of personnel and which motivates them to take action or react.

The crucial element in the conceptual model represented in Figure 23 is the presenting of the data in an understandable format to people such that it is of relevance to them. If

there is no understanding there cannot be any input from the role players. I will investigate this further in the data collection stage.

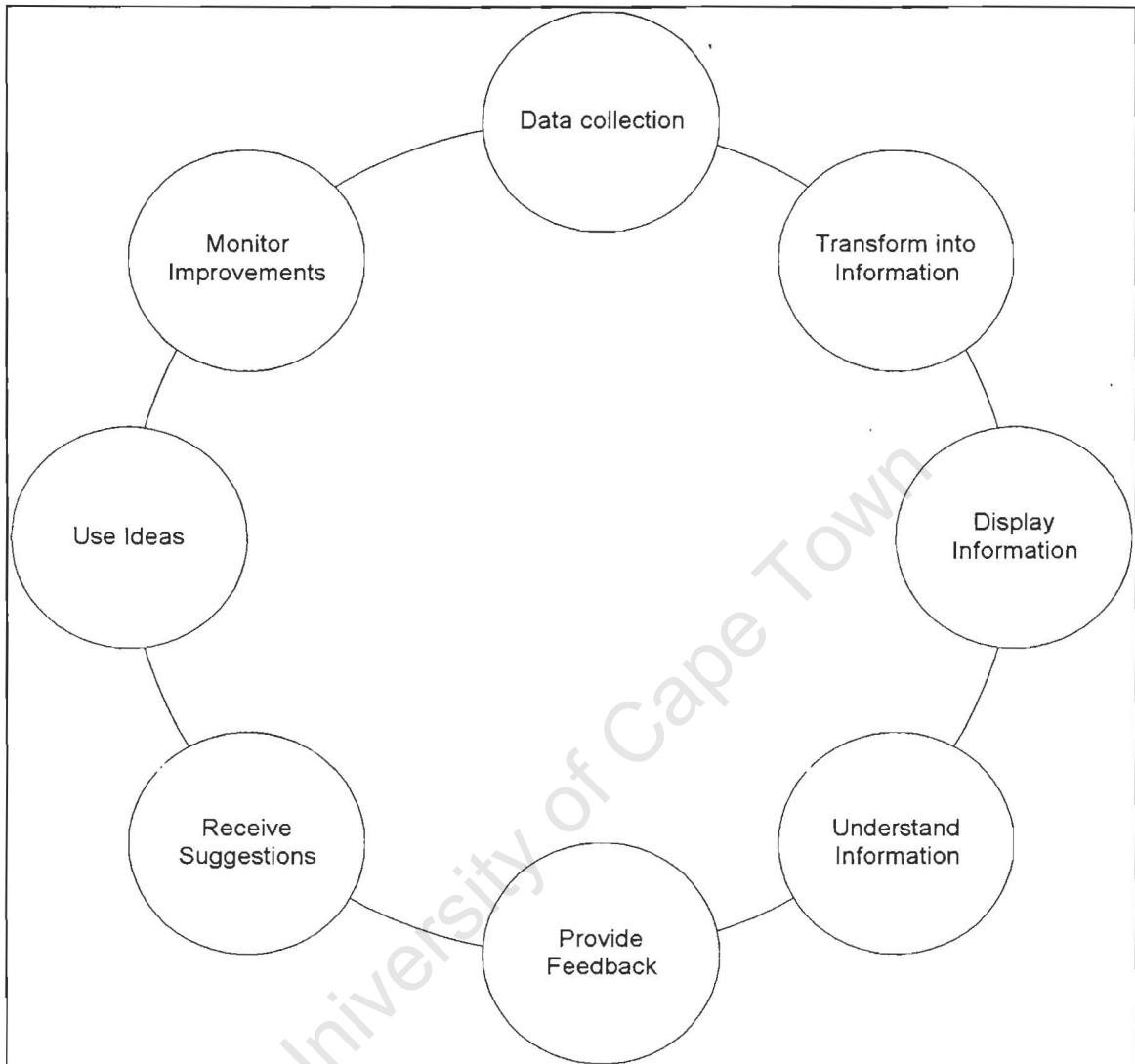


Figure 23 Conceptual Model

GOALS AND ASSUMPTIONS

My deduction is that the feedback provided in our situation is not effective. There is a definitive lack of understanding of the feedback or the information being fed back is not relevant. People seem to have a relative understanding of what is required and what the targets are e.g. scrap rate of 5 % or lower, machine efficiency of 80 % etc., but the understanding of this information to the business does not seem to exist. The idea is to look at the information and to make the feedback pertinent.

Every learning process, investigation or research process has a feedback loop. It is imperative that the feedback is relevant to the situation or else the process can fail miserably or at best blunder on wondering why there is no improvement.

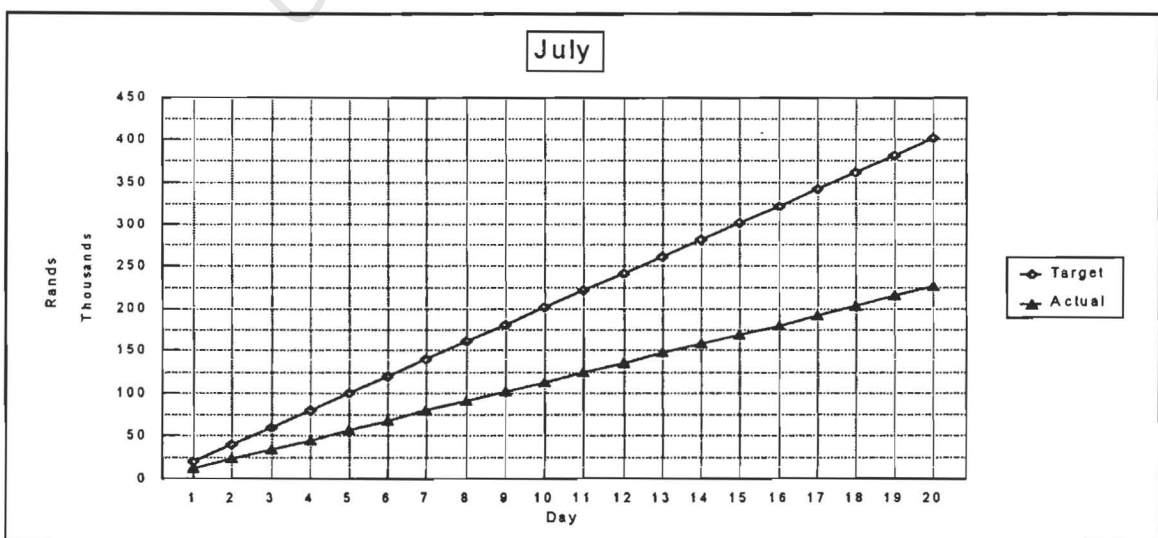
The following assumptions are made about the role players:

- That they are all willing, able and capable of performing their tasks.
- That they have the necessary skills to perform their tasks.

Under normal conditions this would have to be analysed and confirmed, but for the purpose of this project it will not be researched further.

DATA

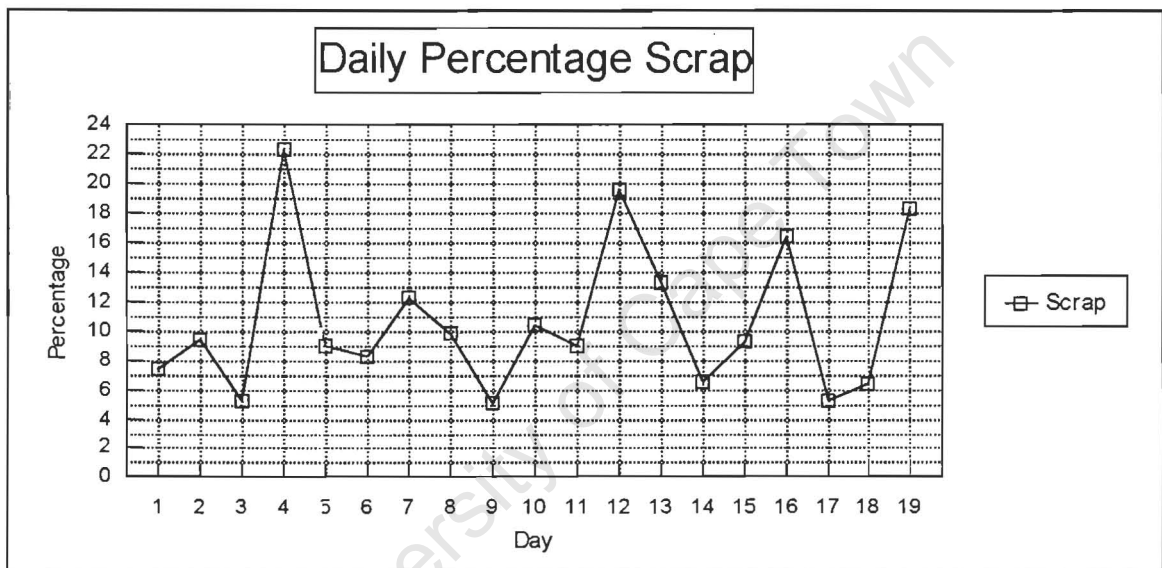
In further analysis of the situation, to assess the extent of my deductions made earlier, I took samples of the kind of feedback being provided to staff members in Fashion Buttons. I will discuss the graphs in some detail and the results I received from the discussion when I selected a cross-section of personnel and interviewed them individually as to what this information meant to them and what kind of information it provided them about the business. The cross section of people questioned were from department heads down to operators with the education level varying from Std 3 to matric with one semester at Technikon. During my interviews it came to light that there were people who could not actually read or were functionally illiterate but were able to read numbers.



Graph 1 Actual Vs Target

Graph 1 is a straightforward graph reflecting performance versus Budget in Rand terms for a month, July, with 20 working days. The upper line reflects the target and the lower the actual performance.

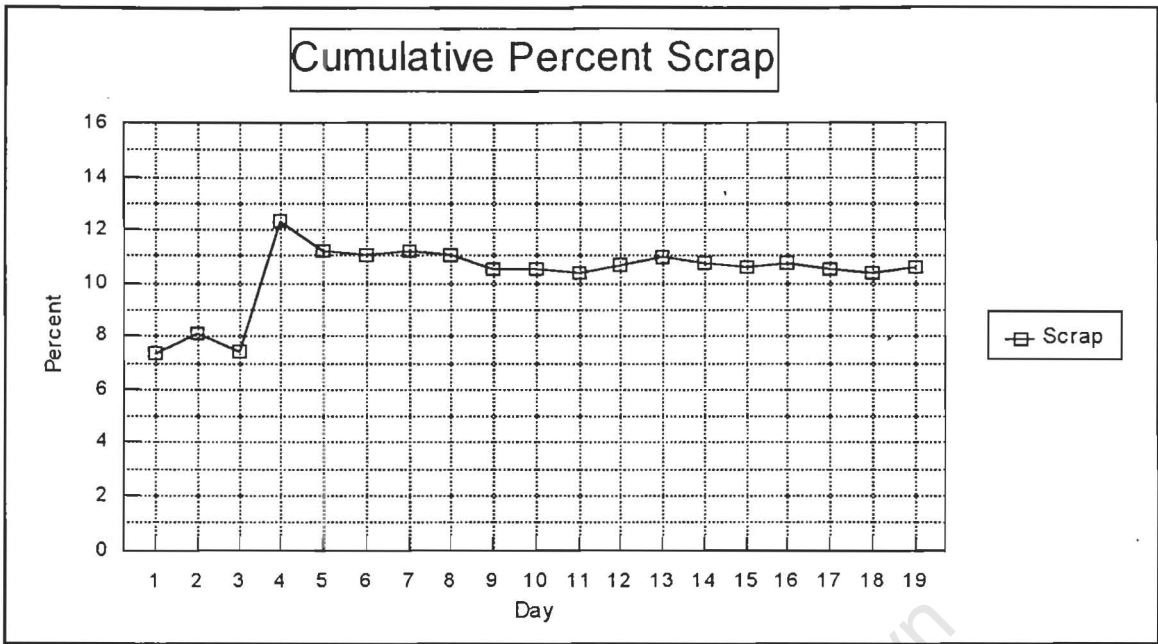
In most instances this graph was recognised correctly and interpreted correctly in that this business seemed to not be doing well. In one instance the wording was interpreted incorrectly in that "Actual" was seen as what actually should have been achieved and the "Target" was what was achieved. Where people were not able to read they seemed to get a handle of the information once prompted with an interpretation of the wording.



Graph 2 Daily Scrap Rate

Graph 2 shows the daily percentage scrap produced and the fluctuation over a 19 working day period.

