

Improving the Costing System at FCI: An Operations Perspective

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Synopsis

This thesis is an attempt to derive a more effective management accounting system to meet the contemporary organisation's needs.

The objective of the thesis is to investigate two management accounting approaches, activity based costing and cost reduction system. Further, to evaluate which one better suits the needs of FCI, a clothing manufacturer in the Western Cape, and also to develop and test a costing system which forms the basis of any management accounting system.

Soft systems methodology was used to evaluate the two approaches. It was found that activity based costing (ABC) is more appropriate in this situation, mainly because the cost reduction system requires an organisational culture of employee involvement and continuous improvement, which is currently lacking.

The ABC system for FCI was developed with the specific aim of separating garment related costs (production) from order related costs (sales and design). This, however, was done within the constraints of the information available and the number of cost drivers was therefore limited to seven. The simplicity of the new system will enhance its transparency. Reasons for variations in cost estimations from the current system can be identified. This reduces the potential resistance to accept the new system for decision making.

The proposal of the ABC system was tested in two different experiments, namely a computer simulation and a test with real data.

The simulation was done using a systems dynamics modelling (SDM) software package. The SDM model showed that the proposed ABC system improves the

accuracy of cost estimations. It also showed that the improvement of the cost estimations is dependent on the quality of the cost driver and the accuracy of the input information.

The test with real data was done on a spreadsheet which automated the costing procedure. The spreadsheet contained information about the bill of activities, budget forecasts and output levels of activity pools and can, without further adaptation, be used as a temporary means to determine costs once ABC is introduced.

Costing a sample of orders with the spreadsheet showed the effect of the order quantities. ABC estimates costs of a small order to be higher than the current system predicts. This is especially the case for high fashion garments requiring significantly more design and sales resources. The test also revealed that ABC cost estimations of garments with a high sewing content (high SMV) are lower than estimations by the current system. This is in accordance with the expectations, which gave rise to the investigation into alternative costing methods.

Product and customer profitability analysis of the sample of orders showed the typical trend. Some products/customers are highly profitable, the majority yield an acceptable profit, but some are produced at a loss.

Both experiments show that the ABC system for FCI was developed successfully.

It is recommended that the proposed ABC system be implemented and used concurrently with the current system until confidence is gained with regard to the validity of the estimations.

It is also recommended that the system be continuously improved by improving the input information and introducing better cost drivers and more activity pools.

Table of Contents

	Page
Declaration	i
Acknowledgement	ii
Synopsis	iii
1. Introduction	1
2 Research Process	5
2.1 The Scientific Method	5
2.1.1 Creative Phase	8
2.1.2 Verification Process	10
2.1.3 Justification of the Method	12
2.2 The Impact of Systems Thinking on the Scientific Method	14
2.2.1 What is Systems Thinking	15
2.3 Research Methodology	18
2.3.1 The Classical Experiment	19
2.3.2 Quasi Experiment	21
2.3.3 Action Research	22
2.3.4 Survey Research	23
2.3.5 Ethnography	24
2.3.6 Systems Dynamics Modelling	25
2.3.7 Soft Systems Methodology	29
2.3.8 Choosing the Right Research Methodology	34
2.4 Thesis Framework	35

3 Literature Review	37
3.1 Shortcomings of Traditional Costing Systems	37
3.2 Activity Based Costing	39
3.2.1 Terminology of Activity Based Costing	39
3.2.2 Concept of Activity Based Costing	42
3.2.3 Process of Activity Based Costing	43
3.2.2 Activity Based Management	45
3.3 Japanese Cost Reduction System	48
3.3.1 Target Costing	48
3.3.2 Kaizen Costing	50
3.4 Application of Soft Systems Methodology	51
3.4.1 Stages 1 and 2: Finding Out	51
3.4.2 Stage 3: Formulating Root Definitions	52
3.4.3 Stage 4: Building Conceptual Models	55
3.4.4 Stage 5: Comparing Model and Reality	58
3.4.5 Stage 6: Defining Change	61
3.4.6 State 7: Taking Action	62
3.5 Literature Review of Activity Based Costing	62
3.5.1 Kaplan	62
3.5.2 Cooper and Turney: Internally Focused ABC	63
3.5.3 Kofman: Double Loop Accounting	63
3.5.4 Drury: An Evaluation of ABC	64
3.5.5 Innes and Mitchell: Limitations of ABC	65
3.5.6 Glad and Becker: Activity Based Management	65
3.5.7 Case Studies	66

4. Developing the Activity Based Costing System at FCI	70
4.1 The ABC System	72
4.1.1 Establish the Value Chain	72
4.1.2 Analyse Labour Cost	72
4.1.3 Identify Activity Pools and Cost Drivers	73
4.1.4 Allocating Cost to Activity Pools	80
4.1.5 Determining the Output of the Activity Pools	80
4.2 Accuracy of the New System	82
4.2.1 Fraction of Total Cost Absorbed on Activity Basis	83
4.2.2 Using the Right Cost Driver	83
4.2.3 Quality of Information	84
4.3 Implementation of the ABC System	84
5. Testing	86
5.1 A SDM Model of the Activity Based Costing System	87
5.1.1 Assumptions	88
5.1.2 Details of the Model	88
5.1.3 Balancing the Model	92
5.1.4 Comparing the Two Costing Systems	93
5.2 Costing with ABC	94
5.2.1 Design of ABC Spreadsheet	94
5.2.2 Testing the ABC System with Real Data	96

6. Findings	98
6.1 SDM Model of the ABC System at FCI	98
6.1.1 Effect of Variance of Estimation of Resource Consumption	98
6.1.2 Effect of Variance of Output of Activity Pools	102
6.1.3 Comparison of Costing Methods	103
6.1.4 Discussion	104
6.2 Testing the ABC System	107
6.2.1 Analysis of Difference between the Two Costing Systems	107
6.2.2 Product Profitability	112
6.2.3 Customer Profitability	113
6.2.4 The Impact of ABC on Decision Making	114
6.3 Discussion	116
6.3.1 Internal versus Ecological Validity	116
6.3.2 Biases introduced by ABC	117
6.3.3 Impact of ABC on the Viability of the Organisation	118
7. Conclusions	120
8. Recommendations	124
9. Reflection	127
Reference	130
Appendix A SSM Stage 5: Comparing Models with Reality	AI
Appendix B Graphical Representation of the Research Process	BI

1. Introduction

This thesis is an attempt to derive a more effective management accounting system to meet the contemporary organisation's needs.

Increased competition world-wide forces manufacturers to continuously find new ways to maintain competitive advantage and thus ensure the viability of the organisation. In South Africa, this is even more so since most organisations have to gain or regain their competitiveness which was lost during the years of economic sanctions.

Competitiveness is the advantage which an organisation has over its competitors. This advantage can be categories into five broad categories: cost, quality, delivery, flexibility and innovation. All five of these variables are interrelated and maximising one will inevitably mean neglecting others.

Traditionally, cost is regarded to be the most important aspect of competitiveness, but more and more manufacturers emphasise quality and deliverability.

Competing on the basis of quality and deliverability means providing customers with a product which fits their requirements in terms of product specification and on time delivery. To achieve this, organisations need to become diverse in their product range and flexible in the manufacturing processes. In essence, this means a much more complex operation. The emphasis is no longer purely on production, but marketing and product development become an important part of a successful business. However, these functions add to the total expenditure and hence increase cost. Furthermore, reliable 'on time delivery' can only be achieved with some excess capacity which again adds to the cost of the final product. Similarly,

flexibility might impact on the delivery performance when product specifications are changed at short notice and prototypes have to be approved before commencement of production. Alternatively, high quality standards might result in late deliveries or extra costs if products have to be reprocessed.

Accepting the interconnectedness of the competitive variables it should not be attempted to maximise individual elements, rather, the aim should be to optimise the whole. This essentially is the responsibility of operations management - optimising the system of competitive variables within the framework set by the organisation's marketing strategy and financial, human resource and technological constraints.

Clearly, in order to achieve and maintain an organisation's competitive advantage management require relevant, reliable and accurate information regarding the factors that affect competitiveness.

The traditional cost accounting systems were designed for highly production orientated organisations with a limited product range and little marketing and product development expenses. They were adequate for determining product costs in relatively simple operations, where the main activity was production, and hence the majority of costs were production expenses. However, it is questionable whether these simple systems are capable of dealing with the complexity of modern organisations, which not only produce but also enquire about customer needs and design products, and which produce products which consume different amounts of these different activities.

Furthermore, traditional cost accounting systems were designed for cost controlling. Cost reduction was achieved by technological break-through. Today, however, the emphasis is on continuous incremental improvements on costs, and cost accounting systems should be broadened to include cost reduction.

Fashion Clothing International¹ (FCI) is a clothing manufacturer in the Western Cape which is experiencing many of the changes mentioned above. In particular, the company is dealing with an increasingly diverse range of customers which resulted in an increasing variety of products. These products consume different amounts of different activities. Furthermore, each one of these customers requires a unique service with different demands on the available resources.

The validity of FCI's cost accounting system is questioned frequently. The following indicators gave rise to concern. There is only one measure of productivity, namely the number of sewing minutes produced, but measuring the performance of other departments in terms of this is unfair. It is not possible to explain why some international customers place orders for only very particular products, but will not buy others. Only 48% of all costs are related to production, but still 100% of the costs are recovered on the basis of production time. There is no incentive to a customer to place an order which requires little design effort. The profit made on export orders is unknown since high transport and communication costs are involved which are not included when product costs are determined. Designers claim that some orders are unprofitable, whereas the cost estimations show a good profit margin.

The question is therefore: If the cost accounting system is outdated and can no longer handle the diversity of products and customers, what are the alternatives? Are there systems which can handle the complexity of modern manufacturers and is it feasible to introduce such a new system, i.e. will the benefits of a new system outweigh the costs of it?

¹This is a fictitious name.

This thesis attempts to answer some of these questions by evaluating two new approaches to cost accounting. Thereafter, a costing model is developed (which forms the basis of a new cost accounting system) of the more suitable approach. This model is then tested with the aid of a computer simulation.

The scope of the thesis is limited to the development and testing of an alternative costing system. The full implementation of the system will only be possible once confidence is gained regarding its suitability and accuracy. This confidence will only be gained over a period of time.

The thesis begins with a discussion of the research process which was followed during the course of the investigation. This section entails a short introduction to the scientific method and the different research methodologies which can be used within the framework of the scientific method. The concepts of systems thinking are also introduced here.

The literature review comprises two new approaches to cost accounting, together with an evaluation. Thereafter, the new costing model for FCI is developed.

This is followed by the documentation of the experimental details, which consists of two parts: the computer simulation and a test run of the suggested model. The findings of the experimental work are presented thereafter.

Finally, conclusions are drawn and recommendations are made. The report ends with a reflection on the research process and the contribution of systems thinking.

2. Research Process

In the 17th century it was realised that the contents of science should be separated from the method of science (Checkland, 1, p26). Until then no distinction was made between issues related to the contents and issues related to the method of inquiry. Separating the method from the contents allowed the refinement and generalisation of the method, which could then be applied to any 'scientific problem'. This significantly improved the rate at which scientific research progressed.

The importance of the research method or *process* is often neglected. The emphasis is on the contents of the research. But the former is crucial to the success of scientific research. This section is therefore devoted to the research process which was followed during the thesis.

The section begins with a detailed description of Charles Peirce's scientific method and its strength as a tool of inquiry. It then introduces the concept of systems thinking and its impact on scientific research. Further, it discusses the different research methodologies which can be adopted within the framework of the scientific method. These include traditional as well as systems thinking methodologies. Finally, the research process of this thesis is established.

2.1. The Scientific Method

Peirce (as cited by Reilly,3) developed the scientific method based on what he defines as pragmatism. To explain this consider Figure 2.1. The object under consideration has some practical consequences (some effect on its environment).

These consequences are observed and interpreted by the observer. Peirce (3) argues that the observer's understanding of the consequences of the object is the whole understanding of the object. In other words, the observer understands the object only in terms of the consequences it has on its environment.

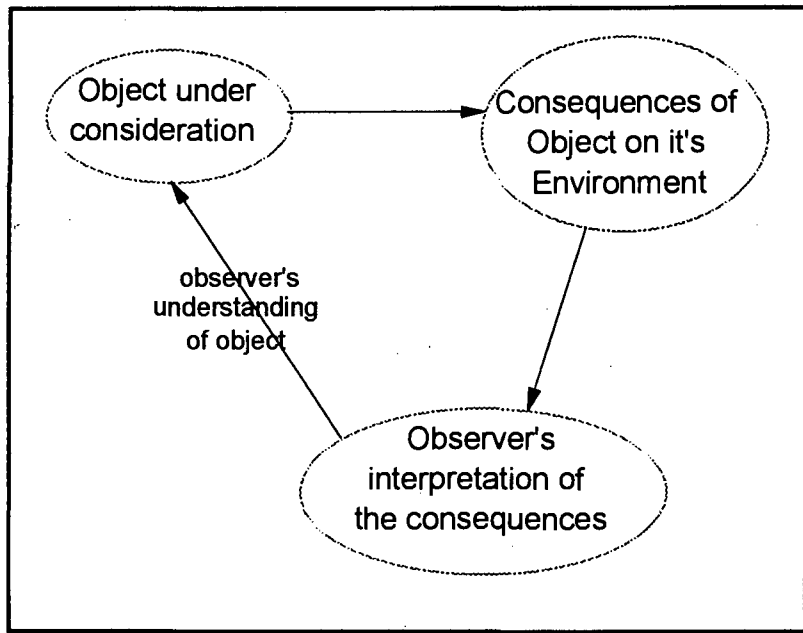


Figure 2.1: Pragmatism as defined by Peirce (3)

Viewing this from a different perspective, being pragmatic means being concerned with those objects or phenomena which have direct consequences on our action. From this Peirce (3) concludes that action is taken based on some belief of what the consequences of the action are. As long as the belief predicts the outcome of the action it is regarded as true and action is possible. But belief can be changed into doubt if an event occurs which the belief would not have predicted. Action is paralysed, because of the uncertainty of the consequences of the action.

This uncertainty or doubt initiates inquiry which intends to explain the previously unexplained behaviour. Inquiry thus seeks to find a new, more holistic belief which would predict the so far unpredicted behaviour. It fixes belief and thereby allows action again. Figure 2.2 illustrates the cycle of belief, action and doubt which initiates inquiry.