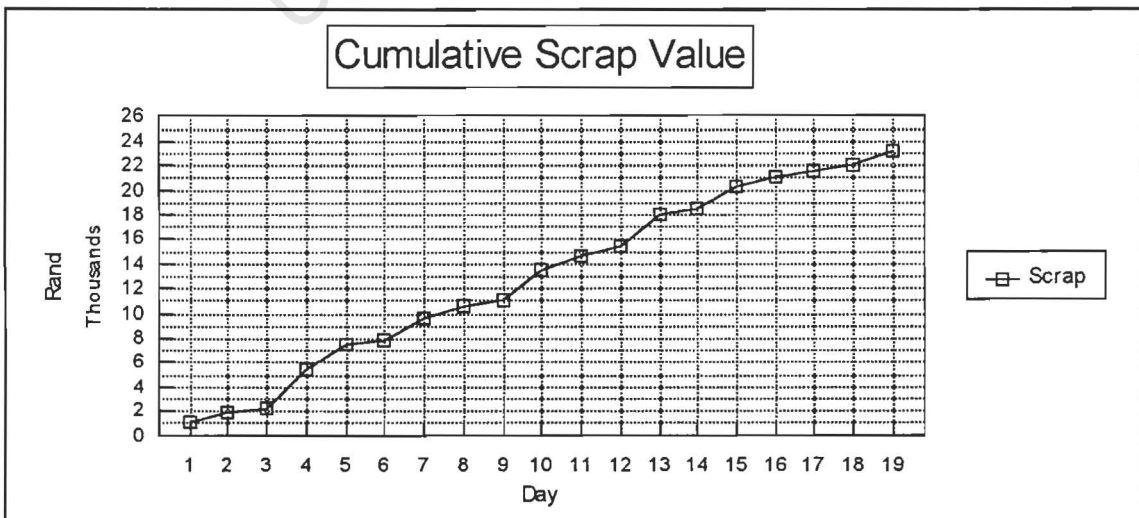
A few people were confused by the variation and fluctuation and were not able to identify the graph. Others were horrified by it and felt it was a process out of control. Some immediately stated that the target scrap rate was 5% and therefore this situation was not good. Again those that were not able to read thought it was some sort of daily output performance measurements and saw the high points as good days.



Graph 3 Cumulative Scrap Rate

Graph 3 shows the same scrap information as represented in graph 2 but on a cumulative basis.

Most people felt more comfortable with this graph as the situation seemed more stable, that the average scrap rate was just over 10 % and that this was not too bad as the target, as everyone knew and stated, was 5 %. This for me was significant, as people seemed to be lulled into a comfortable feeling of "this is not too bad".



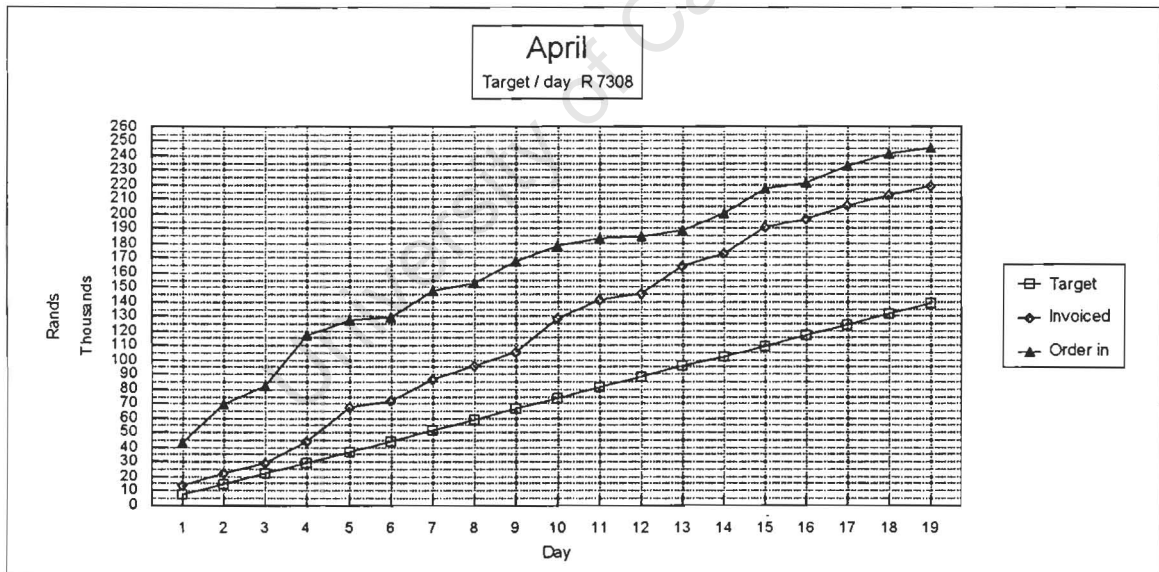
Graph 4 Cumulative Value of Scrap

Graph 4 shows the same information as Graph 2 and 3 but the scrap here was reflected in Rand terms cumulative for a 19 working day period.

Again most had no difficulty identifying this and felt that this was horrific as the value was 23 000 Rand. Some had difficulty interpreting the scale for the Rand value but knew it could not be R23. Most felt that day 1 was not too bad but day 19 was atrocious. It seemed interesting that there was no understanding of cumulative. Some felt that the situation was just progressively worse.

When asked whether the information represented in Graph 2, 3 and 4 were from the same source, most felt that it was not. Only one person (most experienced and highest qualified) identified it as coming from the same source.

Graph 5 reflects for a particular April month with 19 working days and a target of 7308 Rand per day, the invoicing, the order intake and the actual target achieved. The graph shows the company is performing well above budget.



Graph 5 April Performance against Budget

Most identified it as such although one commented that the target should be higher than the invoiced amount, or the business would run into trouble. I realised from this that the person did not really interpret target correctly. Most felt that this was a business that was doing extremely well and that is probably why most have been

wanting to talk about wage increases. The understanding was that if the performance was so high the profits must be great.

Table 2 shows the expenditure and profit line as pertaining to Fashion Buttons. This is the format the feedback session with the general manager took in June 1996 and has been continued since. All the figures are represented as a percentage of sales. The original plan was to aim for a break-even situation, but due to the better than expected performance the goals have been revised.

All interviewed recognised it as the information being represented during the feedback sessions. All thought that only 1-percent profit on the kind of performance being achieved was not good, but when asked what could cause this there was no understanding. In some instances the feeling was that if the amount were made bigger the value would be bigger. It would seem that the concept of percentage is not tangible to most of the people yet we tend to measure most performances in percentage.

Item	Goal	Jan + Feb	Mar	Apr
Sales	100	100	100	100
Resin	23	27	25	25
Wages	20	20	25	25
Elect				
Cell Pho				
M/Vehi	25	21	26	27
Pensions				
Salaries				
Machines				
Factory	10	10	11	10
Rent				
Sales Reps	2	2	2	2
Admin	5	5	5	5
Interest	5	5	5	5
Profit	10	10	1	1

Table 2 Expenditure per Month

OPTIONS

The option that I am selecting in this instance is to represent the Scrap not as a cumulative percentage of output, as has always been done, but in monetary terms. If one summarises the thinking behind Human Performance Technology³¹ (Figure 24), as a possible approach, one vital aspect thereof is the Feedback process.

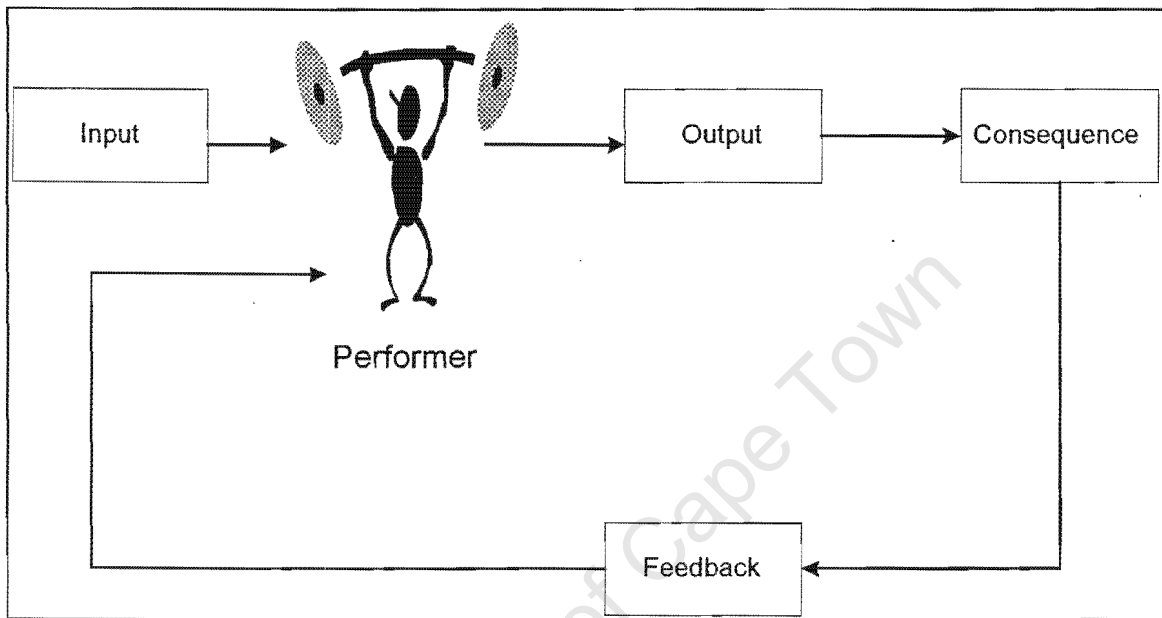


Figure 24 Human Performance Technology

Some key questions asked about the information in this feedback loop are:

Do performers receive information about their performance?

- Is it relevant?
- Is it accurate?
- Do they receive it on time?
- Is it specific?
- Is it constructive?
- Is it easy to understand?

Work Systems research has suggested that there are three types of information processes.

³¹ Geary A Rummier, Alan P Brache, Transforming Organisations, pg 38

1. Strategic Information Processes: information processes that contribute to management. These create, convey and develop meaning to all people involved in a work system.
2. Control Information Processes: lead to a corrective, regulative action by people contributing to transformation processes, Control information flows through a corrective feedback loop.
3. Audit Information Processes: which lead the actors to a more profound understanding of why the process is carried out, what it does, with what means it is performed and how these means are used.

If we then look at the Value-adding Domain³² which is the process level for this project the kind of aspects that drive our information process and the need for it are the following:

- Basic Strategic Dilemma can the required output be realised with a minimum of waste? The demand for efficiency for meeting a defined client requirement with the tools and methods at hand is satisfied in the processes taking place at this level. Nowhere else can efficiency be achieved
- Control Information there is a need to have direct feedback about the present state of the required output and the waste produced in the process.
- Audit Information reviewing the understanding of the output specifications and the standard procedures to achieve them and the analysis of waste patterns generated in the process.

The primary concern in the Value adding Domain is that of wastage. This is wastage in any form, which can be due to:

- Time
- Faulty product
- Rework
- Quality
- Performance

To be able to relay this information, feedback is a vital component that, if not understood, has no effect whatsoever on the people it is meant for.

³²Luc Hoebeke, Making Work Systems Better, John Willy & Sons New York, 1994 pg 37

Based on my experience within Fashion Buttons and believing that I have a fair understanding of the people involved, my prediction is that a reasonable understanding of the information, or providing information that is meaningful and tangible, will actually bind people into working towards a common goal.

This type of performance measurement is actually difficult to measure as it is based on soft issues. All that can be observed are people’s reactions and their response, as the other issues are only visible over a far longer period.

EVALUATION

The action that I took was to represent the scrap value in Rand terms and observe the reactions of the people and see whether it has any effect in other aspects of the business. It must also be understood that people who were not able to interpret the information were given the necessary skills and training. The preliminary results are shown in Table 3 and as can be seen there seems to be a slight improvement in the scrap figures. This will have to be measured over a longer period to see whether the change is self-sustaining.

	Feb	Mar	Apr	May	Jun
Ave %	10.8	10.9	10.3	7.3	6.6
R Scrap	34393	20837	23153	20083	15049
R / Day	1720	1158	1218	873	1003

Table 3 Average Scrap per Month

Another change that was observed, but which is probably the result of other factors as well (one being the monthly feedback session of the financial results), is that people were actively looking at cost savings. For the first time without reminders and prompting, staff were checking the ex-stock blanks to try and fill orders without having to pour them. This was even more noticeable as some of the blanks were packed into a redundant store for later disposal and were as such not readily accessible. Sorters are resorting scrap, becoming aware that they tend to shift the goal posts. They themselves are aware that they become good at seeing faults and thus contribute to the scrap rate unnecessarily.

As can be seen from the graphs in Appendix F there is a steady improvement in the scrap figure from May month onwards. For June the scrap rate has come down to 6,62% which a remarkable improvement over such a short time. What is very noticeable is the initial reduction when the R 20 000 scrap value from May month was still fresh in everyone's mind.

This simple implementation of just presenting information in a different format made all the difference. It is important to get the input of key role players and not take anything for granted, even the ability to read.

LEARNING

It is so easy to take certain things for granted, be it:

1. The ability to read
2. The ability to understand information
3. The ability to interpret information

It is very evident from this that even though everybody may have a similar understanding of the targets and goals, this does not mean that they are seen or interpreted the same way.

In Chapter 6 I will apply the Inquiry Framework to a second cycle of learning based on the new situation.

CHAPTER 6

As a result of the findings of the first application of the Inquiry Framework a new situation developed that needed to be addressed. In this instance, after applying the Inquiry Framework and analysing the new situation, I had to look at the situation from a more soft issues point of view as the measurement of the changes were not really quantifiable. There were rather changes in attitude. In this instance I swapped people in their line-function and observed the changes that took place.

OUTCOME CYCLE 2

SITUATION

Three months after having revelled in the glory of the successful implementation there was a change in the situation. The graphs were not being displayed as the clerk who collected the data had to go to hospital for a month. Within one month the scrap rate had again risen to 9,5%. This is a clear indication that change is not self-sustaining.

Is one of the overriding factors of systems thinking not to expand the worldview, to expand ones awareness about the environment of which we are a part? The greater ones awareness is, the more one is aware of the influences of ones own actions and interactions as well as actions and interactions of others. For some reason this did not happen in the cycle of the first application of the Inquiry Framework.

CONCERN

This leads us back to why we are again going through the inquiry process? The solution did not resolve the problem, therefore is the problem solving process flawed? Have we still not learnt to learn effectively?

The hypothesis that I am going to investigate is that effective communication is essential in the transfer of information and that the information on its own is not the critical aspect i.e. as can be seen from the previous cycle the information is still relevant, but it is not a learning experience.

QUESTION

The question that arises is how does one improve communication within an organisation? When looking at it from an epistemological viewpoint one needs to look at what knowledge regarding communication is available and what proof is available that it is effective. What needs to be done to make information relevant and thus changes that were made, self-sustaining?

ANSWER

For this purpose I needed to go back to the role-players and try and gain more insight into the situation. For this purpose I will again use Soft Systems Methodology (SSM) within Action Research, keeping in mind Critical Thinking i.e. questioning everything.

The idea put forward was for people to change positions for a time-period so as to increase the awareness, knowledge and understanding of the process. Both Charlotte and Vivian have many years' experience in their respective fields and have worked closely together. They both attend production meetings on a daily basis and it is assumed are aware of the problems and issues that need to be addressed. The reason for this selection is that Vivian in the Polyester Plant is at the starting point of the process and Charlotte is involved in the planning and the loading order.

RATIONALE

Most of the key role-players have been in Fashion Buttons for 12 to 16 years and been in the industry even longer. Everyone felt communication was important, and everyone had a slightly different interpretation of communication. All had enough experience about the business to have had some exposure via communication with other departments and as such it is assumed they understand the relevant problems.

Something that was quite noticeable for me was that communication was taking place, this was based on having worked with someone for a number of years and a relationship having developed, but it did not seem to be effective communication.

Communication can take various forms. In the *Macroscope*³³, Joël de Rosnay refers to Communication as: the exchange and circulation of information in a network that connects transmitters and receivers. The significance of the information thus transmitted varies from individual to individual. The example that he cites is that of the information, that it is going to rain, this means something completely different to a holiday maker than to a farmer waiting on rain.

He refers to three different types of information transmission (Figure 25 taken from pg. 137 *The Macroscope*, J de Rosnay).

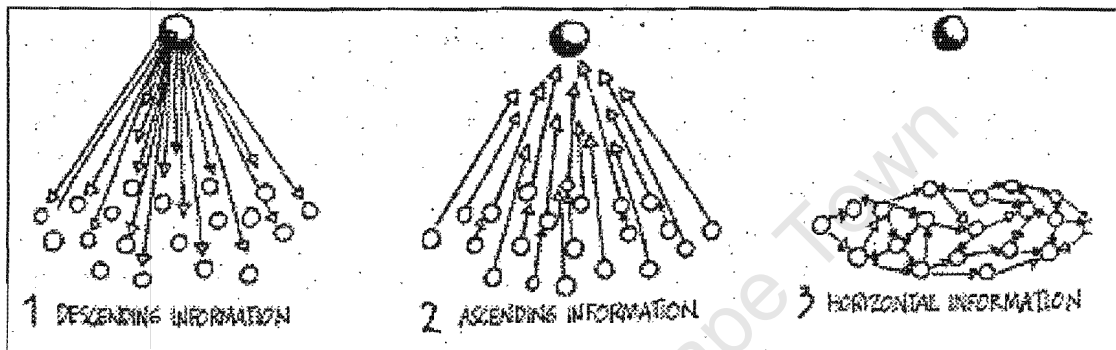


Figure 25 Communication Systems

For information transmission one could also read communication. In the organisation it would seem that there is a lot of descending and ascending information or communication but very little effective horizontal communication. People it would seem need to be told what to do, like to believe that they have a channel to be heard, but do not communicate enough between departments.

Another point that he makes is:

"The two evolutions involve the continuation in society of two fundamental actions of the individual conscience: *observation* (acquiring knowledge, informing oneself) and *creative action* (organising the world, informing matter). In the first case, all acquisition of knowledge is counterbalanced by an increase in entropy in the universe. In the second case, all creation of new information by the human brain contributes to a decrease in entropy locally. Daily experience shows that the first mode of activity is

³³ Joël de Rosnay, *The Macroscope*, Translated from the French by Robert Edwards, Harper & Row, 1979, pg 137

considered easy, requiring little effort; the second is considered more difficult, more demanding."

This is one particular comment that led me to look rather at an active way of improving communication than a passive. The passive way of acquiring knowledge is in essence what has happened all these years. Departments would communicate their difficulties and problems continuously but this is a passive acquisition of knowledge or information. Until a person has experienced it, it is just acquired information and not relevant information.

Another book that I found to be pertinent for this particular situation was "Maverick"³⁴. It is a book about work and the experience of a Brazilian company called Semco. In it Ricardo Semler describes the transition of the company that he took over from his father and transformed it into quite a remarkable company. One of the aspects that they evolved over the years was job rotation. This meant that no one stayed in a particular position longer than five years. Their reasons were the following:

1. Obliges people to learn new skills
2. Makes life interesting
3. Forces the company to prepare more than one person for a job, which generates opportunities for those who might otherwise be trapped in the middle of the pyramid
4. Encourages the spread of diverse personalities, outlooks, backgrounds and techniques and thus injecting new blood and fresh vision
5. Discourages empire building

It was the fifth point that made me feel more confident that the implementation would make a difference. Empire building is a serious deterrent to effective communication. People spend too much time "defending" their position rather than focusing their energies on the business.

The action required is the exposure of people to other areas and as such not only increasing knowledge, but also awareness. To this end I decided to get department heads to swap roles for a period of time so that they could get firsthand experience as to what the problems are.

³⁴ Ricardo Semler, *Maverick: The Success Story behind the World's Most Unusual Workplace*, Warner Books, 1995

To investigate this issue further I had separate discussions with various role-players. The questions I asked related to their current position and sphere of influence and then how they saw the others position. I also tried to frame it in a manner that could give me some insight into their current beliefs. The questionnaire is added in Appendix B together with a condensed version of the answers.

RICH PICTURE

For the purpose of completeness I have drawn a rich picture of the situation as described earlier (Figure 26). To explore the idea further I had discussions with the various department heads. The questions asked are displayed in Appendix B. The focus of the questions being directed towards information feedback and why, when it is removed, there is a return to the previous unacceptable situation (high scrap rate). This is even though it is the same actors and their awareness had supposedly been increased.

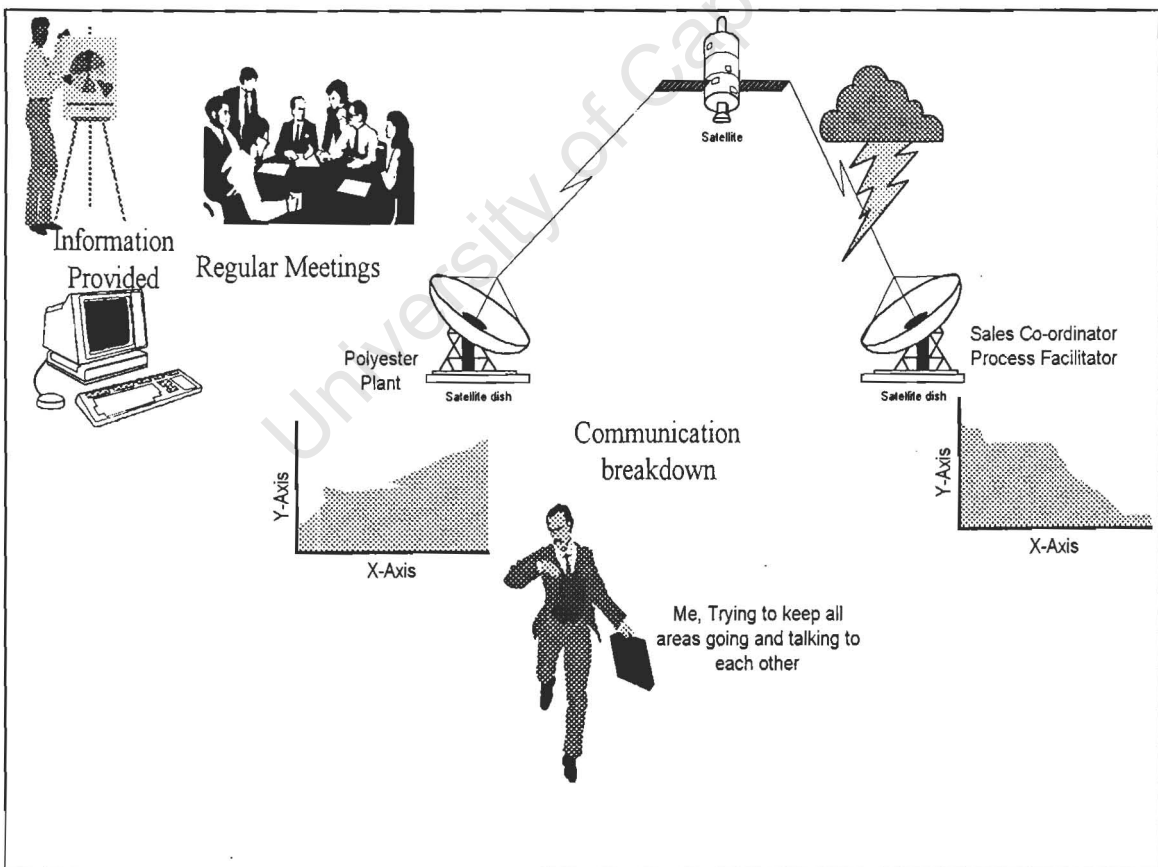


Figure 26 Rich Picture

Information is being passed between departments but somewhere there is a communication breakdown. What needs to be looked at is whether these problems are real. I would say so, as information that is available is not being effectively transmitted.

From the questioning it would seem that not only must the information feedback be relevant, but also the communication must be clear and unambiguous. Socio-political barriers must also not contaminate the communication.

Everyone questioned made it quite clear that communication is vital for the effective running of the business. When probed further everyone had a different definition of communication. All had elements of the others, but none were exactly the same. The definitions ranged from talking to each other to the transfer of relevant information to another person.

RELEVANT SYSTEM

The relevant system is the information interaction between the departments. At the same time this must be an understanding that is internalised, i.e. understood implicitly.

ROOT DEFINITION

The root definition formulated in this situation is a system that allows for free flow of relevant information between role-players that is understood implicitly and internalised.

I will do a CATWOE analysis for completeness.

Customers: actual customers of the business that will benefit from the better interaction.

Actors: the role-players delivering the goods and providing the service

Transformation process: the interaction brought on by the understanding of the roles and the team effort created.

Worldview: the education level of the role-players guides the thinking

Owners: Shareholders of the business

Environmental Constraints: the limitation of the manufacturing process and the industry it supports.

The activities of the conceptual model are the transmission of information that is relevant to the business and is not seen as an invasion of or interference into another's

territory. For this to take place the roles of the other manufacturing areas together with their limitations, restraints and strengths must be understood.