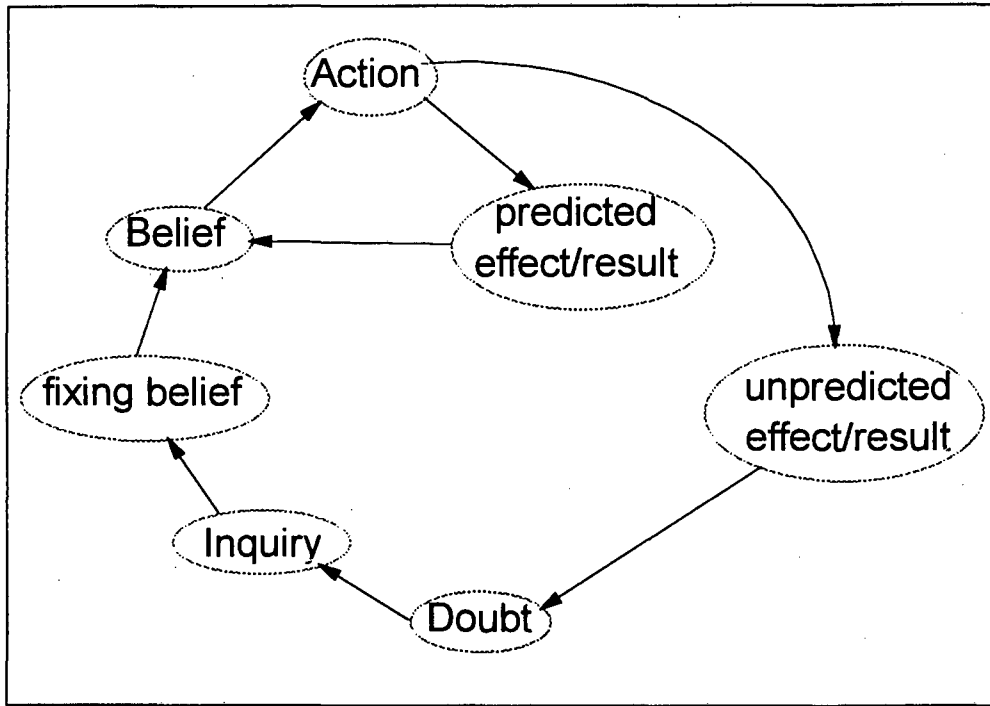


Figure 2.2: Peirce's View of the Initiation of Inquiry

Peirce (3) continues by arguing that the method of inquiry should be the most efficient one available and suggests the scientific method because it is self-correcting and will therefore always converge on the truth.

This method is particularly attractive to business management because it is based on pragmatism and hence result orientated. Management requires action which brings about predicted results. As long as these predicted results occur, the belief on which action is based is adequate. Management is not concerned with the 'ultimate truth', but only with an adequate understanding of a situation which allows action.

The method consists of two phases - the creative phase and the verification phase, represented graphically in Figure 2.3. Both will be discussed in more detail. This is followed by a critical assessment of the scientific method.

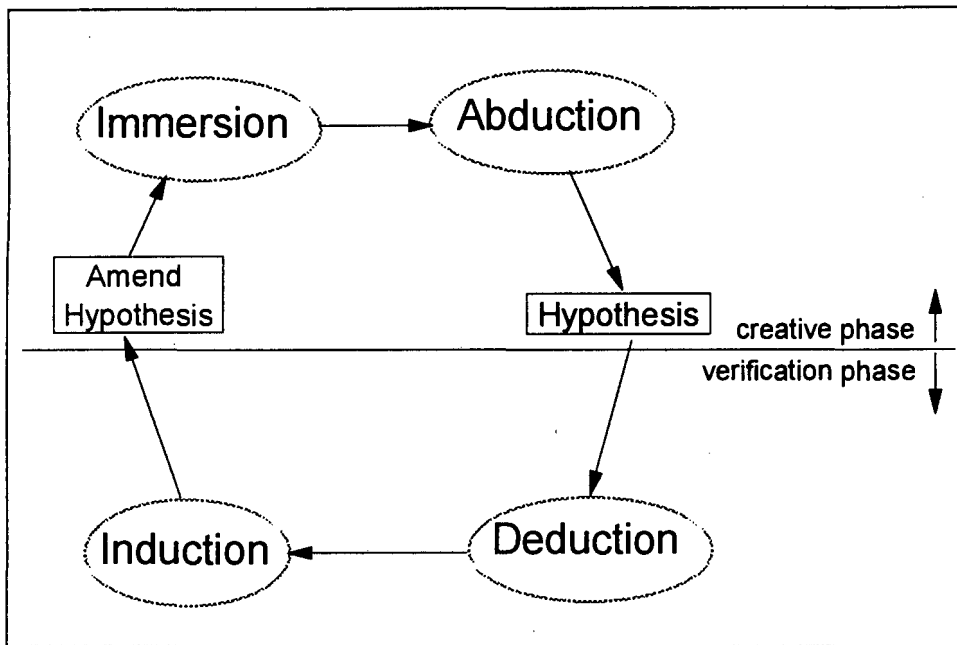


Figure 2.3: The Scientific Method

2.1.1 Creative Phase

During the creative phase new ideas for possible solutions of the problem are generated. The phase consists of two equally important stages - immersion and abduction.

2.1.1.1 Immersion

Immersion is the stage of familiarisation. The situation is analysed to establish a deeper understanding. The immersion phase often includes a stakeholders analysis, where the views of different interest groups are identified. It also includes literature searches.

The immersion into a problem situation can follow a rather informal approach without any predetermined structure. Or it can be formalised using specific methodologies such as surveys, VSM and SSM. For more details about these methodologies refer to Section 2.3.

2.1.1.2 Abduction

Being familiar with the situation and having identified the unexplained phenomena, the next step in the scientific method is forming a hypothesis of how the unexplained can be explained. This is what Peirce (3) calls abduction.

The process relies on the power of the human mind to combine experience with creative thinking. In addition, Peirce believes that there exists something like an instinct for the truth, since the human mind is a reflection of reality and thus the truth lies within us (as cited by Reilly, 3, p43).

The function of the hypothesis is to suggest a probable explanation of the experience which caused the doubt. The hypothesis needs no justification until it is proven to be a true representation of reality. This is important, since the hypothesis was derived from an intuitive process, a mixture of experience, creativity and instinct, which would be undermined if logic reasoning were allowed to interfere.

Proving the hypothesis is the aim of the second phase, but first some practical aspects of choosing a hypothesis are examined.

2.1.1.3. Some Requirements for Choosing a Hypothesis

Although the abductive process brings up new ideas, these nevertheless have to withstand the verification phase. Therefore, the chosen hypothesis needs to fulfil the following requirements:

- a) The proposed hypothesis needs to be verifiable experimentally.
- b) The hypothesis needs to be economically viable. Time and financial constraints need to be taken into consideration when selecting a hypothesis.
- c) In the case of a false hypothesis, it should be possible to prove it false.
- d) Other aspects are relevance and generality of the hypothesis.

The creative phase of the scientific method ends with the selection of a hypothesis. In the next phase the hypothesis is put to the test by forcing it to make verifiable predictions.

2.1.2 Verification Process

This is the process whereby the hypothesis is tested and only after passing the test can it be accepted as true. The verification process needs to be carried out according to a set of rules to ensure that it is unbiased and fair. The test is carried out in two steps - deduction and induction.

2.1.2.1 Deduction

Although the hypothesis need not be verified by its own observability, its plausible consequences need to be predictable. Deduction is the process where these consequences are inferred logically. Hence, it is also called the theoretical verification of the hypothesis.

Deduction is to infer or deduce what the experimental results would be, if the hypothesis were true. The "...[effect]...would be, if...[hypothesis]...is true" is the character of deduction. For example: Assume the hypothesis to be that tall people are intelligent. If Ian is tall, then we can say by deduction that he **would be** intelligent, if the hypothesis is true.

Deduction is in fact a question put to nature: Is Ian intelligent because he is tall? During this phase the questions are constructed, which are answered during the inductive stage. The inquirer must guard against biased inferences. He/she should not prejudice the outcome by selecting predictions which are already known. He/she needs to be detached from the hypothesis and should try repeatedly to prove it wrong.

For practical reasons, mentioned above, the deductive step must generate observable predictions from the hypothesis.

2.1.2.2 Induction

The inductive phase begins with the design of the experiment which is aimed at proving the predictions made during the deductive phase. The next step is 'running the test' and observing whether the predictions become true.

This is essentially the nature of inductive proof: The tests are only designed, run and evaluated after the deductions from the hypothesis have been made. The hypothesis is proven by induction only if the predictions of the deductive phase are observed. To continue the above example: Because Ian is intelligent and tall, we can conclude by induction that all tall people are intelligent¹.

¹ disregarding the issue of probability for the sake of simplicity

Induction ends the scientific method of inquiry, but generally a hypothesis is not proven entirely true. Testing the intelligence of a number of tall people will probably yield true and false cases. The hypothesis thus needs to be adjusted to describe reality more accurately. And the whole process of immersion, abduction, deduction and induction begins again.

Note here that immersion is a vital part of this new cycle of inquiry since only a deeper understanding of the situation can yield a better proposal for a new hypothesis.

Having described the method, it will now be justified why it is regarded as such a powerful way of gaining knowledge.

2.1.3 Justification of the Method

"The substance of Peirce's discussion of scientific method centres around his perception that science is more sure of the correctness of the general procedures it employs than it is of any specific results achieved by them."(Nagel, 4, p381) This perception can be attributed to the following:

2.1.3.1 Convergence on Truth

From a philosophical point of view, it is impossible to know the whole truth. Peirce (3) repeatedly states that scientific knowledge can not be absolutely exact. This view is shared by systems thinkers and postulated in the darkness principle (2) : "No system can be known completely."

Accordingly, it is impossible to have a hypothesis that is generally true. It will always be an approximation of the truth.

Therefore, testing a hypothesis will always yield that some experiments support it, while others prove it wrong. But experiments that prove the hypothesis wrong will initiate a new cycle of inquiry. The result will be a more general hypothesis, since more experiments support it.

The resulting hypothesis is a closer representation of the truth, and repeated cycles of inquiry will thus necessarily converge on the truth.

2.1.3.2 Moderate Fallibilism

Accepting the above mentioned statement that the truth can never be known absolutely, the scientific method is fallible in that it can never reach the absolute truth. And another cycle of scientific inquiry (abduction, deduction and induction) will prove the previous truth at least partially false. Fallibilism, whether due to the evolutionary nature of truth or due to the method of the inquiry, will always initiate new inquiry. This is so, because the inquirer accepts the fallibility and will never claim to have found the truth. He/she is thus always open to criticism and in search for a better representation of the truth.

2.1.3.3 Rigorous Verification

The scientific method follows a sequence of immersion, abduction, deduction and finally induction. This sequence is important because it first allows total freedom to postulate the hypothesis. But then it requires that the outcome of the experiment which will prove the hypothesis true is predicted before the test results are known. This rigorous procedure ensures that deductions from the hypothesis are not affected by the results of the experiment. As Peirce puts it: *'It is of the essence of induction that the consequences of the theory should be drawn first in regard to the unknown, or virtually unknown, result of the experiment; and that these should virtually be only ascertained afterwards.'* (Peirce as cited by Reilly, 3, pg. 96).

2.1.3.4 Synergy between Creativity and Rigour

Creativity and rigour are both vital aspects of advancing knowledge. Creativity supplies new ideas and the rigorous verification process accepts or rejects these ideas. The synergy that arises from the combination of creativity and rigour makes the scientific method so powerful.

The combination of moderate fallibilism and convergence on truth makes the scientific process a powerful tool for gaining new knowledge. Many methodologies were developed which can be used within the framework of this process. These will be examined later, but first the concept of systems thinking and its impact on research and the research process will be discussed.

2.2. The Impact of Systems Thinking on the Scientific Method

The scientific method was generally used within the framework of reductionist thinking. Reductionists believe that a system can be understood in terms of its isolated parts, or ideas can be explained by simple concepts.

The approach to research would therefore be to analyse, i.e. to reduce a system to irreducible parts and study these in isolation. Dividing a problem into small parts and examining the parts became so effective that today it is often viewed as the only means to study a phenomena - analysis which means dividing and separating, is often used interchangeable with words like investigation or examination.

Analysis was most successful in the fundamental sciences like physics, chemistry and biology. The reductionists believe that biology can be explained in terms of

chemistry and that chemistry can again be explained in terms of physics. Although this is true to the extent that a phenomena in chemistry could be explained in terms of the physics (energy, forces and masses) of molecules, physics failed to explain away the fact that the phenomena of chemistry exist. As Checkland (1) puts it: 'We are left with a level of complexity which is characterised by its own autonomous problems.'

There are therefore characteristics at a particular level which are irreducible - characteristics which *emerge* at that level of complexity. Analysis cannot explain the emerging characteristics at these higher levels of complexity. Ackoff (25) illustrates this well: The ability of a car to move cannot be explained by separating it into its parts (engine, gearbox, wheels). None of these parts can cause a car to move. This ability can only be explained by the interaction of these parts with one another. But by isolating the parts from the system, the interaction with other parts terminates. Hence reductionism alone cannot explain why a car can move.

What is required is a new approach to examine problems. An approach which does not make analysis redundant, but which includes it in a more holistic worldview. Systems thinking attempts to achieve this.

2.2.1 What is Systems Thinking

Systems thinking was developed from the inability of scientific analysis to explain the emerging characteristics at higher levels of complexity. Systems thinking accepts that there exists wholes which cannot be analysed (taken apart) without losing the essential characteristics of these wholes. These emerging characteristics come into being by the interaction of the parts of a system - by synergy.

To answer the question what is systems thinking, we first have to explain what is meant by a system. Flood and Jackson (11) define a system as essentially

consisting of elements and the relationship between the elements. The processes are characterised by feedback. The behaviour of one element may feedback, through other elements to influence the original element again.

A richly interactive group can be separated from those with few or weak interactions by drawing a boundary around them. Anything outside the boundary is said to be the environment of the system which to a greater or lesser extent influences the system.

The system does work by transforming inputs into outputs. It maintains itself over time by communication and control mechanisms. Furthermore, systems occur in hierarchies. A system at one level can be a subsystem of a wider system.

To this definition of systems Checkland (1) adds the subjectivity of the observer. The intention of the observer determines the principle which makes the system under consideration a coherent entity, distinct from its environment.

Developing and working with these concepts in an attempt to resolve the limitations of reductionist thinking is what is called systems thinking.

The application of systems thinking to business management resulted in a change of the conception of organisations. Flood and Jackson (11) give a detailed account of these changes, which are summarised here.

The reductionist view of an organisation was that of a machine. Each part functions like a machine, independent from any environmental influences. This was congruent with the mechanistic worldview.

At first, systems thinking viewed organisations as organisms, with independent subsystems each of which has a function to perform. It also viewed organisations as

open systems - influencing and being influenced by their environment. This supplied a much richer picture, but also had shortcomings.

Another model of the organisation as a information processing system or brain was developed by Stafford Beer (8) based on the realisation that organisations are purposeful systems, i.e. goal seeking, and that these goals are changing in a rapidly changing environment. His viable systems model (VSM) which was developed from the principles of cybernetics is a powerful tool to diagnose and 'repair' the organisation of purposeful systems. However, the VSM assumes that the purpose or goal of such a system is generally identifiable and agreed upon by all stakeholders which is not always the case because of cultural or political differences.

Again another model was developed, which viewed organisations as cultural systems in an attempt to deal more effectively with cultural differences amongst stakeholders of a problem. Soft systems methodology (SSM), strategic assumption surfacing and testing (SAST) and iterative planning (IP) were responses to this more holistic view of organisations. Rather than attempting to reduce the complexity of problems so that they can be modelled mathematically, soft systems thinkers seek to explore the different perspectives of stakeholders.

Lately, another notion of organisations is developing, namely organisations as political systems. It has been realised that relationships between individuals in organisations are 'potentially' competitive - an aspect which soft systems methodology neglects. Critical systems heuristics (CSH) provides a means for critically reflecting upon the goals attained and means used by hard systems thinking, and upon the nature of the consensus achieved.

All these problem solving methodologies, based on the different models of organisations, are by no means incompatible. Every model views organisations

from different perspectives, but every perspective adds to a better understanding. Every methodology has its strengths and weaknesses and was developed with the specific aim to solve a particular type of problem. Thus each approach views the problem from a different perspective and thereby adds to a better understanding of the whole.