ROLE PLAYERS

I provide a short background of the people that I selected for the purpose of the report. The questions put to the role players are attached in Appendix B. In deciding on the process of gathering this data I chose the personal interview³⁵. William Trochim states that interviews are amongst the most challenging and rewarding forms of measurement and that they require personal sensitivity and adaptability and to guide the interview such that it remains within the boundaries. I felt for the purpose of gathering this information the scaling methods would not be appropriate as there is no "scoring" required in this instance.

The interviewing principles I followed were the following:

1. The interviewer needs to:
 - Select the respondents
 - Be personally motivated to transmit the importance of the interview
 - Clarify any confusion without directing the response
 - Asses the quality of the response

2. In setting up the questions the following needs to be observed:
 - Is the terminology clear and not too difficult?
 - Is the question explicit?
 - Is the wording objectionable?
 - Is the wording loaded or slanted?

3. In asking the questions the interviewer needs to:
 - Stick to the questions given
 - Ask the questions the same way every time
 - Follow the sequence
 - Ask all the questions

4. In ensuring an adequate response the interviewer needs to:

³⁵ William MK Trochim, The Research Methods Knowledge Base, 1997, pg 133-139

- Listen attentively and wait for the respondent to finish
- Encourage the respondent directly
- Encourage the respondent to elaborate
- Ask for clarification
- Repeat what the respondent said

5. In recording the responses the interviewer needs to:

- Jot down (record) the answer immediately
- Include all probes

I have also included the answers, in Appendix B, in a condensed form and highlighted where there were some dramatic changes, both in learning and in understanding.

PROCESS FACILITATOR

Charlotte Samuels is 39 years old and started with Fashion Buttons in 1983 and has been with company for 16 years. She left the company for six months in 1996 for personal reasons and returned in 1997. Charlotte's job title is Process Facilitator and she is responsible for the planning of the orders and ensuring that the buttons leave the plant as required by the customer. Charlotte has to liase with the customer regularly.

Charlotte has worked her way up through the ranks having started as a sorter in the despatch to sampling clerk to despatch supervisor to process facilitator which includes supervision of the despatch staff and finishing department.

Charlotte's formal schooling background is a STD 4 education. From there she started work as a packer at OK Bazaars progressing to till operator and lastly till controller. Thereafter she was employed by ACA, which is another Cape Town based button manufacturer, where she worked in the despatch department.

POLYESTER PLANT DEPARTMENT HEAD

Vivian Lang is 49 years old and has also been with Fashion Buttons for 16 years. She started in the polyester plant with colour matching and is now the polyester plant department head. She is responsible for the colour matching and pouring of resin in the polyester plant.

Vivian worked for Buttrim another Cape Town based button manufacturer for 14 years before she joined Fashion Buttons. Here she worked her way up from hand moulding to colour matching. This skill is completely based on experience and self taught, as Vivian never attended a colour matching course.

Vivian has a STD 8 formal education. Her working career began in the shoe manufacturing industry in the gluing department before she started issuing work to the machines. She remained at this job for one year before joining Buttrim.

EVALUATION

The process and the results were rather encouraging. There was an excited buzz about Charlotte and Vivian. As one observer stated: "like a child with a new toy". This highlighted some of the points made earlier, that people require variety and excitement. The only instruction given was that they were to swap their positions and use their common sense to make it work. They spent about half a day showing each other the ropes and thereafter were left to their own devices.

It was impossible for Charlotte to be able to colour match so she needed to make use of Vivian's services. Also Vivian needed assistance with the generation of job cards. In this respect communication had to be effective as there was mutual dependency.

When I interviewed them afterwards and asked them to describe the event, both found the experience to be exciting, enjoyable and challenging. There were a whole set of new insights gained for both, both about the others job as well as aspects that were important within the job. What was interesting was that aspects that they knew about the others job were so much more meaningful since they had experienced them first-hand.

What stood out for me was how differently they viewed each others position after the process. For example Vivian, having felt that the raw materials of Charlotte's job were stationary and phones, afterwards realised that there were many other raw materials that were required for the finishing process. With Vivian having to communicate with customers she found out how important it was for the polyester plant to provide accurate feedback regarding pouring schedules and where delays would occur.

Previously she saw this as a hassle and a disruption in her routine when Charlotte "pestered" her for answers

Charlotte also had a dramatic change of heart in that she previously felt that the Poly Plant never took ownership of problems or mistakes and went into the plant with a negative attitude when having to confront them with a problem. She now discovered that this was not the case and would in future be far more open to constructive dialogue and problem solving.

What was also striking was the fact that even though for 16 years they had been colleagues they knew so little about each other's jobs and responsibility. What surprised everyone was that even with daily production meetings and communication taking place there was little real or effective knowledge about the others position.

One observation that was made was that there still seemed to be some form of blockage to communication when they swapped. There was a particular problem happening in both areas and both removed themselves from it even though they saw it happening. In discussion afterwards they stated that their brief had been to leave the other person to the new responsibility and not interfere unless asked to. What was quite evident was the camaraderie that evolved from the exercise.

Others that had observed the process also felt that they had gained from the exercise. All felt that this process needed to be continued and to let all department heads participate in the exercise. Another point of view that was strongly put forward is that the exchange should be done for at least a month to get more effective results from the exercise.

If nothing else people spoke about it openly and exchanged ideas and views afterwards.

CHAPTER 7

In this chapter I will reflect on the learning that took place. I will summarise my own learning and the effect it has had on the other participants and myself.

REFLECTION

What I need to point out before I continue is that any situation that is monitored, will by the very nature already produce a different result and change the situation that is being evaluated. This is basically because the person looking at or observing the system will have an influence on it and people that are being monitored or observed will behave differently.

With this in mind I want to look at the learning that took place. In the first instance there were surprising results. Surprising only because the mindset of the inquirer had been previously conditioned to think in a particular way. My comment in chapter 5 regarding the question of the staff's commitment to the business in a way reflects my own thinking. It is often difficult for a participant in the process to remove him or herself and take a helicopter view of the business. The framework allows this by not being restricted to one technique or process. All too often the basics are missed in a business as a person is too involved with fire fighting in the operation and obvious causes are not evident.

In the first instance the obvious fact that people did not understand percentages might seem very trivial but by correcting this, immediate results were produced. Had we not gone through the format of the Inquiry Framework this would not have been picked up and a totally different outcome could have developed.

The idea of the application of the framework was for the organisation to learn. This could not have been achieved if an outsider or consultant had done the implementation or intervention.

There was some obvious learning that took place

- An exposure to various techniques, methodologies and philosophies
- Re-looking at the business from a different vantage point
- By asking pertinent questions better understanding of the staff developed
- Time taken to analyse the business

The last point for instance seldom happens in an operational environment. In most instances the South African managers are inundated with work and to cope have to make quick knee-jerk decisions. There is generally very little time to reflect or analyse which decision has had which effect. I am not saying that South African managers are bad managers, but if we took a little more time at reflecting on the businesses we would be far more effective.

Not having a corporate philosophy or vision is like trying to steer a ship without a rudder. The Japanese in the 60's adopted a philosophy of total quality. This philosophy was adopted at a national level and has brought the nation to where it is now. This might be over simplifying the philosophical change that happened, but I believe it is pertinent. The Americans introduced a philosophy of "Buy American" and it has definitely not done their economy any harm.

If I had to develop the framework again I would rather start at the philosophical level. If one had a well thought through philosophy and then incorporated it in the ethos (values), based it on reality and experience, one would be set for success. My build-up to the framework started by looking at the techniques and methodologies and then understanding the philosophy behind it. Although using Systems Thinking probably circumnavigated this to a degree.

I believe that the rigour is provided by the fact that the outcome was one of positive change. A methodology as stated earlier in this Thesis cannot produce a precise repeatable result and the robustness (or rigour) can only be measured by the success or failure that the change brings about. The best one can hope for is to answer the question: Was the problem solved?³⁶

I believe the results speak for themselves.

ENVIRONMENT

The working environment had definitely changed in that people had been challenged in new ways. Their interaction within the organisation and with customers changed.

- People became more proactive regarding possible problem situations.

³⁶ Peter Checkland, Systems Thinking, Systems Practice, John Wiley & Sons, 1981, pg 17

- People were more conscious of clarifying their thoughts.
- People were not trying to force their learning on others but rather to impart it.
- People were not taking things for granted, but rather communicating more effectively.

People who participated in the implementation process were also more confident in taking decisions. They had become aware that to have full knowledge about a situation is impossible and sometimes they had to make a decision without this. Being aware of this limitation made them more comfortable with it.

My own particular growth as a manager was to play more of a facilitator's role and guide rather than a controller. People are generally very competent and experienced in their roles, especially when they have been in a particular environment for many years. What is required from managers is to be a resource for information and to make unemotional decisions. People require more guidance rather than the old autocratic, dictatorial style of management.

It is more effective to provide a learning experience than to tell people and teach them. The effects are more permanent and long term. Another aspect that we changed in our sales force training program was to make it far more hands on. Previously new representatives had been sat down in a boardroom and told about the product. Now they are briefed and then sent into the factory for hands on experience. Telling someone it is not possible to have pigmented buttons within 24 hours is very different from someone having experienced why they cannot have them.

APPLICATION

There are certain questions that arose out of the application and are left unanswered. I want to first list some of the positives that came out of the application and then address the questions.

Positives drawn from Cycles:

- Personal learning for myself
- I was forced to do an in-depth analysis of the business
- I had to evaluate my thinking
- I had to question my knowledge-base and gain understanding

- I had to question people's values and gain an understanding of people's values
- I had to Gain a better understanding of the reality pertaining to the system

New questions:

- So what?
- What value has been added?
- Where to from here?

To answer the first question, if nothing else, I have brought theory and practice closer together. All too often ideas and theories are shot down because one is told that "there is a real world out there and that will never work here".

Not enough time is spent on thinking through the application of a theory. Our theories are shaped by the events around us and we develop our theories based on explanations of these events. Practice generally uses description and explanations to try and predict and control an event. This generally happens in real time and is relevant to the participants.

A theory is only relevant if the assumptions made are made by the participant. If an outsider had to make assumptions about Fashion Buttons these would not have been pertinent other than to himself / herself.

The value that has been added might not be measurable in monetary terms (although the reduction in scrap does relate to monetary terms) but in people's own development. They have grown through their own learning experience and are able to impart that to others. This insight also guides them in their interaction with others and making themselves understood.

Where to from here? I have subsequently been moved to another division and have found application in the framework in getting to know and understand the new manufacturing environment faster. The framework has application in solving problems, in guiding thinking and in guiding learning.

CONCLUSION

The framework and pertinent aspects have been tested in a real situation and had application in guiding the process of inquiry and thinking. The organisation as a whole learnt from the project as people were aware of it and as such were observing and awaiting the results.

University of Cape Town

APPENDIX A`

VIABLE SYSTEMS MODEL³⁷

SYSTEM 1 - MANAGEMENT FUNCTION

System 1 concerns itself with the management of interactions amongst the operating elements. Management within system 1 is charged with ensuring that the elements which provide the operating capacity, work well together.

They also establish what can be produced, taking into consideration the following:

- methods;
- materials;
- manpower;
- machinery;
- money;
- messages (communication).

Where oscillations arise management generally apply methods to attempt to resolve these. In reality they cannot control oscillations which occur, because they are responsible for causing them in the first place.

SYSTEM 2 - CO-ORDINATING FUNCTION

Co-ordination in operations is handled at the S2 level. This entails mainly exterior facilities that contribute to the operation as e.g. MIS and accounting. This is the anti-oscillating mechanism of the organisation, to ensure that the action by one element of capacity (e.g. front-line staff) does not have the opposite effect to what was intended on another element of capacity (e.g. support staff). System 2 prescribes and regulates in its co-ordinating role in order to avoid oscillations, but it does not have the right to dictate what has to be done.