Although a hierarchy of complexity of these methodologies does exist, it does not mean that less complex methods are less valuable. Rather, the complexity of the method needs to be compatible with the complexity of the problem at hand. Organisational problems can not be solved with critical systems heuristics but are best solved with the viable systems model. Similarly, VSM is incapable of dealing with social or political problems.

All these systems thinking tools have to a greater or lesser extent been tested and were found to be useful. But the pool of techniques is rather messy - by no means systematic. Flood and Jackson (11) therefore developed a framework which attempts to classify the problem and hence suggest the most appropriate methodologies to solve it.

Regardless of whether research is conducted from a reductionist or a systems perspective, the scientific method remains valid as a framework for the research process. However, the methodologies which are used within this framework can change. The wide range of traditional methodologies will be discussed now, followed by two systems thinking methodologies.

2.3. Research Methodologies

A whole spectrum of alternative methodologies can be utilised to complete the process of the scientific method. At the one end of the continuum of research

methodologies is the very 'hard' classical experiment, which originated from researching the natural sciences, and relies mostly on quantitative data. At the other end of the spectrum is the 'soft' ethnographic approach which originated from anthropological research, and which relies mostly on qualitative data.

Research methodologies are selected based on the problem on hand, but also on the type of validity the research findings generate. Gill and Johnson (5, pg.121) define two types of validity:

- a) 'Internal validity refers to whether or not what is identified as the 'cause' actually produce what has been interpreted as the 'effect'.'
- b) 'Ecological validity is related to the issue of how artificial or atypical the research setting is relative to the 'natural' context typical of normal, everyday life.'

During this study a variety of methodologies were used in an attempt to gain high internal as well as high ecological validity. These methodologies are introduced below together with an explanation of where and why they were used during the research process.

2.3.1 The Classical or True Experiments

The classical or true experiment is often described as the method of differences. Some factors affecting the phenomena under consideration are changed and the results are observed.

What is required, is a theoretical model of the phenomena of interest and its relation to the factors effecting it. Three different kinds of variables have to be identified:

- a) The dependent variables, which describe the phenomena of interest. The changes in the dependent variables must be explained.
- b) The independent (or explanatory) variables, which influence the behaviour of the dependent variable.
- c) The extraneous variables, which might affect the dependent variables, but are not of interest to a particular experiment.

The logic of the classical experiment is to isolate the extraneous variables, manipulate the independent variables and observe the changes in the dependent variables.

The most efficient way to achieve both, isolating the extraneous variables and observing changes in the dependent variables, is to introduce experimental and control groups.

By randomly assigning subjects to the two groups, biases are eliminated and extraneous variables will affect both groups equally. Data is collected for both groups before and after the 'test'. Four sets of data are thus generated and by careful evaluation, conclusions can be drawn on the effects of the independent and extraneous variables, as well as possible biases arising from non-equivalent experimental and control groups.

Other biases may arise during the course of the experiment. These include biases due to changes affecting the group members (e.g. political, economic or psychological), and biases due to changes in the measurement processes. But the most important biases arise due to the subjects' reaction to the experiment.

The well-known Hawthorne study showed that the mere attention given to special groups during experimentation changes the subjects' behaviour. One reason is that people behave according to the situation in which they find themselves. They behave differently in different social contexts, and an experiment changes the context. Another reason is that subjects try to interpret the experiment and thus behave according to their interpretation - what Johnson and Gill (5) call 'mediation through interpretation'. These effects are the weaknesses that makes the classical experiment unsuitable for research in the social sciences. As Johnson and Gills (5, pg. 52) summaries: 'It is the presence of subjectivity in human beings and their consequent variable reactivity to the artificiality and manipulation of the true experiment that casts doubt upon the internal validity of this type of research design. Furthermore, the artificiality of the experiment ... makes it doubtful whether or not the finding can be extrapolated to everyday behavioural situations: that is, the ecological validity of the true experiment appears to be low.'

Because of the low ecological validity of this approach it was decided to rather use the quasi-experiment which avoids this problem.

2.3.2 Quasi-Experiments

The quasi-experiment is used in the second part of the inductive phase, which involves testing the new costing system with real data.

In the quasi-experiment the researcher applies the logic of the true experiment to a naturally occurring event. The experiment takes place in a natural environment, thereby gaining ecological validity.

However, internal validity is lost, since the researcher has less control over extraneous variables. Experimental and control groups can no longer be allocated randomly or systematically.

The quasi-experiment is often used to avoid the artefacts of the context in which the true experiment takes place (laboratory conditions). The research findings can therefore be extrapolated without difficulty. Sometimes this approach is used when the true experiment is ethically or practically not feasible.

2.3.3 Action Research

Whereas in the quasi-experiment the emphasis is on observing a naturally occurring event, action research is a planned intervention to solve a particular problem in business. It is thus a very pragmatic approach. As Gill and Johnson (5, pg.57) put it: 'Solving the problem is the test of validity rather than high correlation and perfect causal models'. The emphasis is thus on ecological validity.

This approach is often used in a consultancy situation, where the client pays the researcher or consultant for solving a specific problem. The client is only interested in a solution for the problem. Valuable contributions to test the researcher's theories can only be extracted later.

The economic aspect of this approach makes it vulnerable to short-term solution without gaining a better understanding of the underlying dynamics of the problem. Especially in the case of consultants, a conscious effort has to be made to conclude the scientific process by generalising and hypothesising. Given this, action research can be a very powerful approach to research. It serves both the practical concern of business and adds to the body of knowledge. It is an 'economically viable' research technique.

Action research is the ideal approach for the implementation of new systems. However, the purpose of this study is not the implementation of a new costing

system but merely an investigation into its feasibility. Action research was therefore not used in this thesis.

2.3.4 Survey Research

The survey research does not have an experimental character, like the three methods described above. Rather, it is only observing events in their natural environment. This is achieved by analysing carefully designed questionnaires, which are filled in by a random sample of subjects of the population under consideration.

Two kinds of surveys are possible. The analytic survey attempts to test a theory deductively. The questions are often very specific and the data gathered rather quantitative.

The descriptive survey attempt to assess the attributes of populations. The questions are broader and the data is therefore qualitative.

Since the test is not of the form of an experiment, experimental and control groups are not possible. Therefore extraneous variables are controlled using statistical methods. Appropriate data has to be collected which makes this check possible, and careful planning has to precede the design of the questionnaire. A preliminary survey during the immersion phase will reveal many problem areas, not anticipated before.

The survey research is conducted in the 'field', and therefore has a high degree of ecological validity. The internal validity is largely dependent on the sample size and the care with which the research was designed.

Because of the non-experimental character of a survey it is best suited for the immersion into a problem situation. As such it was used to develop a model of the current costing system at FCI. However only a preliminary survey was conducted without the formal design of a questionnaire. The emphasis was on qualitative and ecological valid information rather than on testing a theory.

2.3.5 Ethnography

Like the survey research, ethnography observes without deliberate intervention. It focuses on the manner in which people interact and is therefore suitable for socio-technical problems. It is a 'soft' approach, which relies mainly on qualitative data.

The aim of ethnography is to learn about the culture under investigation and so to interpret it in the way its members do, i.e. to think and feel like them. Only by understanding their way of thinking can action be predicted, i.e. theories of how people act be generated.

The difficulty is to immerse into a culture but at the same time be critical, i.e. not to become part of the culture - not to 'go native'.

The ideal approach to ethnographic research is through direct, participant and covert observation. The typical approach is working as a machinist while conducting research on a shop floor level. In this way most of the biases discussed above are eliminated, which gives this approach strong ecological validity.

But for practical reasons direct observation may not be possible. In this case data can be gathered through interviews, which are less structured than those used in survey research to avoid any prejudgment.

Introducing a new costing system is certainly a socio-technical problem with many threats to a successful implementation being related to rejection of the system by department managers, sales personnel, etc. However, this study is concerned with the 'hard' aspects of a new costing system, the tangible benefits of more accurate product costs, and therefore does not use ethnography. Only the selection of the better approach to costing is dealt with on a social level. SSM is used for that

Having discussed the spectrum of traditional methodologies, two systems thinking methodologies will now be introduced. Systems dynamics modelling (SDM) is used during the testing phase where a simulation model of the new costing system is built. Soft systems methodology (SSM) is used during the immersion phase to identify the more suitable approach to product costing for FCI.

2.3.6 Systems Dynamics Modelling

Systems dynamics modelling (SDM) is a simulation technique which was made possible through the development of powerful computers. The methodology aims at explaining phenomena by building a model of the system which causes the phenomena. The model can then be used to gain an understanding of the interaction of different parts of the system. In this thesis SDM is used in the inductive phase to model the new costing system in order to establish whether it is an improvement to the old system.

2.3.6.1 Concept

SDM assumes that the dynamic behaviour of the real world can best be described in terms of its structure and the processes within the structure. Structure refers to both physical aspects like plants and production processes, as well as intangible aspects like policies and traditions.

SDM further assumes that these structures and processes can be analysed objectively and re-created in a systems model. This model then represents a portion of the real world and can be used to explain it. In an organisational context this means that it becomes possible to model complex situations and predict future business scenarios. Since changes to the structures and processes in the model can be determined it is possible to simulate the effects of ideas and strategies and hence predict the future. Different strategies can be tested and the best solution selected.

The underlying idea of systems dynamics modelling (SDM) is that reality can be viewed in terms of elements and the relationship between these elements. Complexity only originates from the interaction of many elements, which may form feedback loops and hence influence each other. It should therefore be possible to model any situation, provided that the modelling tool (the simulation software) is powerful enough. The elements and their relationships can be modelled one after the other. And hence, the complex situation is broken down into small and easy-to-model steps.

The interaction of these various elements is what causes the complexity, but provided that the relationships between the elements are correctly representing reality, the resulting output of the simulation also represents reality correctly.

2.3.6.2 Modelling Elements

Three basic elements are used in SDM: levels, rates and auxiliary variables. A level is a quantity that changes over time (like the level of a water tank). A rate determines the flow which changes the level over time (like a valve). Auxiliary variables can influence the rate of flow into or out of a level.

Figure 2.4 below shows these elements and how they are commonly used. Note also that there are two different kinds of links between elements. The information flow as a single line arrow and the physical flow as a double line arrow.

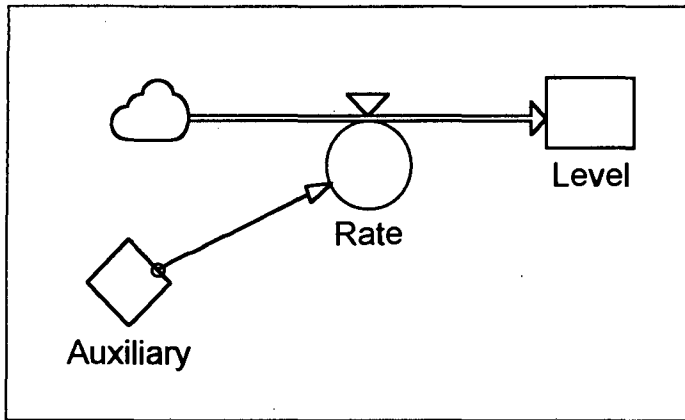


Figure 2.4: Basic Building Blocks

Any cause and effect diagram can be represented with the aid of these three basic elements and their relationships. SDM only becomes valuable when multi-causal relationships are modelled, where the behaviour of the system is no longer 'obvious'.

2.3.6.3 Modelling Methodology

Practical experience has shown that especially with the latest simulation packages it is possible to begin writing a model without proper conceptualisation of the problem. This however often results in unnecessarily complex models which frequently have to be rewritten and the final model takes much longer to complete.

It is therefore important to follow a process which ensures that enough preliminary investigation is done. This would include identifying the users and the purpose of the model. (Will the model be used for qualitative scenario

testing or for accurate predictions? What aspect of the real world is tested?) This will determine the scope of the model.

It should also include a clear statement of underlying assumptions and the laws and theories used. Furthermore, the system boundaries need to be set and a preliminary cause and effect diagram should be drawn up.

Flood and Jackson (11) suggest a modelling methodology which addresses the issues mentioned above. It begins with an explicit statement of the purpose of the model and the main assumptions on which the model is built. It also relies on a feedback loop between user and developer of the model, making it an iterative modelling process.

2.3.6.4 Critique

Although one can argue that in theory it would be possible to simulate complex situations, the practical difficulties of simulating, surfacing underlying assumptions and finally bringing the model to a stage where it does represent a part of the real world impact on the usefulness of SDM. Even relatively simple situations take time to model and only represent reality to a limited extent since often many assumptions have to be made to simplify the model. SDM is therefore of little use to the everyday user who perhaps wants to test a marketing strategy or a new production process.

Furthermore, SDM is often accused of having abandoned scientific rigour. Conclusions drawn from SDM models should thus be restricted to qualitative statements.

Fundamentally, SDM is criticised by soft systems thinkers for attempting to solve complex social problems with mathematical equations, however loosely

defined. They argue that social problems need to be solved by acknowledging the diversity of different perspectives and belief that 'the richness of social reality defeats SD modellers' (Flood and Jackson, 11).

Finally, SDM does not acknowledge the subjectivity of the modeller and possible biases which might be introduced.

2.3.7 Soft Systems Methodology

Traditional (hard) systems engineering is a methodology which is used for the design of systems. The principle of this approach is to identify the purpose or objective of the system and then to design it, such as to achieve the objective. However, in complex social systems, like management, these objectives are not always clear. Checkland (1), therefore, developed soft systems methodology (SSM), which accepts the complexity of social problems and identifies commonly agreed upon objectives by investigating different perspectives hold by stakeholders of a problem situation.

2.3.7.1 Concept

SSM is a methodology which allows multiple perspectives of the problem. It seeks to include different interpretations of a problem by different stakeholders. Different interpretations which are derived from different worldviews often include different objectives which have to be achieved to change the present situation into a more favourable one.

These differences then form the basis for discussion to arrive at a set of objectives which are agreed upon by all. This is in fact a learning process. Compared to the hard approach which aims to achieve objectives, SSM aims to gain a better understanding of the different perspectives and their underlying worldviews. In that

sense SSM is a learning system, whereby a common understanding of a problem situation is developed. This common understanding then allows a commonly agreed upon solution to the problem.

The multiple perspectives not only results in a 'richer picture' of *what* has to be done, but it will also highlight different approaches of *how* it can be done. Complexity is dealt with by viewing the situation from different angles, each one emphasising different aspects and thereby adding to the overall understanding of the problem.

2.3.7.2 Process of SSM

Checkland (1) formalised the process of SSM in a sequence of seven stages as shown in Figure 2.5.