³⁷ Dr Barry Clemson, Phd, *Cybernetics: A New Management Tool*, Abacus Press, 1984, pgs 96-143

The co-ordination system (S2) is another channel through which the Control system (S3) effects its will on the operations units (S1). This is achieved by reconciling or harmonising the mental models of the operations units management with each other and with that of the Operations System management. The harmonisation is achieved

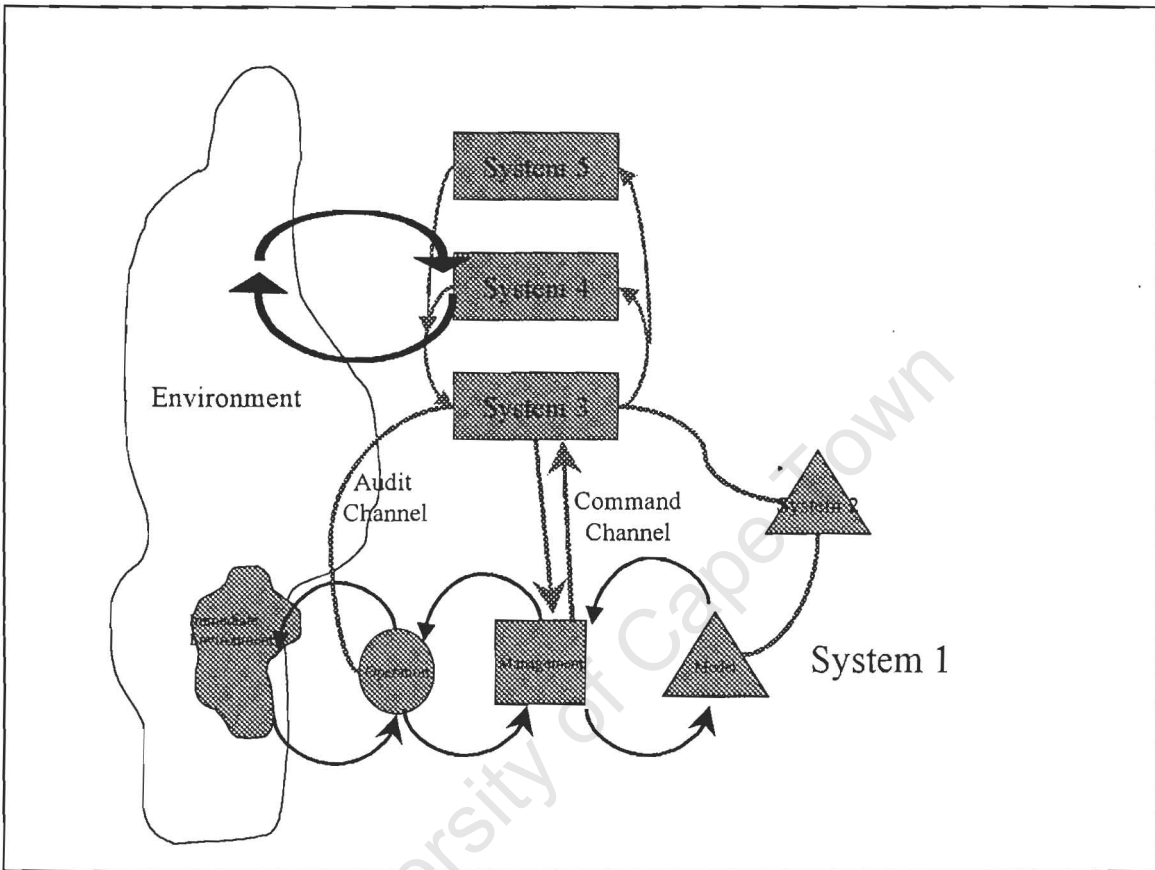


Figure 27: Viable Systems Model.

by the minimisation of oscillations created by the interaction of the management of the three operations units. The co-ordination capability of S2 is facilitated by the S2 operations management wide view that includes all the three operational units. Co-ordination is an important function as it guides the day to day activities of the operations function. In co-ordination clear lines of communication should be set by:

- clearly defining the operations structure;
- setting regular meetings.

The flow of information is of vital importance to the whole organisation since it will:

- improve decision making;
- allow managers to react before anticipated changes occur;
- decrease the size of the blind spot (Darkness principle).

SYSTEM 3 - CONTROL

Here a constant check has to apply to ensure that the work centre is not overloaded and this would occur at the S3 level with the necessary feedback being provided to operations via the audit channel. These exert influence directly on the management of the S1 operation. The control system is an after-the-fact evaluation of operations activities. It effects corrective measures when necessary. It acts as feedback mechanism to the Operations System management.

The mechanism of effecting control involves three steps:

1. Observation and data collection;
2. Comparison;
3. Action.

The control system observes the effects of the implementation of policy on the activities of the Viable System. This is compared in the context of set objectives. For example, in the context of market demands and resource utilisation. If objectives are not met, changes which need to be made are determined and implemented to bring about the required result. The control system is therefore concerned about dynamic equilibrium of Operations Management function; about present happenings in the operations function.

The control system (S3) carries out its function through a number of channels:

- Resource Bargaining Channel;
- Report Channel;
- Policy and Legal Constraints.

The resource bargaining channel is concerned with the interaction of the management of the three operations functions; activity scheduling, inventory management and capacity management. The channel matches the output and the resources each management would need (deserves) from operations.

Control is the fact evaluation and correction of the operations process with regard to capacity, scheduling and inventory. The standards for comparison should be linked to

what the market demands are, example a delivery rate of 95% when the competition guarantees 100%. There are three steps to control they are as follows:

1. Observe (what is actually happening);
2. Compare (examine what did happen in context of what should have happened);
3. Decide (determine what needs changing).

COMMAND CHANNELS

RESOURCE BARGAINING CHANNEL

Sets definitive roles, responsibilities and accountabilities. It should ensure that the resources have the capacity (required skills to meet tasks and if not what training is required), ability (the proper equipment and operational environment) and are enabled (the authority and responsibility to do what is required to complete the tasks).

REPORT CHANNEL

This is the setting up of performance measurement criteria, systems and feedback channels to constantly monitor inputs and outputs. It would ensure effectiveness and efficiency. Doing the right thing and doing it right.

POLICY AND CONSTRAINTS CHANNEL

This is the setting of rules and procedures for doing the tasks. The procedure and constraints will be directly based upon the policies of operations so as to gain standardisation to reduce the requisite variety.

SYSTEM 3* - AUDIT FUNCTION

The audit channel serves in a auditing capacity for quality assurance and safety checks. Quality assurance can be in the form of ISO 9000 which will check both internal and external quality checks. Safety is the setting up of safety assurance that will monitor the external (government laws and regulation) and the internal (safety committees) checks.

Auditing involves an in-depth analysis into the operational units. It looks at efficiency and efficacy, i.e. how well are resources inventory used and how well is the transformation process in Inventory organised to produce the outputs relative to the

larger organisation. The information so gathered is relayed back to the control system which sets up corrective measures through the command channels.

SYSTEM 4 - INTELLIGENCE FUNCTION

System 4 concerns itself with the overall health (viability) of the operations function relative to its environment. It is the intelligence gathering function of operations and has as its prime purpose an external and future focus, whilst ensuring that all information gathered is constantly fed back to the System 3 (control) function.

It has command of those resources which are left over after the needs of the productive system have been met and unlike System 3 which represents "operations in being" System 4 represents "operations in becoming".

In order to achieve its purpose, it formulates a model of the operations function, (i.e. its measures of input and output - what it does and how it does it), assesses its overall health, explores its synergistic relationships (and impact on other parts of the organisation) and evaluates future alternatives based on the current state of, and current choices exercised by, the operations function relative to its changing environment.

Alternatives are always oriented towards growth and change, toward dealing with new threats and capitalising on new opportunities and towards being more efficient and more effective.

SYSTEM 5 - POLICY FUNCTION

System 5 represents the identity function of operations. It is concerned with defining and clarifying the basic purpose of operations, by creating a policy framework within which the principle System 1 functions of Capacity Management, Inventory Management and Activity Scheduling can operate.

The framework contains a definition of procedures and the organising principles of operations.

Operations policy is influenced by the organisations' overall policies, which take an organisation wide perspective and concern themselves with the role, purpose and success of the organisation as a whole and therefore, with the total resources of the organisation.

The three major organisation Policy decisions that influence operations policy are:

- the nature of the product / service that is offered to the market;
- the nature of the market to be served;
- the manner in which the market is to be served.

The major operations policy decisions influenced by the overall organisation policy decisions are:

- the choice of the operations structure
- the selection of the operations objective, and
- the selection of strategies for operations

A primary function of System 5 is to ensure that the interaction between System 4 (Intelligence) and System 3 (Control) is at an optimal level (i.e. that the balance between stability and the rate of change is optimal) and that an equilibrium is maintained.

System 5 guides the decision making process in operations by creating boundaries, thereby reducing requisite variety and improving decision making by guiding managers to only take cognisance of the variables within the constraints of policy.

System 5 also acts as the closure mechanism of the VSM.

APPENDIX B

QUESTIONNAIRE

I ANALYSIS - THE HOW

1. What is the input and what is the output?
2. What are the parts of the system?
3. How do the parts interact?

II SYNTHESIS - THE WHY

1. What is the actual and desired purpose of the system?
2. What is done to achieve this purpose?
3. What is the measure of performance?
4. What are the boundaries, where does the responsibility start and where does it end?
5. What are the limiting factors on the system?

III STAKEHOLDERS - THE WHO

1. Who is the Client, Beneficiary?
2. Who are the actors?
3. Who are the Decision-Makers?
4. Who is affected by the decisions?
5. Who can stop what is happening?

IV MANAGEMENT - THE WHAT

1. Are the right things being done?
2. Are the resources managed and how?
3. What is required to run the business on a daily basis?
4. What enables the organisation to be effective?

V PHYSICAL DYNAMICS

1. What are the raw materials of the operation?
2. What goods or service are the output?
3. Is inventory managed?
4. Is variety managed?
5. Is capacity managed?

VI HUMAN WORK SYSTEMS

1. Is the organisations purpose known by the worker?
2. Is performance feedback provided and if it is does it work?
3. Do people work in teams and if they do how are they broken down?
4. Does each team have a leader?
5. Do teams do their own planning?
6. What is their reaction to mistakes?

VII INDIVIDUAL

1. Does each person know what is expected?
2. Is the individual willing, able and capable?
3. Is the job challenging?
4. Does the individual have the necessary skill and knowledge?
5. Does each person plan his or her own work?
6. Does each person feel they are adding value to the organisation?

QUESTIONS ASKED OF VIVIAN AND ANSWERS

Charlotte	Vivian Before	Vivian After
Analysis		
1. Orders come in, finished buttons go out	Order status in, orders going out	Order comes in, buttons go out
2. Order loading, printing Job Card, planning,	Order status, sequencing, check process, package.	Order loading, printing Job Card, planning, Poly Plant.

<p>Poly Plant, pouring, turning floor, polishing, sorting, finishing (if necessary), dispatching.</p>	<p>send button out</p>	<p>pouring, turning floor polishing, sorting, finishing (if necessary), dispatching</p>
<p>3. Instructions have to be passed on from one overall responsible person to ensure that the activity happens.</p>	<p>Interact, one person follows through and checks up</p>	<p>Communication is essential between the parts</p>
<p>Synthesis</p>		
<p>1. FB provides buttons for garments as specified by the customers</p>	<p>Deliver goods on time, does not always happen</p>	<p>Receive orders and deliver buttons on time while communicating with the customer</p>
<p>2. Provide sampling from which come orders</p>	<p>Team work</p>	<p>Keep customer informed</p>
<p>3. If there are no complaints from customers then we are doing well</p>	<p>If we are getting work out, we are doing well</p>	<p>Daily invoicing, % late</p>
<p>4. Receipt of order and liase with customer to when the required buttons are sent out</p>	<p>Starts with customer and ends with customer</p>	<p>Starts with customer and ends with customer</p>
<p>5. Late pouring in poly plant, running times on machines not adhered to, not adhering to plan</p>	<p>Absenteeism, promises not kept</p>	<p>Raw material availability, human errors, machine breakdowns</p>

<p style="text-align: center;">Stakeholders</p> <p>1. Paying customer</p> <p>2. Starting with Gadija, everyone involved in the process</p> <p>3. Charlotte</p> <p>4. Decisions affect customer</p> <p>5. Customer, raw material supplies</p>	<p>Customer</p> <p>Workers</p> <p>Charlotte</p> <p>Customer</p> <p>Customer</p>	<p>Customer</p> <p>Workers</p> <p>Vivian</p> <p>Customer</p> <p>Workers, customer</p>
<p style="text-align: center;">Management</p> <p>1. Not always, there is room for improvement</p> <p>2. Yes, through daily meeting try to optimise planning</p> <p>3. By everyone doing what they are supposed to</p>	<p>Should hope so</p> <p>Not as it should</p> <p>Communication, attitude, understanding</p> <p>Teamwork</p>	<p>Information can be displayed more clearly, e.g. Stock in stores</p> <p>Yes</p> <p>Orders, raw material, planning, Sales force, customers,</p>
<p style="text-align: center;">Physical Dynamics</p> <p>1. Resin, pigment, tool tips, moulds, dye stuff, electricity, water, gas</p>	<p>Stationary, phones, computers</p>	<p>Moulds, rings for buttons, stationary, plastic bags etc</p>

2. Buttons	Buttons to customer	Service to customer
3. Inventory is not managed well	Not managed	Yes, monthly stock take
4. Variety not managed	OK	Yes
5.	OK	Yes
Human Work Systems		
1. Yes	Should be, some do	No
2. Feedback is provided by myself to people, they are informed whether they are doing right or wrong	?	Yes, it is effective
3. One big team, people always help out, jump in for others	different teams in stages	Teams at every stager of process
4. No	Yes	Yes
5. Yes	Yes	Yes
6. Pass the buck, do not take responsibility	Resolved by team leader (department head)	Department heads talk to each other
Individual		
1. Yes they do, but most want to be told what to do next	Yes	Yes
2. All are	Yes	Yes

3. Yes	Yes	Very
4. Yes	Acquired experience	Yes
5. Yes, do their work without interference	Plan own work	No await instruction from leader
6. Yes	Yes	Yes

QUESTIONS ASKED OF CHARLOTTE AND ANSWERS

Vivian	Charlotte before	Charlotte after
Analysis		
1. Job Cards come in, Blanks go out	Job Cards come in, Blanks go out	Job Cards come in, Blanks go out
2. Job card, develop formulation, mix pigments, prepare in resin, pour, blank, cure blank	Job card, formulae + pigments, mixing, pouring, blanking	Job card, formulae + pigments, mixing, pouring, blanking
3. Instructions are passed down the line, details are on the job card	Instructions on the job card, department head passes on instructions	Each stage checks their work and follows instructions on job card
Synthesis		
1. Produce a blank to suite customers finished product	Provide correct blank for button order	Provide blank to suite button required by customer
2. Produce samples, develop buttons with	Follow instructions and keeping correct records	Follow instruction provided on job card

designer, turning floor needs to be involved		
3. No. of sheets poured / day	Sheets blanked, resin, used, no of re-pours	Information is available but not really passed on
4. From receipt of job card to when the finished product goes out the door	Correct formulae on job card to providing correct blank	From receipt of job card to when the finished product goes out the door
5. Absenteeism, wrong information on job card, raw material, machine breakdowns	Pouring efficiency, raw material,	Incorrect formulae, colour numbers not correctly marked, raw material
Stakeholders		
1. Charlotte (turning floor)	Turning floor, customer	Turning floor, customer
2. Workers	Workers	Workers
3. Vivian	Vivian	Vivian
4. Turning floor	Turning floor, customer	Turning floor, customer
5. Bosses, customer, opposition, raw material suppliers	Customer, raw material supplier	Customer, raw material supplier, management
Management		
1. Yes	Not always	Yes
2. Yes, check efficiencies	Yes,	Yes
3. Orders, raw material, manpower	Raw Material People	Raw Material, People, Machines, orders

<p>4. Communication, understanding, raw materials, machinery, skills</p>	<p>Everyone do what they are supposed to do</p>	<p>New developments, colour approvals</p>
Physical Dynamics		
<p>1. Order, pigment, resin, styrene, methelene chloride,</p>	<p>Pigment, resin</p>	<p>Various resins, pigment, methelene chloride</p>
<p>2. Correct blanks as required by order</p>	<p>Blanks</p>	<p>Blanks</p>
<p>3. Stock managed</p>	<p>Yes</p>	<p>Yes</p>
<p>4. Yes</p>	<p>Yes</p>	<p>Yes</p>
<p>5. Yes, know what is required and what can be achieved</p>	<p>Yes</p>	<p>No, know what can be achieved but do not keep target in mind</p>
Human Work Systems		
<p>1. Yes, quality blanks for buttons</p>	<p>Yes, sometimes</p>	<p>Yes but need to be motivated</p>
<p>2. No performance feedback from outside plant</p>	<p>PP informed of performance but not fed back to people</p>	<p>Yes but not fed back to workers</p>
<p>3. Yes</p>	<p>Yes</p>	<p>Yes</p>
<p>4. Yes, Vivian</p>	<p>No</p>	<p>Charlotte, Dept Head</p>
<p>5. Yes</p>	<p>Own planning</p>	<p>No, wait to be told</p>

6. Mistakes picked up in the plant are picked up and rectified, take ownership & resolve	Do not take responsibility	Take responsibility for mistakes
Individual		
1. Yes, can work on own	Yes	Yes
2. Yes	Yes	Yes
3. Yes!	Yes	Yes
4. Acquired skills and knowledge	Skills yes, knowledge ?	Acquired skills and knowledge
5. Plan own work, evaluate own work	Yes	Yes, part of problem, don't work to common plan
6. Yes	Yes	Yes

APPENDIX C

WORK SYSTEMS³⁸

TRANSFORMATION

The basic purpose of a work system is transforming inputs into outputs.

PROCESS LEVELS

Process levels describe the hierarchy of activities performed. By definition the relevance of a work system's input is lost as the process level is removed from the immediate area of influence. People can contribute to up to three different successive process levels and are only restricted by their limited information processing capabilities. It must be clear that it is not possible to relate organisational positions to process level influence. Organisational hierarchical positions are linked to authority between people in an organisation, while process levels are concerned with the contribution made to an activity or in the broader sense the enterprise. Contributions are made on three different successive levels. A process of a higher order is one whose output creates conditions for a lower order.

Process levels can be grouped into different domains, depending on the time span, i.e. the time needed to materialise the results of activities deployed. The longer the time span, the higher the process level.

CHARACTERISTICS OF A PROCESS LEVEL:

- It has an output that supports a lower process level. The lowest level creates the output required by the customer.
- It has contributions from people, up to three levels - requisite variety.
- It has self-organisation.
- It has information processes, viz. channels of control, audit and strategy (feedback loops).

³⁸ Luc Hoebeke, Making Work Systems Better, John Willy & Sons New York, 1994

CONTRIBUTION

Contributions are those activities which realise the output of a particular process level. This is defined by the result or output, rather than the activities that lead to an output. It is not possible to determine to the processes level to which a person contributes purely on the basis of their organisational position.

A definition of the process and its outputs must be completed. For the contribution to realise its full potential it is necessary for everyone involved to be responsible for their own contributions and possess some discretionary power.

As a formal simplifying mechanism it may be useful to have someone accountable for the process and its output. In this way, responsibilities and accountabilities become nominally known. Anonymous entities such as organisations, department, institutions, groups, and government can be held neither responsible or accountable.

CLIENT, ACTORS, OWNERS: THE MAJOR STAKEHOLDERS OF THE PROCESS

Those who contribute to the realisation of the output of the process are assuming the actor's role. Those who are the beneficiaries or the victims of the output of the process are adopting the client's role. Those who can effectively decide to stop the process are assuming the owner's role.

INFORMATION PROCESSES

Information is the raw material of creating meaning or the effective organisation of cybernetics as described by Beer

STRATEGIC INFORMATION PROCESSES

Those information processes which contribute to management, are know as strategic information processes. These create, convey and develop meaning to all people involved in a work system.

CONTROL INFORMATION PROCESSES

Control information processes are those which lead to a corrective, regulative action by the people contributing to the transformation processes. Control information flows through a corrective feedback loop.

AUDIT INFORMATION PROCESSES

Audit information processes are those which lead the actors to more profound understanding of why the process is carried out, what it does, with what means it is performed and how these means are used.

DOMAINS

The domain is a representation of the various strata of process levels and work systems. Four domains have been identified, each having three successive strata.

The domains are:

Added value domain	stratum 1 to 3, 1 day to 2 years
Innovation domain	stratum 3 to 5 from 1 to 10 years
Value systems domain	stratum 5 to 7 from 5 to 50 years
Spiritual domain	more than 20 years.

Each domain has its own emerging characteristics as a viable system.

VALUE ADDED DOMAIN

Added and subtracted value is created for clients, actors and owners. The reason for its existence is the mutual appreciation by suppliers and customers of the added value around an exchange. It is not always possible or desirable to meet all the needs of customers. In order to maintain manageable systems, the range of requirements, or variability, needs to be limited.

The key variables of this domain are :

Throughput Time | Time span required for the process, work capacity rather than

	actual process time.
Volume Requirement	Relevant unit for the customer.
Quality Requirement	Emergent systemic quality in which customer places appreciation.
Price Requirement	Appreciation directly related to the price customer is prepared to pay (2 approaches to price, $SP = costs + margin$, $Margin = SP - costs$) also related to how far customer is willing to go for product, how long he is willing to wait.

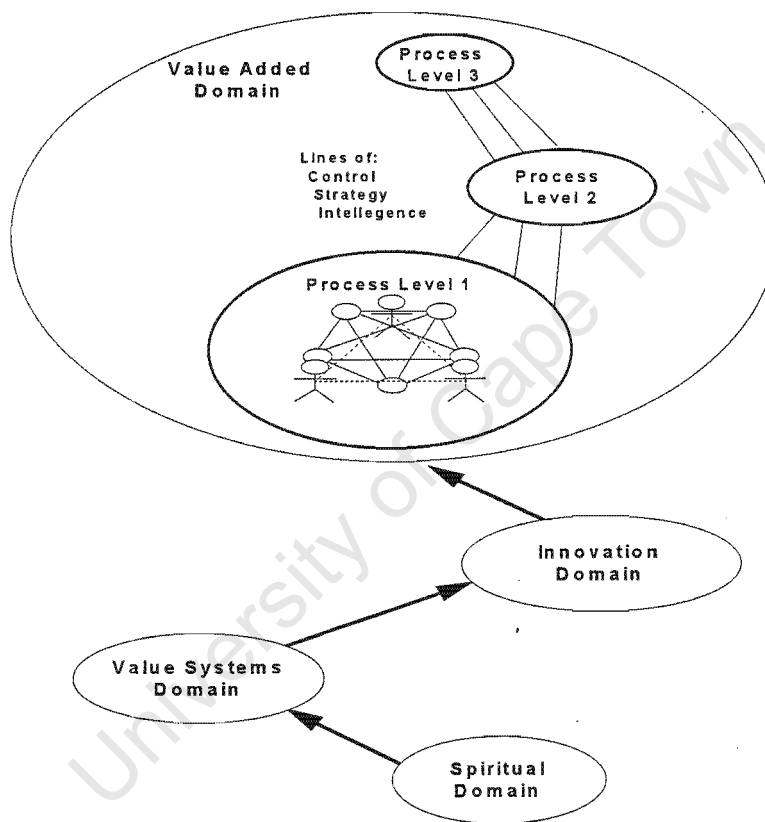


Figure 28: Process Levels And Domains.

The contributions of the process levels are:

Process level 1	<p>Produces the output (the lowest order) to materialise a specific output with a prescribed means, technology and method in the most efficient way.</p> <p>Efficiency is defined here as the realisation of the process with a minimum of waste.</p>
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Process level 2	<p>Creates conditions for Process Level 1 to meet its objectives. It's purpose is to mould the specific requirements of the client into minimal critical specifications regarding the output, the procedure, the tools and the input for those who perform the activity on level 1.</p> <p>This level deals with efficacy - quantified descriptions, specifications, and targets. Monitoring processes occur monthly at this level.</p> <p>Annual audits are completed, which should result in improvements.</p>
Process Level 3	<p>This level concentrates on developing alternative products and services and alternative ways of meeting the requirements and needs of known clients.</p> <p>These are strategic actions with the objective of determining effectiveness. e.g., planning, contingency planning, simulations, what-if studies, marketing research, consumer preference inquiries, design of measuring tools and procedures for use by process levels 1 and 2.</p>

RECURSION LEVELS

The concept of recursion, described by Beer, maintains that a recursive organisation is a viable system which is contained in and in turn contains a viable system. Although one recursion level is embedded in another the emerging characteristics are quite different. Organisation structures are only meaningful in a value added domain and lose their meaning elsewhere.

Relationships between work systems of a higher domain with those of a lower domain are not that of management and control. It should lead to the creation of conditions which foster viability.

APPENDIX D

SOFT SYSTEM METHODOLOGY³⁹

STAGE 1:

Identify the Problem Situation in an unstructured manner. At this stage the situation can only be dealt with in an open manner, as no insight is yet available to you the observer, also the entire situation is really a mess i.e. a situation of interrelated problems, which are as yet unidentifiable.

STAGE 2:

Use a cartoon techniques to representation or summarise the situation into a Rich Picture (a description containing all relevant information) of the situation. This is a means of uncovering the intricacies of the situation in an efficient manner with the purpose of moving from finding out about the problem situation, to taking action to improve the situation.

The main reason for using a picture, is that it is the most appropriate medium for representing the situation as a whole.