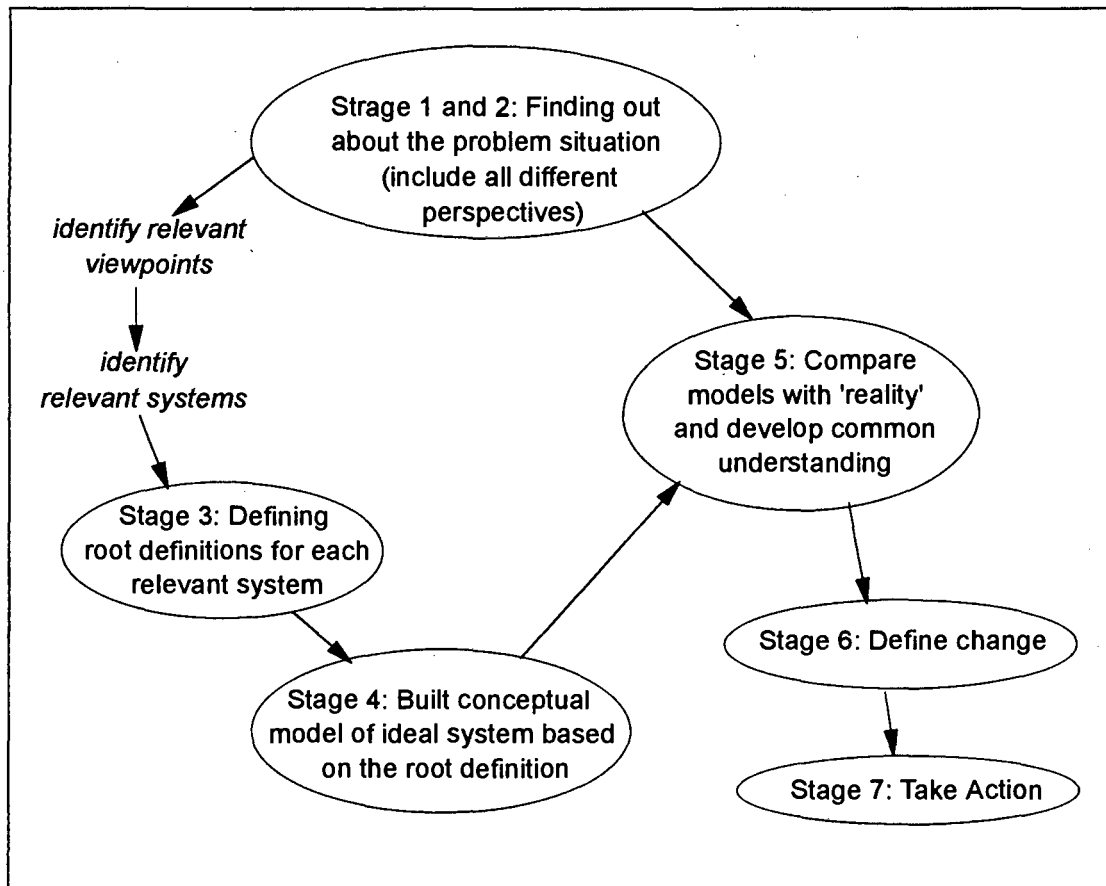


Figure 2.5: Seven Stages of SSM

Stage 1 and 2: Finding out

This can be done in three different ways. The most useful one will be described here. Details on the other approaches are discussed by Checkland (1) and Flood and Jackson (11).

Finding out is done through three related analyses. Analysis One takes the intervention as subject matter. It identifies the client, who causes the intervention to take place, the problem solver and all other parties who have an interest in the situation or are affected by the interventions.

Analysis Two deals with the situation as a social system, taking culture into account. Relevant social norms and values according to which performance will be measured are established. Expected social behaviour which will impact on the intervention is also envisaged.

Analysis Three attempts to deal with the political aspect of the situation, by asking who can influence the situation and on what power basis.

The three different analyses give a richer picture of the situation from which a number of themes emerge which can then be expressed as relevant viewpoints. Each of these viewpoints will have a different set of objectives and accordingly a different system to achieve these objectives. These systems are defined in Stage 3.

Stage 3: Formulating Root Definitions

During this stage the relevant viewpoints and their corresponding systems are developed further by doing a CATWOE-analysis which identifies the following:

Customer - the victims or beneficiaries of the purposeful action.

Actor - those who do the activities.

Transformation - the purposeful activity which transforms an input into an output.

Weltanschauung - the view of the world that makes the definition meaningful.

Owner - who can stop the activity.

Environmental constraints - those constraints that this system takes as given.

(adapted from Checkland, 7)

From the CATWOE analysis a root definition (RD) for each relevant system is formulated. The RD is a concise statement of an ideal system which would achieve the objectives relevant to a particular viewpoint.

Stage 4: Building Conceptual Models

The RD is in essence the ideal system. The conceptual model which is developed from a RD is an account of what activities have to be performed in order to fulfil the requirements of that RD.

The conceptual model is developed by identifying a minimum number of verbs that are necessary to describe the transformation (T) of the RD and then ordering them in a logical sequence. The conceptual model can be in descriptive form but is best accompanied by a systems diagram. This facilitates the comparison during the next stage.

Stage 5: Comparing Models and 'Reality'

The conceptual models are 'pure', idealised systems. Comparing these to the real world will reveal differences which highlight likely changes. There are four ways to compare the model with the real world.

The first one entails merely listing the differences and discussing whether they matter or not.

The second approach is more formal, where the following questions are asked: Does this happen in the real world ? How? By what criteria is it judged ? Is it a subject of concern in this situation ? The answers are then assembled in a table.

The third approach is to develop a crude systems dynamic model and to simulate possible future outcomes of the alternatives at hand.

In the fourth method a model of reality is built which is compared to the conceptual model from Stage 4. Differences can then be discussed.

Stage 6: Defining Change

The comparison stage highlights differences between the real situation and the conceptual models. The differences indicate where the real system deviates from the ideal systems developed in Stages 3 and 4. The differences are possible areas of change and form the basis for discussion which should reveal whether the changes are logically desirable and culturally feasible.

Stage 7: Taking Action

The desirable and feasible changes are then implemented. SSM could be used to develop a system by which these changes are implemented.

2.3.7.3 Conclusion

SSM is a means of introducing some ordered, structured thinking into the complexity of everyday life. It takes the social aspects of problem situations into account, and is capable of dealing with situations where objectives are not clearly identified.

It is a learning process where understanding is gained by accumulating different perceptions (and worldviews) and then developing a temporarily common culture which allows action. It introduces a degree of rigour into the way of dealing with complex issues.

The introduction of a new costing system is not only a technical issue (where to find the relevant information and how to change the information system) but also a 'social' issue. The new system has to gain acceptance by those who have to use it as a decision making tool, and those who have to support and maintain it.

It is therefore imperative that the selection of a new costing system is based on an understanding of the underlying worldviews which gave rise to the alternative approaches under consideration. The worldview of the selected approach should match that of the company to ensure acceptance amongst stakeholders.

SSM was therefore used to identify the better alternative in the light of the social and cultural context of FCI. This is done in the second part of Section 3.

2.3.8 Choosing the Right Research Methodology

All the methodologies described above have their strengths and weaknesses and all approaches have proved in the past to be suitable for some or other kind of research. It is therefore not a question which method is best, but rather which one is most suited for a specific research problem.

The true experiment is most powerful when dealing with a 'hard', mechanistic problem, where things behave in a system. The ethnographic research is most suited when dealing with social issues, where people experience, interpret and act based on their interpretation. SDM is suitable when the elements of the system under consideration are identifiable and their relationships quantifiable.

Furthermore, the methodological pluralists argue that different research methodologies complement each other and overcome the biases inherent in a single-method approach. As Smith (6, pg. 273) puts it: 'We are all like blind men led into an arena and asked to identify an entity (say an elephant) by touching one part of that entity (say a leg). Certainly we might make better guesses if we could pool the information of all the blind men, each of whom has touched a different part of the elephant.'

In this thesis a diverse range of methodologies is used. The following section outlines where the different methodologies were used and how they contributed to the completion of the cycle of inquiry.

2.4 Thesis Framework

The thesis follows the scientific method as a research process and is therefore divided into four distinct phases: immersion, abduction, deduction and induction as reflected in Figure B.1 in Appendix B.

It begins with the immersion (Section 3) into product costing, management accounting, the limitations of the current system at FCI and the possible alternatives - activity based costing and cost reduction. Soft systems methodology is used to evaluate these alternative approaches to management

accounting in the light of FCI's needs. A second immersion phase follows, where the better suited approach is studied in more detail with different views on the approach being presented and case studies being analysed.

In the abductive phase (Section 4) , the theoretical knowledge is then applied to the (practical) situation at FCI by designing the new costing system. This phase ends with the formulation of the hypothesis.

The formulation of the hypothesis ends the creative cycle of the research process. The next cycle is the rigorous testing of the hypothesis. It begins with the deduction of the consequences of the hypothesis (beginning of Section 5). The inductive phase follows, where two test are designed - the SDM model and the costing of real orders on a spreadsheet.

In Section 6 the outcome of the tests are analysed and compared to the predictions made during the deductive phase. Conclusions about the validity of the hypothesis are drawn based on the test results, and recommendations for further research are made. This essentially starts a new cycle of the research process, which would then result in another immersion phase, etc.

3. Background and Literature Review

This section commences the creative cycle of the research process - the immersion phase. The shortcomings of traditional cost systems will be discussed first, followed by a short overview of two alternative management accounting systems: the American/British activity based costing and the Japanese cost reduction system. Both approaches will then be evaluated using the soft systems methodology. The purpose of the evaluation is to determine the more suitable solution for FCI. No attempt is made to make a general statement. After the evaluation during the second immersion phase a detailed literature review will be done.

3.1 Shortcomings of Traditional Costing Systems

The traditional costing systems were designed many years ago when manufacturers were producing a narrow range of high volume products. The costing systems were adequate to determine product costs accurately for these relatively simple operations. However, increased competition shifted the focus from producing goods to satisfying customers. This resulted in significant changes within the manufacturing environment.

Firstly, marketing, product development and quality assurance and other business functions were gaining importance and thereby increasing the overheads. Production expenses as a percentage of total costs were decreasing. Between 1929 and 1940 overhead costs amount to less than 10% in the USA (Glad and Becker, 12, pg. 4). Today, however, manufacturing costs amount to only 50% to 60% of the final product (Glad and Becker, 12, pg. 5). Marketing, distribution, research and development and administrative cost contribute up to 30% of the product cost. The significance of direct labour was fading and with it the relevance of traditional costing systems which use direct labour or machine hours as the basis for cost allocation.

Secondly, in order to meet customer requirements the product range was diversified. The result was a mix of simple and complex products. But all products were costed on

Secondly, in order to meet customer requirements the product range was diversified. The result was a mix of simple and complex products. But all products were costed on the basis of time required during production. However, the correlation between the complexity of a product and production time is weak, which resulted in a distortion of costs, often in favour of the more complex products.

Thirdly, in an attempt to satisfy customers needs, the minimum order size was reduced. This impacts on product costs as follows: If processing an order in for example the planning department costs R 1000, then the additional costs per unit of an order of 2000 units is 50 cents. If the minimum order size is reduced to say 500 units, the planning costs per unit increases to R 2. This is a significant increase in costs which is not recognised by traditional costing systems.

Finally, just in time manufacturing was introduced to allow quick response to changes in customer requirements. However, since the traditional costing system allocates overheads on the basis of direct labour or machine hours, it measures the performance of an organisation in total production time, i.e. the more goods are produced, the better the performance. This stands in conflict with the fundamental concept of just in time which is to produce only when required.

The limitations listed above show that the relatively simple traditional costing systems are incapable of supplying accurate information in today's rather complex organisations. However, accurate information on product costs becomes increasingly important for decision making in a competitive environment.

Furthermore, traditional costing systems were developed at a time when data processing costs were high. Additional information to allow for more accurate cost estimations was not justifiable because of the extra costs involved. With the development of modern computers, the costs of processing data are reduced significantly. The benefit of additional information required for a better system thus outweighs the cost of processing that information.

The limitations of traditional costing systems led to the development of two new approaches. Firstly, activity based costing was developed in the United States under the assumption that prices are determined by the producer. Secondly, the cost reduction system is evolving in Japan, which assumes that prices are determined by the customer.

3.2 Activity Based Costing

Activity based costing (ABC) addresses the oversimplification of complex modern organisations by traditional costing systems. It realises that the *raison d'être* of business is to satisfy customer requirements. This is a more holistic view of business than the one upon which traditional costing systems are based, namely that manufacturing is about producing goods, assuming that customers are satisfied with just the product.

Satisfying customers requires performing many activities, not only producing the commodity. These include developing the product, procuring raw materials, planning production and shipping the final product. The principle of ABC is to analyse how these activities cause cost, and how they contribute to the end result - the satisfied customer. But before this concept is developed any further some new terminology has to be introduced.

3.2.1 Terminology of Activity Based Costing

Activities

Inputs are transformed into outputs by a number of small tasks. These tasks or actions are aggregated into activities. For example, all tasks which are required to pack finished goods, can be combined to form an activity called packing. This activity can be used to form the basis of measurement of cost and performance.

Computer Aided Manufacturing International (CAM-I) which was one of the driving forces behind the development of the ABC system, describes 'activity' as an aggregation of actions or tasks which are useful for the purpose of ABC. The term activity is central to the concept of activity based costing. ABC is based on the principle:

Activities consume resources, i.e. cause cost.

Products consume activities. (Glad and Becker, 12)

Activities are therefore costed and the cost of the product is derived from the number of activities consumed by the product. This is very similar to the traditional costing system, but ABC introduces more and more diverse activities, which results in a more accurate system.

Resource or Cost Elements

Resources or cost elements can be viewed as those which are needed to perform an activity. To expand on the above example of packing, the resources consumed would be labour, packing material, space or rent, etc.

Cost Driver

Resources or rather the cost of these resources are traced to the activities using the resource cost driver. The cost drivers are the means by which overheads are allocated to activities. In the traditional costing systems costs were allocated to cost centres and from cost centres to products. This allocation was based on labour or machine hours and was appropriate in the past, because the reason for 90% of these cost were due to labour costs. So labour was 'driving' the costs. Today, this is no longer entirely true, and the new forces that drive costs need to be identified. Hence cost drivers can be defined as the forces behind overhead costs.

Examples of cost drivers are:

- * The number of purchase orders drives the cost of the purchasing department.
- * The number (or volume, or weight) of items drives the costs of warehousing.
- * The number of sales invoices drives the costs of the sales department.

Cost Objects

The most obvious cost object is the actual product, but often other cost objects exist.

These include:

- * Service - Customers sometimes request a special service in addition to the normal product. This might for example take the form of special packaging.
- * Marketing channels - Products can be sold by sales persons or through wholesalers etc.
- * Distribution channels - Products can be delivered by air freight or by road or collected by customers themselves.
- * Customers - Some customers are allowed a trade discount, or special finance arrangements are arranged etc.

Bill of Activities (BOA)

The bill of activities is central to ABC. It is a list of all activities which are consumed by a product or service (to satisfy a customer). The bill of activities is very similar in concept to the bill of materials. The more detailed the BOA is, the more precise will the costing of the product be.

Value Chain

The value chain is an important concept for the design and continuous improvement of an ABC system. It is also essential for any cost reduction initiatives.

An enterprise adds value to a product by transforming input into outputs. More precisely, the activities of the enterprise bring about these transformations. The chain of activities which add value to a product is referred to as the value chain. This concept was first identified and defined by Porter (13).

Porter (13) distinguishes between primary activities which satisfy external customers and secondary activities which satisfy internal customers. In other words, primary activities are those which make an organisation operative, secondary activities enhance the efficiency of the primary activities.

Porter (13) identified five primary activities (inbound logistics, operations, outbound logistics, marketing and service) and four secondary activities (infrastructure, human resource management, research and development and procurement).

Competitive advantage is gained by carrying out these activities in a more cost-effective way than the competition. This includes reducing the number of activities to a minimum and performing these activities at low costs. The value chain approach assists in focusing on value adding activities and eliminating or reducing non-value adding activities.

3.2.2 Concept of Activity Based Costing

Products consume activities and activities cause cost. This was already recognised by the traditional costing systems, however at the time when these systems were designed only one activity consumed significant amounts of resources to be included in a costing system, namely production. ABC recognises that many other activities are performed, unrelated to the actual production. It therefore analyses with the aid of the value chain which activities are performed in an organisation and then traces these activities to the final product.