The information need & it's collection is as follows:

- The elements of structure in the situation, those parts which are relatively slow to change in the situation;
- The elements of process in the situation, those parts which are changing and form the processes of the situation;
- The interactions between the structure and the process, the actual way in which these two elements relate too each other;

³⁹ Peter Checkland, Systems Thinking, Systems Practice, John Wiley & Sons, 1981, pg 149
The Soft System Approach, Soft Systems Analysis: An Introductory Guide, The Open University Press 1984

- Do not try and impose a systemic character to the situation, as it is likely that it is just such an absence thereof which is causing a problematic situation to exist;
- Collect both hard information and soft subjective information;
- Include also the social roles and structure of the situation;
- Try to use as little written notation as possible and then only as footnotes;
- Include yourself as observer in the Rich Picture.

STAGE 3:

Identify the Relevant Systems present in the Rich Picture, then the Root Definitions which define the Relevant Systems also use a CATWOE (Customers, Actors, Transformation process, Worldview, Owners, Environmental constraints) to check that the Root Definitions are complete.

1. The Rich Picture should now be viewed in a systemic manner to reveal the various systems which are relevant to the situation. These should be written one liner statements i.e. as short as possible. Also try to view the situation from various points to find as many systems as possible, before selecting the most relevant one's.
2. Formulate a Root Definition to describe the Relevant System as clearly as possible, where root is used in the context of fundamentals or basics.
3. The CATWOE is now used too check whether the Root Definition is complete, with regard to whether or not it should contain the following:
 - Customer(s) of the Relevant System, both victims & beneficiaries of the system;
 - Actor(s) of the Relevant System, those who perform the activities within the system;
 - Transformation Process, that which the Relevant System does to it's inputs to achieve outputs;
 - World View, this enables you to add relevance to the system by guiding your observation point of the situation;
 - Owner(s) of the Relevant System, are those who have power over the system with regard to it's existence;
 - Environment Constraints, which are taken as given by the Relevant System.

STAGE 4:

Construct a Conceptual Model to depict the activities which should take place in the Relevant System to allow it to be true. This essentially is an activity model containing the logical processes or activities which make-up the Relevant System and are described in the Root Definition. The Conceptual Model will contain both primary and secondary processes or activities, and should be kept to as few as possible.

STAGE 5:

Compare the Conceptual Model to the Rich Picture to identify the non-matching or missing elements within the Rich Picture, these elements will now form the basis of an Agenda List.

This is the process of testing your Conceptual Model against the Real World Situation by comparison with the Rich Picture of the Problematic Situation.

Essentially the following questions are asked:

- How does the Conceptual Model operate?
- How does the Real World operate?
- Where are the two different?
- Why are the two different?

STAGE 6:

Now use the Agenda List as a basis for a debate regarding changes to correct the situation, with the key players in the situation.

In this debate or discussion ideas regarding change, which are both systemically desirable and culturally feasible should emerge, then only those changes which are capable of satisfying both should be considered for implementation.

STAGE 7:

Implement the changes which have been agreed in the debate with key players of the situation.

These are basically divided as follows:

- Structural Changes;
- Procedure Changes;
- Policy Changes;
- Attitudinal Changes.

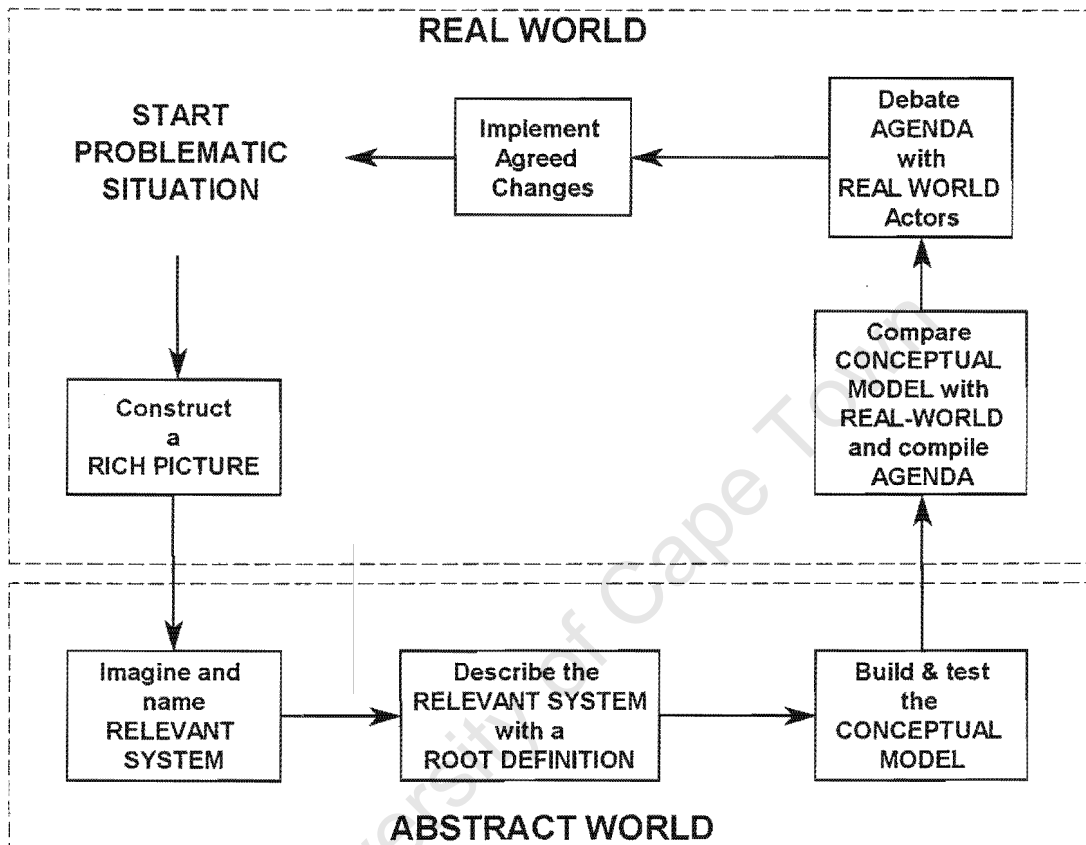


Figure 29: Soft System Process Model.

APPENDIX E

CRITICAL THINKING⁴⁰

Brookfield's concept of critical thinking used as a means to encourage the exploration of alternative ways of thinking and acting, is a crucial component of the Scientific Method. This process has been defined as 'reflecting on the assumptions underlying our and others' ideas and actions, and contemplating alternative ways of thinking and living'. This 'involves calling into question the assumptions underlying our customary, HABITUAL ways of thinking and acting and then being ready to think and act differently on the basis of this critical thinking'

Characteristics of Critical Thinking

A productive and positive activity	Critical thinkers are innovators, creative and see the future as open and malleable. They have a realisation of the diversity of values in the world.
A process not an outcome	A continual process of questioning assumptions and critical scepticism of accepted world truths
Manifestations of critical thinking vary according to the contexts in which it occurs	Can be totally internal or can be external. i.e. workers who change their workplace to be non hierarchical have exhibited critical thinking externally
Triggered by positive as well as negative events	Negative events can promote thoughts of how to prevent a reoccurrence, while a positive event may activate thoughts of how to repeat the occurrence.
Emotive and rational	Emotions are central to critical thinking, asking questions about our accepted assumptions is disturbing. When we abandon assumptions that we have been inhibited by, we feel liberated

⁴⁰ Stephen D Brookfield, *Developing Critical Thinkers*, Jossey-Bass Publishers, 1987

COMPONENTS

Criticism is often thought of in negative terms but the concept of critical thinking should result in a positive modification of a situation. Critical appraisal of a current situation is a matter of survival, in today's ever changing world.

Without this ability people are easily influenced into accepting issues and ideas that are not necessarily beneficial. Critical thought provides liberation from such influences and is culturally and organisational beneficial.

'Assumptions are seemingly self evident rules about reality that we use to help us seek explanations, make judgements, or decide on various actions.' This implicit personal knowledge and making explicit these implicit ideas is central to critical thinking. This process is a combination of hard logical thought and the recognition of the assumptions that give rise to beliefs.

As a concept it can be described as

- The development of logical reasoning abilities
- The application of reflective judgement
- The development of an awareness of the forces at work
- The understanding and resolution of contradictions.

As a result we justify our ideas and predict the consequences of any actions. The accuracy of these predictions can then be tested and result in reflective learning.

IDENTIFYING AND CHALLENGING ASSUMPTIONS

The central component of critical thinking is the identification and direct challenging of currently accepted assumptions. Typically these are taken for granted attitudes, and stereotypical ideas. A prime result of this process is the development of contextual awareness and a greater depth of understanding as to the origins of the identified belief patterns.

EXPLORING AND IMAGING ALTERNATIVES

For any situation alternatives do exist. The identification of these has two major effects

:

- Liberating - free to think in new ways and replace the obsolete with more effective ways
- Threatening - removal of the comfort zone and a disturbance of our mental equilibrium

Techniques for imagining alternatives

Critical questioning	Specific questions related to particular events. From this point it is possible to move to the general. Questions must be conversational and not confrontational
Critical incident	Examine a particular incident, as this is a meaningful point from which to develop alternatives.
Critical analysis	Indicators must be directly observable and unambiguous
Role play and critical debate	Creates the environment which allows the development of an understanding of other perspectives.
Crisis Decision simulation	Force a decision from a number of uncomfortable and difficult choices and this partially reveals the assumptions of the people involved.

A critical thinker must be able to imagine and explore alternative ways of thinking. This leads to a further understanding of both the assumptions and contexts within which the enquiry is taking place. This inevitably results in reflective scepticism of generally believed ideas. The fact that an idea is accepted or practice has existed for a long time, does not mean that they are appropriate for all time.

The Process

Trigger event	Discover an event or action that creates some inner questioning. It is not correct to assume that only negative events can be triggers. Positive factors can result in further positive thought and action.
Appraisal	Question the accepted norm. Clearly identify and clarify the concern and begin the examination process.

Exploration	Examine alternative explanations for the event.
Alternatives	The alternatives that are developed must not be mere modifications of existing behaviour, but at the same time they must make sense.
Integration	Once the new ways have been decided upon they must be integrated into the behaviour patterns.

ATTRIBUTES FOR CRITICAL THINKING

For a worthwhile result to be achieved the process of critical thinking should possess the following attributes :

Clarity	actions are clear to observers
Consistency	behaviour is consistent within same conditions
Openness	honest , ready and able to impart findings
Communicativeness	able to explain the concept and ideas of critical thinking
Specificity	encourage imitation through example
Accessibility	do not threaten or intimidate

APPLICATION WITHIN THE WORKPLACE

The workplace is a multidimensional structure and where democratic worker participation is the norm then the conditions for critical thinking are enhanced. The importance of workers perceptions of anomalies , discrepancies and crises are occasions for prompting critical thinking.

Management concepts that draw directly on the concept of critical thinking:

- Strategic planning
- Effective decision making
- Creative problem solving
- Situational leadership
- Entrepreneurial risk taking
- Research and development activities.
- Organisational team building

A characteristic of an organisation that is innovative and creative, is that normally the organisational channels of communications are horizontal rather than vertical. This type of structure encourages critical thinking as the central element in improving organisational performance, solving real problems and taking action in a purposeful, logical way.

The opportunity for creative thinking is created by the introduction of workplace democracy which includes initiatives such as :

- employee ownership
- flexible hours
- job sharing schemes
- quality of working life experiments, such as job re-design
- forums for grievance sharing

Through confronting the basic assumptions behind prevailing organisational norms, values, myths, hierarchies and expectations, workers help prevent stagnation and dysfunctional habits.

Critical thinking in the workplace should not only be fostered for the benefits of higher productivity and greater work satisfaction but also to affirm individual identities.