Tracing activities to products is achieved by categorising activities. Activities can be related to product type, the order placed by a customer, production batch or single units. The costs related to orders, for example processing an order, are allocated to the single unit by taking into account the quantity ordered. In this way high volume orders are discounted. In traditional systems the costs of processing an order were treated as an overhead expense and each product would absorb the same overhead rate, regardless of the size of the order.

Activities can also be related to other cost objects, like the marketing or distribution channel, etc. These costs are not traced to the product but to the customer.

Secondary activities like personnel and maintenance activities which do not add value to the product directly, are traced to the final product via primary activities which do add value. The activity in the maintenance department, for example, is to service the machinery required for production. The associated costs of a maintenance activity can be charged to the machine being serviced. The costs of the machine are then charge to the product made by the machine.

Having introduced the broad concept of ABC, the process of costing will now be outlined.

3.2.3 Process of Activity Based Costing

Activity based costing is a five step process. It starts with the analysis of the value chain and the separation of costs into activity pools. Then the cost driver is established and the output of the activity pools are determined. Based on the cost and activity output, activity rates are calculated. This is followed by the compilation of the bill of activities and the calculation of cost objects.

Step 1: Analysis into activity centres

This step allocates costs to the different activity cost pools. An activity cost pool in a clothing factory is, for example, the sewing floor or the laying-up operation or the sales and design department. Costs which can occur for such a cost pool are wages, salaries, rent, depreciation and power. The information can be summarised neatly in an activity cost matrix shown in Table 1.

Table 3.1: Activity Cost Matrix

	Cost Pools			
Cost Elements	Design	Sewing	Laying-up	etc.
Salaries				
Rent				
etc.				
Total				

Step 2: Determination of Cost Driver and Activity Output

The next step in the costing process is to find appropriate cost drivers which best explain the cost behaviour of the activity pools. Following this the measure of output of the activity pools need to be determined. In the above example the cost driver could be sewing minutes for the sewing floor, lays for the laying-up operation and designs for the design department. The measure of output would be 10 000 sewing minutes, 200 lays or 25 designs per month.

The output measures are then used to determine the recovery rate of each cost pool. This is done by determining the number of activities during a certain time period performed by the cost pool.

The number of activities performed by a cost pool can either be based on actual output or on the capacity of the cost pool. Both approaches are valuable. The difference between them is a measure of wasted capacity.

Step 3: Determination of Activity Rates

The activity rate are determined by dividing the total cost of a cost pool by the number of activities. The result is a measure of how much one activity costs.

At this stage secondary activities are allocated to primary activities. The primary activities are calculated as above, but are then corrected to include secondary activities.

Step 4: Compilation of the Bill of Activities

Here the number of activities consumed by a cost object needs to be determined. This consumption pattern is described in the bill of activities. In the above example this would be as follows. The product, e.g. a shirt, consumes one design activity, ten sewing minutes and 1/100 of a laying-up operation.

Step 5: Calculation of Cost Object

This is the final step where the number of activities are simply multiplied by the cost per activity. These different costs are then added to give the final cost of the cost object - in this case the shirt.

3.2.4 Activity Based Management

ABC originated from a need for decision relevant information. Most importantly, more accurate product costs were required, but many other management reports were affected by the distortion of product costs as well. Many make/buy decisions were

negatively influenced by the high percentage of overhead costs included in labour hour rates.

Performance evaluation measures were often unjust. For example, the performance of a finishing department is measured with the same criteria as the production floor, namely machine hours, although no correlation exists between machine hours and the time required in finishing.

Strategic marketing decisions were influenced by distorted customer profitability and cost reduction activities were misdirected.

ABC provides much relevant information besides the more accurate product cost. New performance criteria can be introduced which evaluates according to the activity output of the activity pool. Customer profitability can be determined more accurately from better cost information, and make/buy decisions are not influenced by large overhead rates.

But the most important aspect of ABC is the emphasis on the value chain. This focuses the factory on value adding activities and is a powerful approach to cost reduction.

Although the emphasis was originally on more accurate product costs, the latest developments focus on activity based management (ABM), i.e. using the information supplied by ABC for decision making purposes, other than product pricing.

Glad and Becker (12) view ABM as a holistic approach to fundamental issues such as management of cost, quality and time. And as such it is not only a new way to calculate business figures, but requires a thorough understanding of the organisation. For them (12), ABM is a fundamentally new way of managing an organisation. They identified the most important aspects of ABM as:

Strategic Analysis: Although a cost system can only support a strategic management system, and never replace it, ABC can supply more accurate data on unprofitable products, customers, distribution channels, etc. This information forms a better foundation for taking strategic business decisions.

Value Chain: The value chain is a powerful tool in reducing costs, especially when it is linked to suppliers and customers, and when comparisons are made with other organisations.

Continuous Cost Improvement: The value chain and the detailed cost analysis of ABC simplifies the identification of unnecessary cost, which can then be reduced or eliminated.

Capacity Management : ABC can use two approaches to calculate the cost of activities. One is based on the capacity and the other on the actual number of activities of a particular activity pool. The difference between the capacity and the actual output can be highlighted by the ABC-system. This information is useful for planning of future capacity.

Budgeting : Activity based costing provides a clear insight into costs (cost visibility), what causes cost and how costs will behave. This insight is valuable when future costs have to be estimated. Furthermore, budgeting based on ABC focuses on the customers and their future requirements instead of the internal constraints of the organisation.

Activity based costing is thus not only a new way of calculating product costs but can be developed into a whole new management accounting system.

3.3 Japanese Cost Reduction Systems

Japanese manufacturers also realised the shortcomings of traditional cost management systems. But the development of a new system is taking a different direction. It should be noted here that the cost reduction system is still in its infancy and concepts are still evolving. The automobile industry is the only industry which has considerable experience with this new approach. Little literature is available describing cost reduction systems in other industries. In fact, little literature is available about cost reduction systems in general. To the author's knowledge Yasuhiro Monden's book "Cost Reduction Systems" (23) is the only one dealing with this concept systematically. The following introduction to the topic thus relies much on his work.

In today's competitive environment cost control is not sufficient to ensure the survival of a business. Only the reduction of cost will ensure stable profits throughout the life time of a product. The cost reduction system was developed to proceduralise cost reduction activities such that it becomes an integral part of the every-day operation, like cost control is. The new system consists of two sub-systems. Target costing is concerned with cost control and cost reduction during the planning and development phase of the product. Kaizen costing focuses on the production phase. The combination of these two approaches ensure that cost reduction is exercised throughout the entire product life cycle.

Both, target costing and kaizen costing, rely on the same principle. The cost reduction potential is estimated, realistic targets are set and the process or product is scrutinised to identify how these targets can be realised.

3.3.1 Target Costing

Target costing is a procedure to reduce costs at the development and planning phase. The emphasis here is to identify potential markets, establish customer needs and conceptually design a product which satisfies customers both in terms of their needs

and the price. The second stage is then to realise savings by investigating possible alternative types of materials and production processes. The process of target costing can be summarised in five steps:

Market Research: The aim of market research is to survey customer needs and trends in marketing strategies of competitors. According to the findings the market position is determined.

Product Development and Planning: At this stage the conceptual design of the product is done based on the results of the market research and any new technology.

Target Costing: Once the conceptual design of the product is completed the selling price is determined. This can be done in various ways. The price of similar products can be used as a guideline. Prices of competitors can be used. Or the price is determined by the market. Based on the target price and a predetermined profit margin the cost of a product is determined. Following this, the parts are target costed in the same way.

Value Engineering: After the target cost of the product is determined, the actual cost is calculated. If the target can not be met the product is value engineered. This involves an evaluation of all features of the product in an attempt to eliminate some and hence reduce costs. This analysis needs to be done with great care and in consultation with the marketing function to ensure that the product still meets the needs of the customer. The second aspect of value engineering is to investigate alternative production processes and materials in order to reduce costs.

Performance Evaluation: Once the target cost has been achieved and the product is going into production, the cost performance is monitored to determine whether the target costs are met.

3.3.2 Kaizen Costing

Kaizen costing is cost reduction during the production phase of a product. It means continuous improvement costing and is very similar to just in time (JIT) and total quality management (TQM).

JIT was developed to continuously improve on work flow and reduce inventories. TQM was developed to continuously improve on the quality of products. The philosophies of these two approaches are very similar. Continuous incremental improvement, employee participation and more autonomy at lower levels of the organisational structure are the key to success.

The emerging kaizen costing is a similar approach to achieve continuous product cost reduction. This is achieved by focusing on cost reduction, rather than on cost control. Secondly, targets are revised every month and continuous effort is made to reach the target, in contrast to the traditional approach where action is only taken when costs exceed the standards.

Cost control is achieved by involving everybody in reaching the estimated cost targets. Employees are organised into small groups similar to TQM's quality control circles, and autonomously carry out continuous improvement activities. This then becomes the cost control of the workplace and makes traditional accounting control obsolete. Cost control becomes cost reduction and is no longer only the responsibility of the accounting department, but of every employee on the production floor.

Both new cost management systems emphasise the cost reduction function. Both approaches realise the need for more detail in determining costs. The significant difference is that ABC is controlled centrally, whereas with the cost reduction system every employee is involved and responsible for reaching set targets. To establish which approach is better suited for FCI, soft systems methodology will be applied.

3.4 Application of Soft Systems Methodology

The process of SSM to identify the better costing system begins with an investigation of three scenarios - the current situation, the ABC and the cost reduction system. Following this, the ideal systems for the two new approaches will be defined. These are then compared to the current situation and the differences are highlighted. Based on the differences the more appropriate approach is selected. For more detail on the seven stages of SSM refer to Section 2.

3.4.1 Stages 1 and 2: Finding Out

A short description of the current management accounting system is included here. For detailed information on ABC and cost reduction systems refer to Section 3.2 and Section 3.3 respectively.

3.4.1.1 The Current Management Accounting System

Figure 3.1 shows a diagrammatic representation of the current management accounting system. The financial accounting department determines the cost per department. It also estimates the capacity of the sewing floor. This is then used to calculate a recovery rate [Rand/sewing minute].

Work studies of the sewing operation from previous (similar) products are used to determine the production cost, to which material costs are added to arrive at the product cost.

For management purposes the profitability of products can be calculated, but these figures are rather inaccurate since only 40% of the total production costs are allocated directly to the product. Currently customer profitability is not established because it is assumed that the profitability is equally spread.

Management also compares actual output of the sewing floor with the budgeted figures to determine production efficiency. However, there is no appropriate measure of the capacity and no incentives for improvements.

Strategic decision making relies heavily on financial accounting information, which is often unsuited because it is generated for outside stakeholders, and is not relevant for internal decision making purposes.

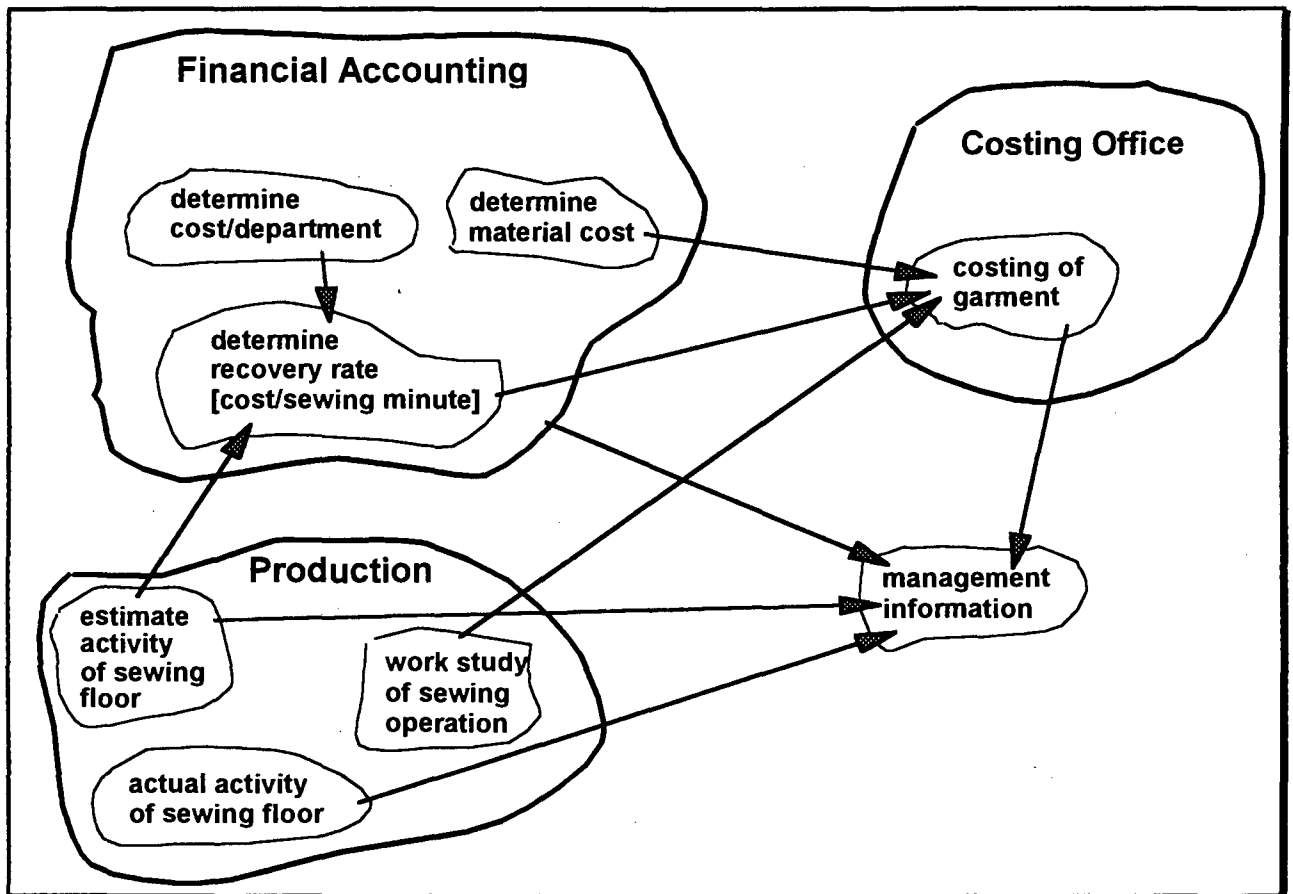


Figure 3.1: Current Management Accounting System

3.4.2 Stage 3: Formulating Root Definitions

The root definitions are concise statements of the ideal systems. The definitions should include the primary tasks (what inputs are transformed into what outputs),

the stakeholders, the worldviews on which the different systems are based and any environmental constraints.

3.4.2.1 Root Definition of System 1: Activity Based Costing

ABC is a management accounting system based on a costing system, which traces costs to the task of satisfying customers. These tasks not only include manufacturing the required product, but often also encompasses customer services.

Stated differently: ABC is a management system based on a costing system, which traces all costs associated with the transformation of customer requirements into customer satisfaction to the transformation activities.

CATWOE Analysis:

Customer: The beneficiaries are the shareholders because the company gains competitive advantage, and management because ABC introduces more appropriate measures of performance.

Actors: The activities are done by the (management and cost) accounting function.

Transformation: The purposeful activity is to trace costs to products/services. Uncosted products/services are transformed into costed products.

Weltanschauung: Tracing costs to products/services is desirable and feasible. It will also focus on satisfying customers and reducing waste.

Owner: This activity can be stopped by the company, or more specifically top management.

Environmental Constraints: Tracing costs can never be done with 100% accuracy. The trade-off is between accuracy and the cost of obtaining data. Employee involvement is low and therefore costs have to be controlled centrally.

3.4.2.2 Root Definition of System 2: Cost Reduction System

The cost reduction system is a management system which emphasises cost reduction rather than cost control. Cost reduction is achieved throughout the entire product life cycle. Target costing achieves this during the design and planning stage. Kaizen costing reduces costs in the production stage. Kaizen costing shifts this responsibility down to lower levels in the organisational hierarchy.

CATWOE Analysis:

Customer: The beneficiaries are the shareholders and top management of the organisation. The design function also benefits since specific targets are set.

Actors: The activities are done by every employee in the organisation.

Transformation: The purposeful activity is to reduce cost in the product planning as well as the production stage.

Weltanschauung: Competitive advantage can no longer be gained only by reducing waste during production, but has to be gained by reducing cost at development stage. Employee involvement, continuous improvement, waste reduction and customer focus are essential to the viability of organisations.

Owner: This activity can be stopped by any group of employees of the organisation - management as well as workers.

Environmental Constraints: Customer requirements have to be satisfied at the lowest possible cost. Profits need to be made by cost reduction. Manufacturing know-how and capital are no longer the only requirements for success.

Having formulated the root definition of the two alternatives, the next step is to build a conceptual model of these systems.

3.4.3 Stage 4: Building Conceptual Models.

A conceptual model is an account of the activities an ideal system has to do in order to fulfil the requirements of the root definition.

3.4.3.1 Activity Based Costing:

The conceptual model of ABC is shown in Figure 3.2. The accounting function has to provide information on the cost of the different activity centres.

Every activity centre needs to determine the actual and maximum level of activity. The question to be asked is: How many activities are performed by a particular activity centre and what is the maximum capacity of that centre?

From the above information (total cost of activity centre and level of activity) the cost of one activity is determined. Furthermore, the wastage associated with excess capacity is also determined.

The planning and design function sets up a bill of activities (BOA). The BOA entails detailed information on how many activities of which activity pool are required to produce a product or to satisfy a customer. The BOA is thus made up of two parts. One contains information about products and the other contains information about customers.

Knowing the cost per activity, the BOA is then used to determine the final cost of a particular product and the required service to a particular customer.

From this basic activity based costing system the following management information can be extracted: product profitability, customer profitability and capacity constraints. This information is then used for strategic planning purposes.

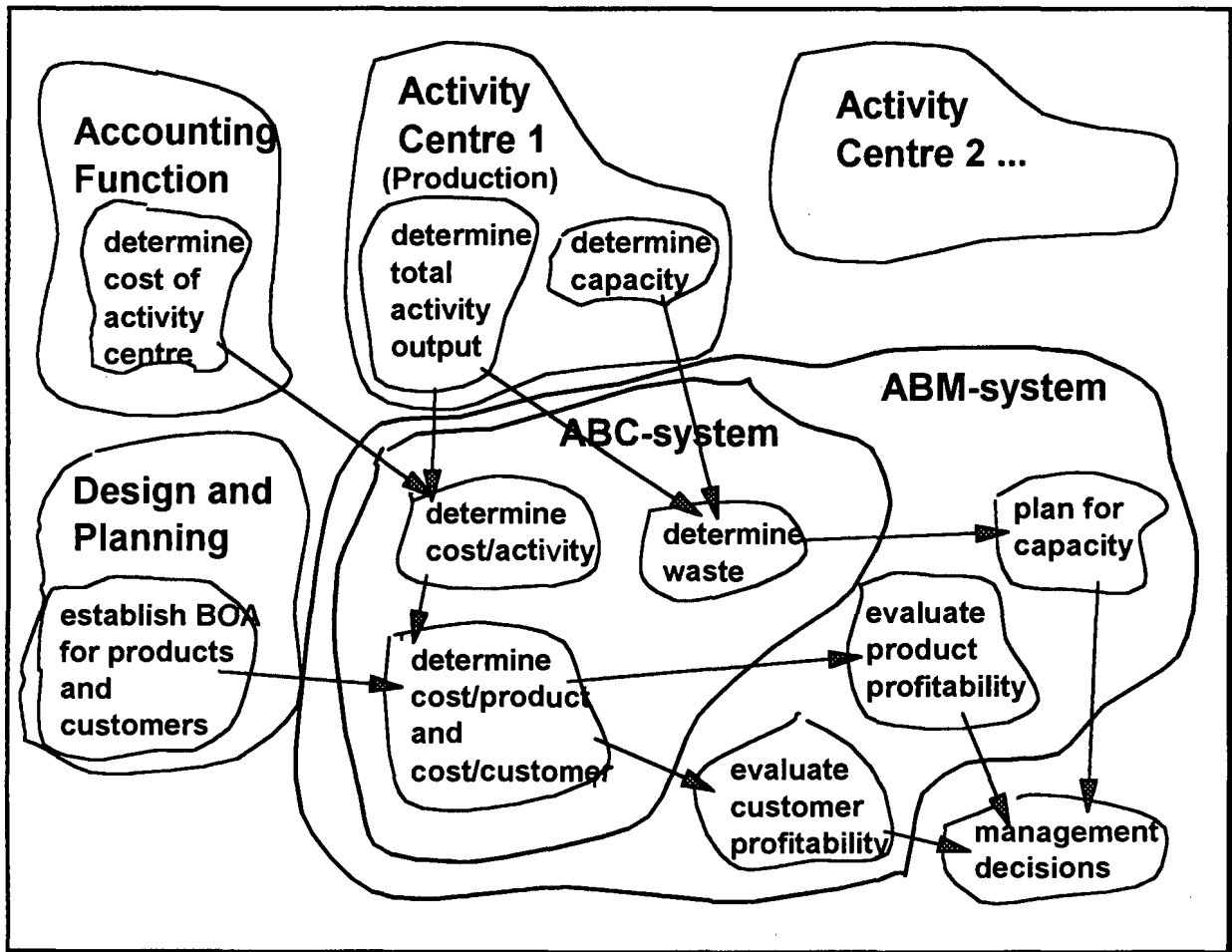


Figure 3.2: Conceptual Model of ABC

3.4.3.3 Cost Reduction System

The conceptual model is shown in Figure 3.3. The cost reduction system is part of the design and planning function. Costs are reduced by setting targets for product cost. This target is then compared with the estimated (or actual) cost and the product and/or the production process are then value engineered to reach the

targeted cost. This process of estimating cost and value engineering is repeated until the target is reached.

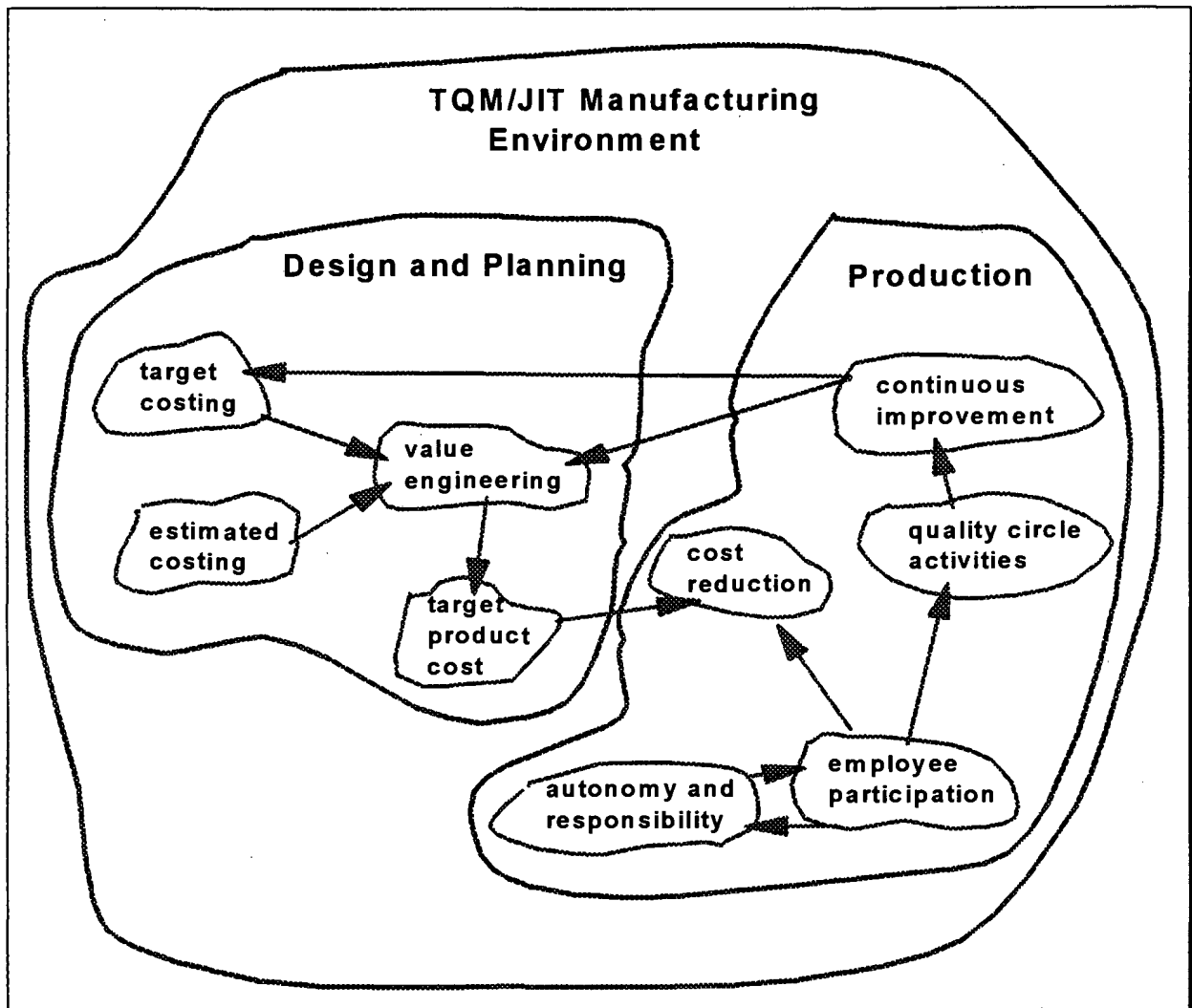


Figure 3.3: Conceptual Model of Cost Reduction System

The final product cost is then further reduced by the production function or rather the subdivisions in the production function. A prerequisite for cost reduction at this level of the organisational structure is a well established JIT/TQM manufacturing environment, which ensures a fair degree of autonomy in the subdivisions of production. Employee participation is another vital aspect here. If employees 'own' their process, if they are responsible for what they are doing, they are willing to control and reduce costs.

A JIT/TQM environment with quality circle activities and the focus on continuous improvement is not only important in production but also in the design and planning function. This is especially true where organisations have little experience in target costing and value engineering. Both require substantial learning since these techniques are relatively new and not well established.

The development of the conceptual models of the ABC and the cost reduction system is now followed by a comparison with the current system at FCI.

3.4.4 Stage 5: Comparing Models and 'Reality'.

The models were compared with reality using Checkland's second 'way' of comparison - identifying differences by question and answer approach. The following questions were answered for each activity: Is this activity done at present?

If so, how? If not, why not? The results are listed in Appendix A and only the important differences are discussed here.

3.4.4.1 Activity Based Costing and the Current System

1. Cost of activities are not currently determined, since the current costing system does not attempt to trace product or customer related costs except for the costs associated with the sewing floor.

Departments are regarded as cost centres. A more detailed break-down of processes and their costs is not considered necessary.

2. Only the output of the sewing floor is determined and monitored. The efficiency of the sewing floor is the only measure of productivity of the organisation. All other departments are also evaluated according to how many sewing minutes were processed, although many activities (like laying up and design) have no relation to

sewing minutes, i.e. the cost of laying-up fabric or designing a new style is not dependent on how many sewing minutes are required.

This approach might be justified in terms of focusing on the total production process, rather than sub-optimising parts thereof, but using this as a measure of productivity is unfair. This particularly causes unfounded accusations from management and frustration amongst employees in departments other than the sewing floor.

3. The capacity of the sewing floor is regarded as the only crucial one. This is so because the sewing floor is the largest cost centre and wasted capacity would mean serious losses. Overcapacity in other functions is accepted to ensure smooth work flow.

Although this might be true, the capacity of functions, like laying up, knitting, finishing, design and planning, were neglected for too long. Consequently the capacity of the sewing floor was expanded without taking these other processes into consideration. This resulted in serious bottlenecks in laying up, knitting and to some extent planning which had adverse effects on the overall efficiency of the factory.

The 'capacity awareness' which ABC introduces does not only allow the reduction of excess capacity, but would also prevent situations like the one described above.

4. The current system only determines material wastage. This is expressed in terms of percentage fabric utilisation and meters of left-over fabric.

An advanced ABC system highlights not only material wastage but also wastage due to under-utilisation of equipment or human resources and bad quality. The value chain approach also helps to reduce the non-value adding activities and thereby reduce wastage due to unnecessary transportation, storage and processing.

5. Currently only the sewing floor expenses are traced to the product accurately. This is only 40% of the total cost. The other 60% of the costs are allocated on an arbitrary basis. Serious cost distortions are the result.

Customer service often results in extra cost. For example, customers request three month credit or special packaging. These cost are customer related and can not be traced to the product. They are therefore not recovered and hence will impact on the profitability.

ABC provides for this by determining not only product cost but also other cost objects such as credit facilities, different distribution channels and special packaging.

6. The current management accounting system does not evaluate products or customers according to profitability, since it assumes that all products and customers are equally profitable. The system distorts product costs such that these differences remain concealed.

3.4.4.2 Cost Reduction and the Current System

1. The nature of the clothing industry makes target costing an unsuitable approach to cost management. Customers often have a fixed idea of what they want. Cost is of secondary importance after adherence to product specification. This scenario leaves little room for value engineering and the effort of target costing would not be worthwhile.

2. The management system suggests that every employee should be involved in cost control. But this can only be achieved in an environment where employees are responsible for their work - an environment which can only be created by JIT and TQM. The company does not have a long history of TQM. The initial efforts of the TQM-program concentrate much on the management levels with little emphasis on

employee participation and flattening the organisational structure. Continuous improvement is not yet part of the organisational culture and hence cost control will not be effective if not done centrally.

3.4.5 Stage 6: Defining Changes

The comparison in Stage 5 shows that the cost reduction system is not appropriate in an organisational environment which lacks employee participation and the strive for continuous improvement. Unmotivated employees will not control cost adequately. A JIT/TQM environment is vital for successful implementation of this management accounting system.

ABC on the other hand would be a feasible alternative. The current costing system could be adapted relatively easily to an activity based costing system. It would be necessary to allocate costs per activity centre and not per department. In addition, the activity output of each activity centre would have to be determined and a BOA developed.

The advantage of implementing ABC is that a crude system can be introduced and then refined whenever necessary. In this particular organisation an ABC system with only two cost drivers would already improve the costing considerably. More cost drivers can be added, or if the effort of gathering information is not worth the benefit, a cost driver may be scrapped.

Furthermore this company deals with a finite number of customers, each one requires a different service. Some want to inspect quality themselves, others require special packaging. Some pay very regularly and others only after three months. It would therefore be ideal to not only cost products but also customer service.