APPENDIX F

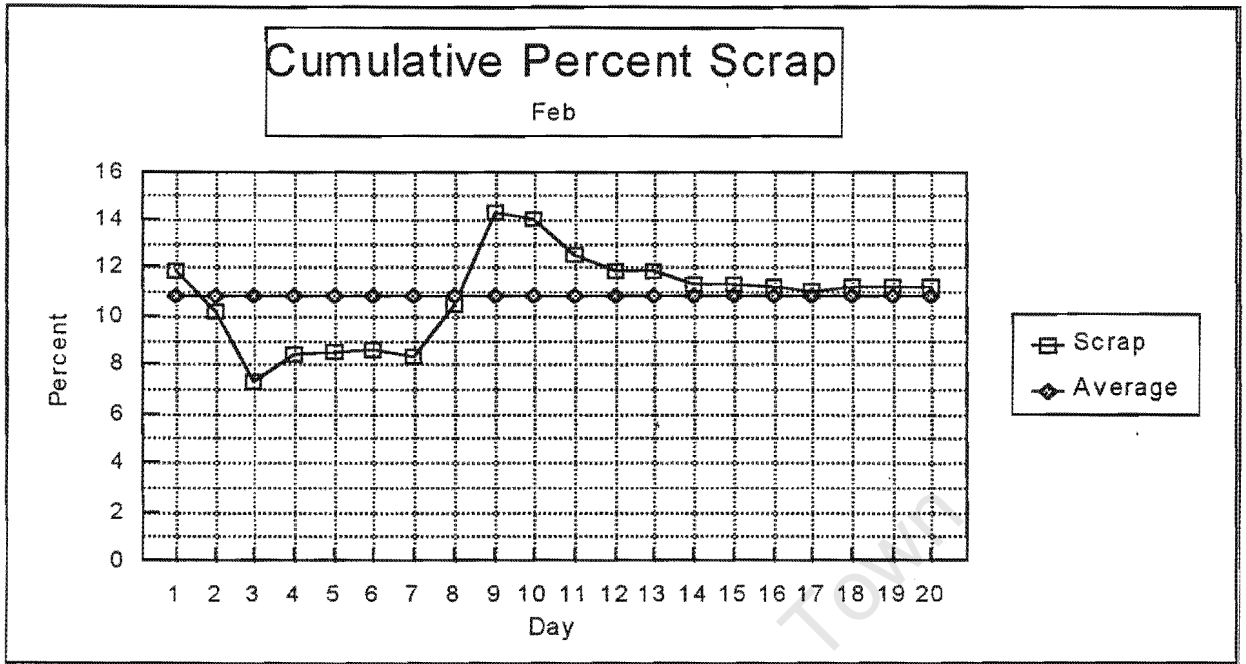


Figure 30 Scrap for February

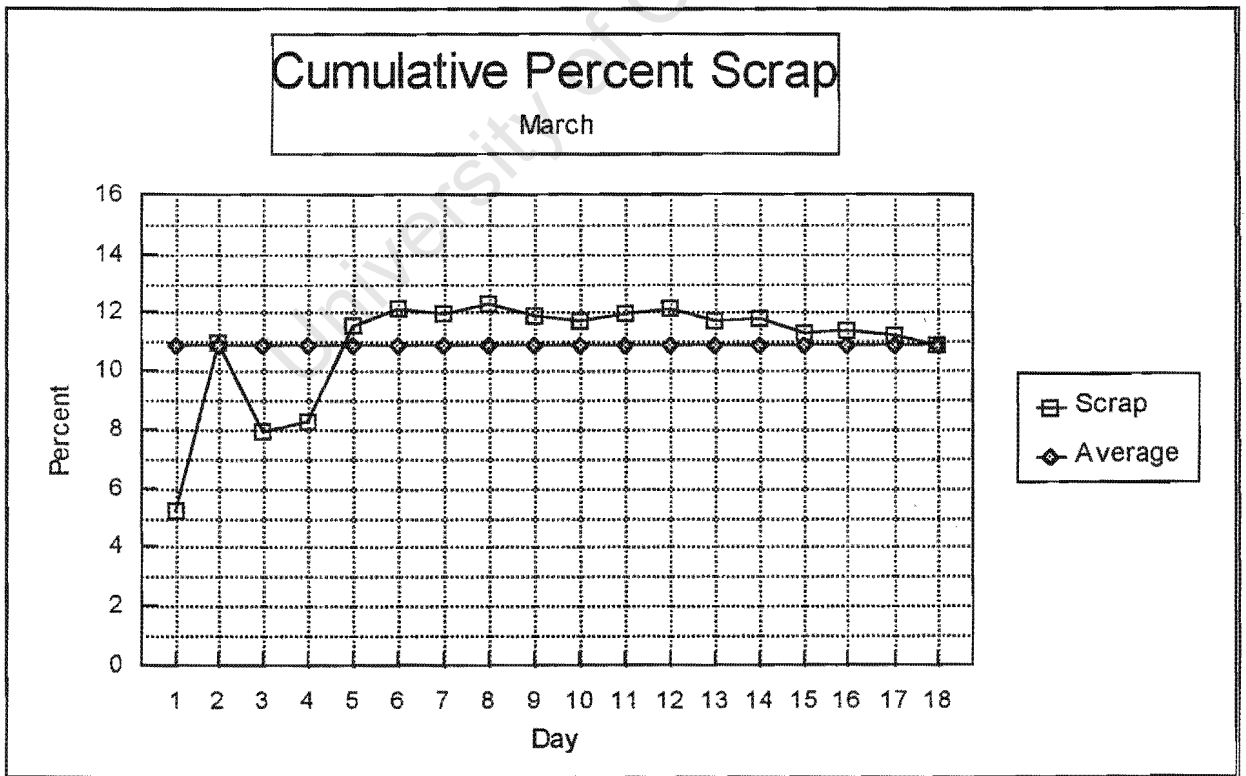


Figure 31 Scrap for March

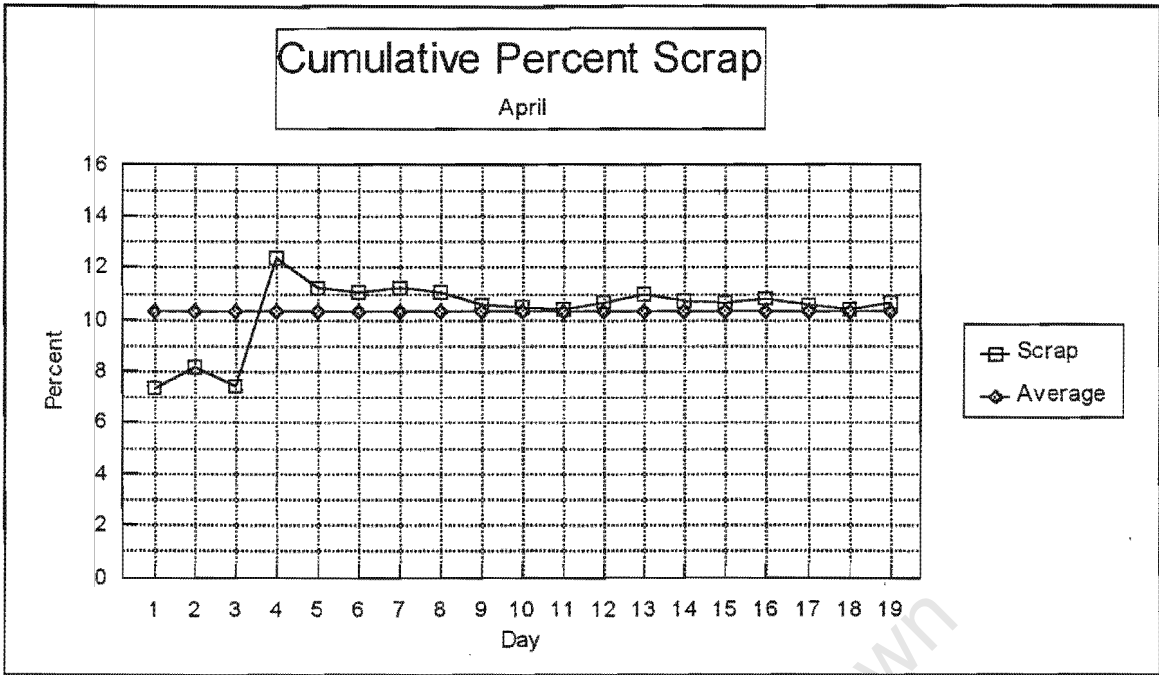


Figure 32 Scrap for April

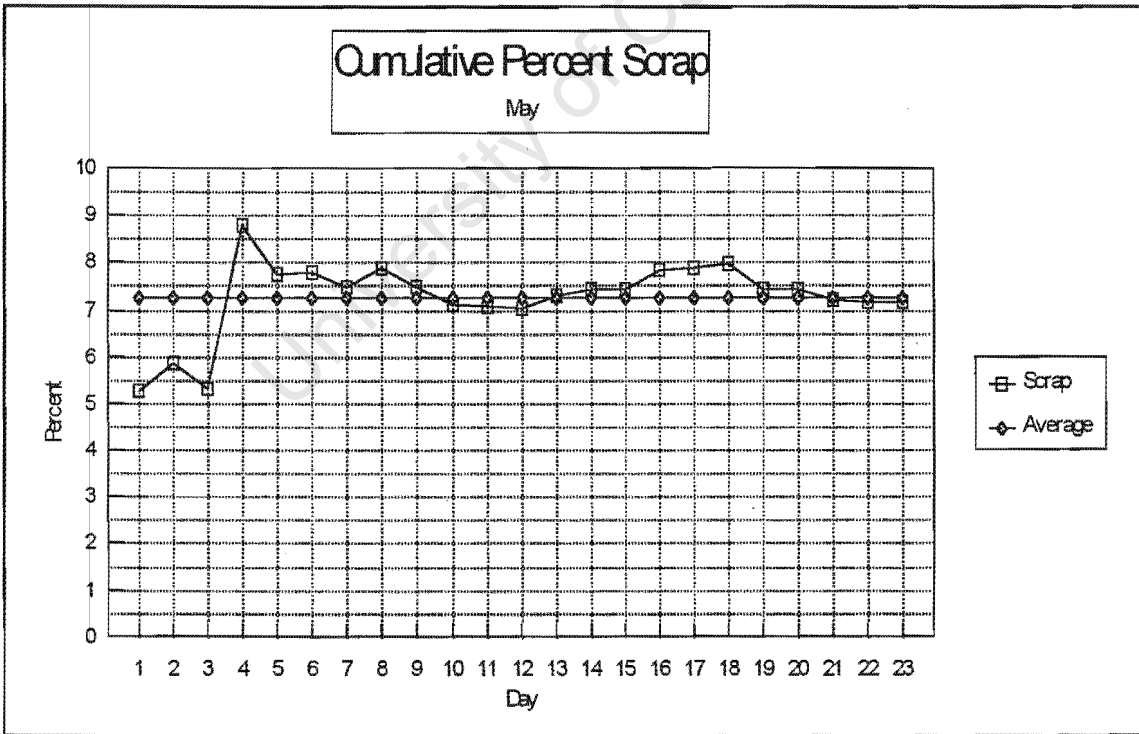


Figure 33 Scrap for May

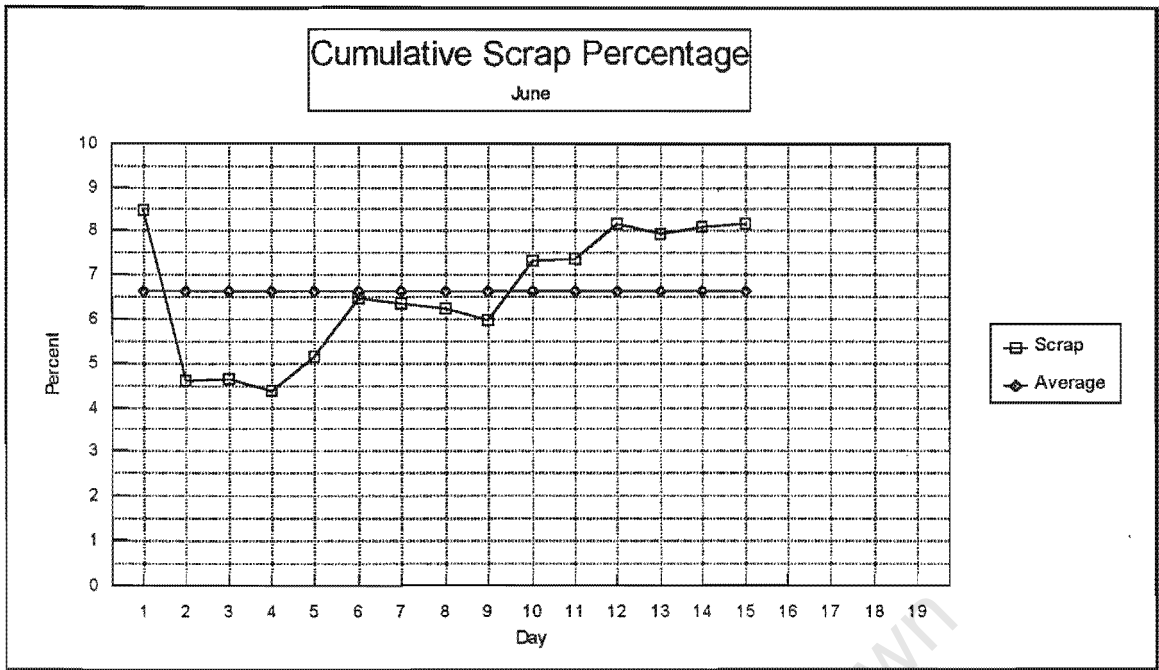


Figure 34 Scrap for June

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