Implementing only the costing system would already improve the profitability of the business. Further reports, like product profitability and customer profitability, could be developed later to even further enhance the benefit from ABC. ABC is thus a system which can be implemented gradually without dramatic changes which might be rejected by those who are affected.

The above evaluation has shown that of the two new management accounting approaches, ABC is the more desirable one for FCI. Change would thus be defined as implementing an ABC system. The details of this are outlined in the Section 4.

3.4.5 Stage 7: Taking Action

Action in this case would constitute implementing an ABC system, but before this is done a closer look at activity based costing is required.

3.5 Literature Review of Activity Based Costing

This section is the second iteration of the immersion phase, whereby a deeper understanding of ABC, its benefits and limitations is developed. An overview of the ABC literature will be given, followed by a summary of case studies.

3.5.1 Kaplan (17)

Kaplan (17) was one of the early academics who criticised the traditional management accounting system. His well known book 'Relevance Lost: The Rise and Fall of Management Accounting (17) deals with this topic extensively. At the same time he was also an early advocate of ABC and contributed to the development of this approach.

However, Kaplan sees ABC as only one aspect of a new management accounting system. In the introduction of 'Measuring Manufacturing Excellence'(18) a book he edited, he emphasises the importance of direct and non-financial measurements of quality, process time, delivery performance and other operational performance criteria.

3.5.2 Cooper and Turney (19): Internally Focused ABC

The original (externally focused) ABC system was designed to trace cost to the product and therefore sell the product at a fairer price to the customer. It is thus a system which focuses on customers and their requirements. Internally focused ABC aims at achieving strategic business objectives by adapting the ABC system accordingly.

Cooper and Turney (19) report on three cases where internally focused ABC was implemented to achieve a strategic goal. An example will illustrate this: A particular organisation in the electronics industry realised that competitiveness can be gained by designing products with a minimum number of unique parts. The costing system was adjusted such that the only cost driver of new product costs was the number of unique parts in the product. In this way, designers were forced to produce products with less unique parts and hence the strategic goal was achieved through adapting the costing system. Once the awareness of the benefits of less unique parts was realised, the costing system was refined to eliminate biases.

3.5.3 Kofman (21): Double Loop Accounting

An investigation of why the traditional management accounting system lost its relevance reveals that many underlying assumptions which led to the development of that system are no longer valid. Production costs no longer make up 90% of the total costs. Organisations no longer only produce one product. Direct labour costs

are no longer significant in a highly automated production plant. And finally, the cost of gathering information does longer outweigh the benefits of the information.

If the assumptions on which the traditional approach was based were stated more explicitly much time would have been saved in realising that these assumptions are no longer valid and hence the accounting system could have been revised earlier.

Kofman (21) suggests double loop accounting to overcome this problem. Double loop accounting in essence means not only looking at the figures but having a thorough understanding of how these figures come about. This includes knowing the underlying assumptions as well as the method of calculation. Double loop accounting thus means understanding the results of accounting not only in terms of the figures used to arrive at these results, but also in terms of the underlying assumptions and hence the system which generates these figures. Double loop accounting is about understanding. It requires much more information and hence time, but resulting decisions are based on a firm foundation.

Although ABC does not attempt to explicitly state the underlying assumptions on which it is based, the newness of this system brings about that these assumptions are analysed before ABC is introduced. ABC is based on currently valid assumptions. It is thus more appropriate than the traditional system. But there is no guard against ABC becoming obsolete, once some of the current assumptions are no longer valid.

3.5.4 Drury (20): An Evaluation of ABC

Drury (20) rightly criticises the eager advocates of ABC for claiming that all costs can be traced accurately to products and the results can therefore be used directly for decision making purposes. 'Hence there is the danger that ABC will be seen as a panacea that provides truly accurate product costs that can be used to predict outcomes of various decisions accurately' (Drury, 20). This is very closely related to

Kofman's concerns (21) - that the underlying assumptions are not taken into account. The system is assumed to generate accurate results.

ABC is a system which attempts to trace costs more accurately and hence be of greater significance for decision making, but it is not a decision making tool as such. Other aspects, especially marketing related issues, may not be ignored just because ABC gives more accurate cost estimations.

3.5.5 Innes and Mitchell (22): Limitations of ABC

Innes and Mitchell (22) claim (so does Drury, 20) that little evidence is available to prove that ABC improves the profitability of organisations. ABC is a very young method and time will reveal whether it is beneficial to organisations.

They also claim that ABC information is historic and internally orientated and therefore lacks direct relevance for future strategic decisions. This is certainly a valid criticism. In the light of the cost reduction system, ABC does not attempt to reduce costs in the design and planning stage. Although internally focused ABC might well direct designers to achieve strategic goals.

However, there is no doubt that ABC supports the management philosophy of JIT and TQM better than the old approach. This is achieved through measuring performance of smaller groups (related to activity pools), the focus on wastage and the value chain approach.

3.5.6 Glad and Becker (12): Activity Based Management

Only in the very recent literature is ABC not only regarded as a new costing system but a foundation for a whole new holistic management accounting system. Glad and Becker (12) give a detailed account of this. Much of this has been summarised elsewhere and will not be repeated here.

3.5.7 Case Studies

Kaplan (18), Innes and Mitchell (22) and Bailey (24) report on various case studies. These are analysed below to gain insight into the practical aspects of ABC systems. Only the relevant issues are summarised.

a) Instrument Inc. (18)

This company previously used a costing system with two cost pools. Costs were allocated either on the bases of direct material costs or direct labour costs. The costing system was criticised for the following reasons: Firstly, the system did not give proper guidance on how to reduce costs. Secondly, low volume production runs were subsidised by high volume production runs.

A team of three members was established to develop an ABC-system with 14 activity pools. This system was regarded as crude, and further refinements were made after the initial implementation.

The major learning points were: Firstly, the implementation should be done by a team with representatives of every area in the organisation and a full time project leader. Secondly, a lack of understanding of ABC hampered the development and implementation of the system. Credibility of the new system was not easily gained.

Product and customer profitability analysis showed the typical behaviour. Some products/customers are highly profitable, some show an acceptable profit, but some are loss makers.

The benefits of ABC are perceived to be more accurate product costs and hence better guidance to cost reductions. ABC also shifted the focus from managing

costs to managing activities, which is the beginning of activity based management.

b) Alpha (22)

Alpha used a standard costing system which allocated cost on the basis of direct labour. It was felt that product costs can no longer be determined accurately, since the cost structure had changed considerably over the past few years. The overhead percentage was alarmingly high. Furthermore, some suspicions had been growing amongst managers that the company was losing market share because of inaccurate product costs. In addition, just-in-time manufacturing was introduced and the old costing system did not support this change well.

It was decided to introduce an ABC system with 32 activity pools and 14 cost drivers. A team of nine members (six accountants) was set-up to co-ordinate the development and implementation of the new system.

The analysis of product and customer profitability again yielded the expected results. This initiated the review of product prices, and an assessment of the viability of product lines. Furthermore, the ABC system highlights the factors which cause costs, which will ultimately influence the product design.

Future developments will include the usage of cost drivers' overhead rates as managerial performance measures. This again is the beginning of activity based management.

c) Beta (22)

The standard costing system at Beta did not support the recently introduced just-in-time manufacturing method. It was also difficult to justify further automation of the production process. In addition, the trend towards customisation of products

rendered the old system incapable of determining product costs more accurately. Finally, continuous improvement initiatives in non-manufacturing functions required some measure of performance.

After substantial in-house training, an ABC system with 18 basic activities was developed. Initially this system was run concurrently with the existing one. The ABC system gained acceptance rapidly after the preliminary data analysis proved surprising and revealing.

d) Survey of ABC systems (24)

A survey of ten companies which introduced ABC revealed the following:

- i) **Team building:** The size of the ABC implementation teams averaged 5.3 members. Six out of ten companies included operations or production managers. Another two organisations said they would do so in future. None of the ten companies included sales/marketing managers.
- ii) **Running Cost:** The majority of the companies reported no significant increase in operating costs of the new system. One company even reported a reduction in running costs.
- iii) **Identification of cost drivers:** Every company reported that department and/or shop floor managers help with the identification of cost drivers. Where consultants were assisting with the identification, the total number of cost drivers was significantly lower than in cases without out-side assistance.
- iv) **Benefits:** All companies showed more accurate product cost estimations. Seven out of ten companies admitted to improved management information. Improved profitability was reported by 40%, and cost reduction by 60% of the companies.

v) Practical problems: Information gathering had been reported to be a problem in 40% of the cases. Difficulties in convincing other management levels of ABC's benefits was experienced by 30%, and in 20% of the cases difficulties with software design were encountered.

In the first part of this section ABC was identified as the better approach for FCI. The second part critically reviewed the theoretical as well as practical aspects of ABC. In the next section the ABC system for FCI will be developed.

4. Developing the Activity Based Costing System at FCI

Having concluded that activity based costing is the more appropriate approach for FCI, the costing system will be developed now. In terms of the research process, the development of the ABC system is the abductive phase which generates a solution - a hypothesis which still needs to be tested (refer to Figure B1 of Appendix B).

FCI is a clothing manufacturer which produces make-to-order garments for a variety of customers. Competitiveness is gained through high quality and innovative designs. A wide range of garments are produced which is possible because of the high degree of flexibility within the organisation.

The process of producing a make to order garment is initiated by the customer who places an order with the sales department. The design department then prepares samples for the customer to approve the quality of fabrics, measurements and other specifications. Simultaneously, the garment is costed and once agreement is reached on the specifications, price and delivery date, fabric and other raw materials are procured. Once all components are available the fabric is laid-up into multiple plies and cut into panels. Then the garments are sewn, ironed, packed and dispatched.

Although the company is currently revising the information system, data capturing and processing is inefficient and time consuming. Therefore, it was decided to simplify the ABC-system as much as possible. The aim was to introduce a crude system, which can be used under the present circumstances, but at the same time can be refined whenever the cost and effort of extra detail is justifiable. This approach to the implementation of ABC is adopted frequently,

especially in organisations with weak information systems and limited resources (refer to case studies by Kaplan (18) and Innes et al (22)).

ABC is a two stage allocation system. Costs are allocated to activities (or activity pools) and activities are allocated to products via cost drivers. A simple ABC-system thus attempts to reduce both the number of activity pools and the number of cost drivers.

At FCI, product costs can be divided into two different categories. The one type of costs being related to the actual garment produced, the other to the order. The main aim of this ABC model will be to split the costs into those which are garment related and will vary with the size of the order, and those which are order related and are fixed regardless of the number of units sold per order.

For example, fabric store and production floor costs would be dependent on the number of garments produced and should be allocated via a cost driver which takes this into account. The simplest cost driver would be the number of units per order. Costs related to design, sales and planning are independent of the number of units produced and should be recovered via a cost driver which ignores the size of the order. A possibility would be 'number of orders'.

Currently no distinction is made between these two types of costs and design, sales and planning expenses are recovered on a units sold basis. This distorts product costs considerably since orders with large quantities absorb much larger portions of these costs than orders with small quantities, although the resources consumed might be equal. This is even further aggravated by the fact that lady's wear which is sold in small quantities, generally consumes much more 'design resources' than men's wear.

4.1 The ABC-System

The ABC-system was designed following Cooper and Kaplan's guidelines in 'Measure Costs Right: Make the Right Decisions' (19). They suggest the following steps: establish the value chain, analyse labour costs, interview department managers to identify activity pools and cost drivers, allocate costs to activity pools and measure the output of these pools.

4.1.1 Establish the Value Chain

The value chain was generated from past interviews with department managers and is shown in Figure 4.1 below.

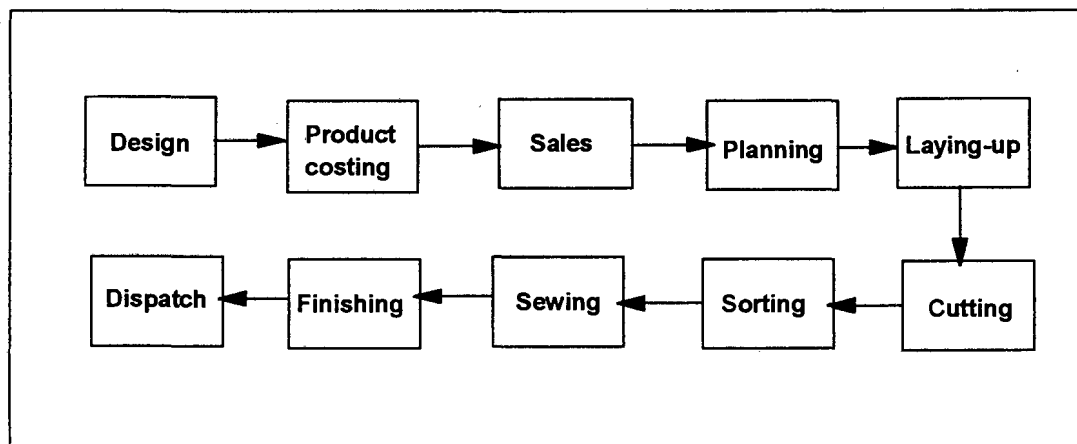


Figure 4. 1: Value Chain

4.1.2 Analyse Labour Cost

To be able to determine the right cost driver of a particular activity pool the nature of the costs have to be determined. Generally the majority of the costs of a department are related to salaries or wages, but this is not always the case. If, for example, expensive machinery is used depreciation might exceed labour

cost. In this case machine hours would be a more appropriate measure of activity than person hours.

The percentage of salaries and wages versus total cost were calculated for each department to establish whether it is justifiable to use a labour related cost driver. The results are listed in Table 4.1 below.

Table 4.1: Salaries and Wages as a Percentage of Total Cost

Department		Department	
Design	51%	Production	95%
Sales	68%	Finishing	71%
Planning	77%	Quality Control	97%
Costing	71%	Stores	90%
Pre-Production	81%	Maintenance	47%

The results in Table 4.1 indicate that the largest proportion of costs are related to labour, except in the case of maintenance where 50% of the costs are general maintenance expenses such as spare parts and new tools. In searching for the appropriate cost drivers this needs to be taken into account.

4.1.3 Identify Activity Pools and Cost Drivers

Informal interviews were conducted with the department managers to divide the departments into activity pools and identify an appropriate cost driver for each activity pool. The survey conducted by Bailey (24) showed that this is the most efficient way of finding the right cost drivers, since department managers know best how resources are consumed. The interviews were done according to guidelines given by Cooper and Kaplan (19). First the nature of the work done was established. Then possible cost drivers were suggested and discussed.

Finally, the number of activity pools and their respective cost driver were decided upon. This last step was significantly affected by practical implications. Namely, a cost-benefit analysis was pertinent to the decision to capture extra information. In most instances it was decided to work with existing information and only to refine the model once a better information system is in place.

4.1.3.1 Design:

The activity of this department is the development of new products (styles). The simplest way of allocating design costs to a product is to use the number of orders¹ which were sold over a period of time as a cost driver. The advantage of this cost driver is that all designs 'cost' the same. The productivity of the department could be measured as the number of designs which were sold. Hence designers would be encouraged to develop only styles which are selling well and require little design effort. They would not be credited for designing high fashion garments which consume more resources than basic styles. According to Cooper et al (19) this would be an internally focused cost driver aiming at enhancing a particular strategy rather than an externally focused cost driver which attempts to allocate cost accurately.

The disadvantage of this cost driver is that costs are not allocated properly. The variation of design input is too high and will affect the cost of the product significantly especially in the case of small orders, where these costs are only spread over a few garments.

An alternative is to allocate the design costs on the basis of the number of hours spent on designing a style. This would allocate the human resources accurately. But it is practically not feasible because designers will have to fill out time sheets

¹ This number is equal to the number of styles designed in a make-to-order environment.

and a general resistance was experienced against the proposal. In addition, only half of the total expenses of the department (refer to Table 4.1) are related to human resources, another significant proportion is made up of fabric used for samples. Hence another alternative is to use the number of samples made per style as a cost driver. Although this does not reflect the actual activity of the designers themselves, much of their activity is related to it. Furthermore, by using this cost driver the fabric costs are allocated reasonably accurately, since the fabric is used for sample making. The number of samples is thus a cost driver which not only drives the cost of working time but also that of fabric.

At this stage however, it will be difficult to count the number of samples made per style, because in the early stages of the development, samples are made without reference to an order number. It will thus be difficult to trace these samples to a specific order. Furthermore many samples are made without ever selling an order. This is especially the case for ladies wear.

However, it is possible to trace each sample to the customer who ordered it, and hence the average number of samples per order placed can be established for each customer. This would give an initial estimate of the design input until the necessary changes are made to be able to trace samples to the final order.

4.1.3.2 Sales:

The activity of this department is the selling of garments. An appropriate cost driver would thus be 'hours to sell an order'. But again for practical reasons this cost driver is inappropriate. Further investigation into the activities of the sales department showed that much time is consumed due to continuous changes to existing orders. Customers change the colour or type of fabric or even the design of the garment, e.g. from a short sleeve shirt to a long sleeve shirt. A

good cost driver for the activities in the sales department is therefore the number of changes by the customer. A new copy of the order is made for each change and the number of amendments can be used as a cost driver.

However, these changes are done only after the price of the garment was agreed upon. It will therefore be necessary to determine the average number of changes from historical data. For practical reasons, this information should only be specific to the customer not to the type of product sold.

4.1.3.3 Planning:

The activities performed in the planning department include the procurement of fabric and other materials, production scheduling and reservation of capacity for printing and embroidery done by outside suppliers. All these are related to preparing an order for production. The interview with the department manager revealed that all orders take approximately the same amount of time to process. The size of an order does not play a role and therefore an appropriate cost driver is the number of orders planned.

4.1.3.4 Production Preparation:

A number of different activities are performed prior to production (sewing). The fabric has to be laid-up, pieces have to be cut out, all printing and embroidery is done at this stage and the necessary binding for the garment is prepared. Ideally, all these activities would need a separate activity pool and a corresponding cost driver. Fortunately, the current costing system accounts for embroidery, printing and binding already. Since this first crude ABC-system only supplements the old system, including these activities again would distort final product costs.

For the laying-up and cutting operation it was decided to use only one cost driver, namely the time required to lay-up the fabric for a garment. The reason is that laying-up is the operation which consumes most of the resources and is the constraining capacity in this department.

Although no accurate information is available on how much time is required for this operation, it was realised that it is an important activity pool which requires an accurate cost driver. The costs of this activity pool compared to the total cost would not justify a cost driver. Allocating production preparation expenses using the same cost driver as the sewing floor would probably not distort product costs significantly. But the limited capacity of this activity pool and the unbalanced workload often causes delays on the production floor. To prevent such delays the work-in-progress (WIP) levels are kept high. This is associated with all adverse effects of high WIP levels - wasted storage place, lost time due to searching for orders, unnecessary cleaning of garments collecting dust, etc. A good cost driver would allow better planning in this area thereby reducing WIP and hence improving the efficiency of the activity pool.

Furthermore, the performance of this department is measured in terms of the number of minutes prepared. This is inappropriate since only a weak correlation exists between the time require for preparation and the time required for producing a garment. The new cost driver reflects the activity of production preparation better and could therefore be used as a measure of productivity. This cost driver is thus not introduced to improve product costing but the management of the department. This Glad and Becker (12) refer to as activity based management.

4.1.3.5 Production:

The sewing operation is the most expensive operation and therefore the standard costing system used the time to produce a garment or the 'standard minute value' (SMV) as a cost driver for all expenses. The new system will maintain this cost driver, but only sewing floor expenses will be allocated on the basis of SMV.

4.1.3.6 Finishing:

The activities involved in finishing a garment once it comes off the production lines include ironing, pressing, folding and bagging. But not all styles require all these activities. The time spent on finishing a garment is dependent on the customer and the type of garment. All operations consume unequal times. It was therefore decided to use the time to finish a garment as a cost driver in this department. Work study standards on each operation are available so that the 'finishing minutes' per product can be determined.

4.1.3.7 Warehouse and Dispatch:

The main activity in this section is the packing of carton boxes. This consumes time and carton boxes - the two cost items that make up most of the expenses. The most appropriate cost driver for this section would therefore be 'number of boxes packed per order'. This is a new cost driver and much information is unavailable. It is also not possible to determine the number of boxes consumed per order before dispatch, but for costing purposes this information is needed at the costing stage. An analysis of invoices over eight months showed the consumption of cartons per customer. This information will be used to allocate warehouse and dispatch costs.

4.1.3.8 Fabric Store:

Although the time involved in storing an 'order of fabric' is dependent on the number of roles or packs to be handled, most of the time is spent on processing an order rather than roles or packs of fabric. Therefore and for the sake of simplicity the cost driver will be 'number of orders processed'.

4.1.3.9 Consumable Store:

The activity of the consumable store is to order materials other than fabric. The level of activity is closely related to the number of items ordered. Since all these items are costed separately, the cost of the store should be allocated to the individual items. Each item would thus be charged with a fixed 'handling fee'. All that is required for this activity pool is to include a small overhead charge for items which were ordered through this department.

4.1.3.10 Quality Control:

The level of activity of this department is highly dependent on the complexity of the style of the garment which in turn is reflected by the time required to produce the garment (SMV). Currently, quality control costs are added to the sewing floor costs and recovered via SMV. It was decided to maintain this, but a future refinement could take into account the newness of the style by utilising learning curves.

4.1.3.11 Maintenance:

This department is serving the sewing floor and the cost should therefore be recovered via SMV. This is currently the situation and no changes are required here.

4.1.3.12 Administration:

These include financial accounting, information systems, human resources and general management, and are mainly costs which are unrelated to the level of activity of the organisation. No attempt is made to allocate these costs to a specific order, since the individual cost items are small. The detail required to allocate these costs more accurately is not justifiable in terms of the benefits.

These costs will be spread over all other activity pools on a percentage basis, and are allocated to the product via the cost drivers of the activity pools.

4.1.4 Allocating Costs to Activity Pools

Costs were allocated to activity pools using half-yearly budget forecasts, which are prepared regularly. This was possible since the crude ABC-system avoids splitting up departments into more than one activity pool. In this respect the accounting system does not require any changes.

4.1.5 Determining the Output of the Activity Pools

The output of the different activity pools is needed to determine the recovery rate. The output of some of the activity pools can be obtained from historical

data, whereas others need to be determined through forecasting. Activity pools with the same cost driver are grouped together as follows:

4.1.5.1 Design:

Not much information is available to determine the number of samples made per order, but an old study on this will be revised with the designers to give an initial estimate. At the same time a system will be put into place to record for which customer a sample is made. This will be used to update the estimates regularly.

4.1.5.2 Sales:

A record is kept of each alteration to an order. A sample of orders have to be analysed to determine the number of changes made over a period of time. Only a general figure per customer will be required here.

4.1.5.3 Planning:

The output of the factory, but especially the activity of the sales, design and planning departments fluctuate considerable from month to month. This is mainly due to the seasonal fluctuation in the fashion industry. It was therefore deemed necessary to average the number of orders processed over a period of a year. This information was obtained from the planning department, which keeps accurate records of the number of orders planned.

4.1.5.4 Production Preparation:

Here the total number of available hours of laying-up time is needed. This is determined from the number of laying-up tables and the total working time (minutes per month).

4.1.5.5 Sewing Floor:

The recovery rate for this activity pool is well known and supported by years of historical data. The total number of sewing minutes as well as the overall floor efficiency were used to determine the rate.

4.1.5.6 Finishing:

The total available 'finishing minutes' are determined from the total number of pressers, ironers, folders and baggers and the working minutes over a period of time.

4.1.5.7 Warehouse and Dispatch:

An analysis of the number of carton boxes packed per month was used to determine the output of this activity pool.

4.2 The Accuracy of the New System

The value of the ABC system is critically dependent on the accuracy of the system. In establishing how accurately the results of ABC reflect the true costs, three questions have to be considered. How much of the total costs are

absorbed on an activity basis? Are the right cost drivers used? How accurate is the information used by the system?

4.2.1 Fraction of Total Cost Absorbed on Activity Basis

An analysis of the fraction of cost absorbed by the old costing system revealed that only the sewing floor expenses were allocated directly to the product using the standard minute value. This only represented 42% of the total costs. With the ABC-system 78% of the total costs will be allocated to the product directly. This is a substantial improvement. It also shows that ABC improves the costing system to a similar accuracy to that of the standard costing system at the time when it was developed. According to Glad and Becker (12) 90% of costs were directly related to production from 1929 to 1940.

4.2.2 Using the Right Cost Driver

This is an important aspect of ABC, since inappropriate cost drivers will result in distorted costs. If, for example, the design costs are allocated on a 'sewing minutes per garment' basis as was previously the case, then costs are allocated arbitrarily. The resources consumed to design a style are not related to the time required to make the garment.

Care has been taken to identify the most appropriate cost drivers taking the constraints on available information into account, but the use of the different cost drivers should be re-evaluated once better information is available. As Kofman (21) would put it: The validity of the underlying assumptions of the ABC-system have to be examined from time to time.

4.2.3 Quality of Information

According to Bailey (24), the quality of information was reported to be problematic in 30% of the cases studied. ABC is only a system which allocates cost. It transforms inputs into outputs and therefore the usefulness of the system is dependent on the validity of the input information.

Poor budgeting and work study information will result in inaccurate recovery rates which in turn can distort product cost. Currently the work study information is outdated and needs urgent revision. This will be done before the final system is implemented. But the trial run will have to rely on the current figures. To ensure that distortion is minimised, a reconciliation of all cost will be done, by comparing the costs absorbed with ABC to those absorbed by the old costing system.

4.3 Implementation of the ABC System

Before implementation the ABC-system will be tested to determine whether costs are absorbed fully. A number of orders will be costed using both the old and new method. The sum of the total costs absorbed by the two methods will be compared and should give a good indication on how reliable the ABC-system is.

Depending on the results of this test and the confidence management has in the system, it should be introduced on a trial basis running concurrently with the current costing system. This approach is widely adopted and allows ABC to gradually gain acceptance (refer to case studies by Kaplan (18) and Innes et al (22)).

During this trial run the ABC-system as it was designed on the spreadsheet can be used by the person preparing the product costings. She will need to learn how to use the new system, but with a thorough introduction to ABC, the activity pools, cost drivers and the mechanics of the spreadsheet, a few days practice should make her an efficient user of the new system. She will also have to collect the additional information. This includes the time required for finishing the garment, the number of boxes packed in the warehouse, the number of samples made and the number of alterations made. All other information is on the current costing system and only needs to be transferred.

The extra time required to do an ABC costing should not take longer than ten to fifteen minutes and therefore will not add much to the current workload.

Once ABC has proved to be reliable and beneficial to the company it should be incorporated into the current costing system. This will require reprogramming the current system.

A regular revision of the output of the activity pools will have to be introduced to keep the ABC system updated. This can be done simultaneously with the budget forecasts every six months. The new recovery rates will thus be based on the latest information.

The formulation of the ABC system ends the creative phase of the research cycle. It forms the hypothesis of this thesis which will be tested during the verification phase - deduction and induction. During this phase the superiority of the ABC system needs to be proven.

5. Testing

In this section it will be verified whether the proposed ABC system is an improvement to the current costing system. Following the scientific method, the first stage during the verification phase is to deduce plausible consequences from the hypothesis. This is best achieved by examining the shortcomings of the current costing system since it is claimed that the ABC system addresses some of these.

The main criticism of the current costing system is its inaccuracy in determining costs. The first deduction that can be made from this is:

- a) The error in product cost estimation is smaller for the ABC system than for the current costing system.

Certain biases are introduced by the inaccuracy of the current system. Small orders and high-fashion garments are undercosted. Garments with high labour contents are overcosted. Hence the second deduction is:

- b) The cost estimations of the ABC system will deviate from those of the current costing system in the following way: ABC will estimate
 - i) small orders to be more expensive,
 - ii) high-fashion garments to be more expensive and
 - iii) garments with high labour content to be cheaper.

Although a fixed profit margin is added to all cost estimations, profitability is not uniform because of the inaccuracies in cost estimations. Hence the third deduction is:

c) Product profitability and hence customer profitability is not uniform.

Having deduced plausible consequences from the hypothesis, these will now be verified by induction. During the first stage of this phase two different tests are designed.

The first test is a system dynamics model which simulates the new system. It is expected that this simulation will indicate the improved accuracy of the new costing system (deduction a)). The second experiment entails costing a sample of orders with the ABC system and comparing the results with the current system, thereby testing deduction b) and c).

5.1 A SDM Model of the Activity Based Costing System

A systems dynamics model is built to compare the ABC system with the current costing system. The aim is to simulate both systems as accurately as possible, but any simulation will only be a limited representation of reality and will therefore be based on assumptions. The assumptions on which this model is based are highlighted below. Stating these assumptions explicitly helps to understand the model and its limitations and thus guards against misinterpretations of the results¹.

¹ refer to Kofman (21): eliminating miss-interpretation through surfacing underlying assumptions and to Flood et al who suggest this as part of a systemic method for developing SDM model

5.1.1 Assumptions

- 1) The consumption of resources allocated by ABC is only an estimate, and the true consumption follows some probability distribution curve about a mean equal to the ABC estimate.
- 2) This probability distribution is assumed to be normal.
- 3) No correlation exists between the difference of estimated and actual consumption of resources and any other characteristic of the product. More specifically, it is assumed that no biases are introduced in the ABC system which distort cost estimations in favour of some products.
- 4) The sample of 110 orders which is used to obtain an accumulative probability distribution of the order size and the standard minute value (SMV) is assumed to be a fair representation of the true distribution.
- 5) Finally, it is assumed that no correlation exists between the consumption of design and sales resources and the SMV of the garment.

5.1.2 Details of the Model

The model simulates six activity pools. The simulation begins by determining the estimated consumption of resources. Based on these values the actual consumption is derived. The cost of these resources is then calculated and added to give the total actual, as well as ABC estimated cost. From the SMV and the cent per minute value (CPM) the traditional product costs are determined. The differences between ABC and actual cost as well as traditional and actual costs are then accumulated over a whole simulation run. These

accumulated differences are a measure of the accurateness of the costing systems.

5.1.2.1 Actual versus ABC-estimated Consumption of Resources

Regardless of how accurate the ABC-system is, it will never be able to determine the exact amount of resources consumed by a product. There will always be a discrepancy between the true consumption and that estimated by the ABC-system. On average, however, the estimated consumption will be equal to the actual. It is thus concluded that the actual consumption followed some probability distribution curve with a mean equal to the estimated consumption. The exact shape of the distribution curve is unknown. For modelling purposes it is assumed that these variations follow the normal distribution as shown in Figure 5.1. The possible error introduced with this assumption affects both costing methods (traditional and ABC) equally, and therefore does not impact on the validity of the model.

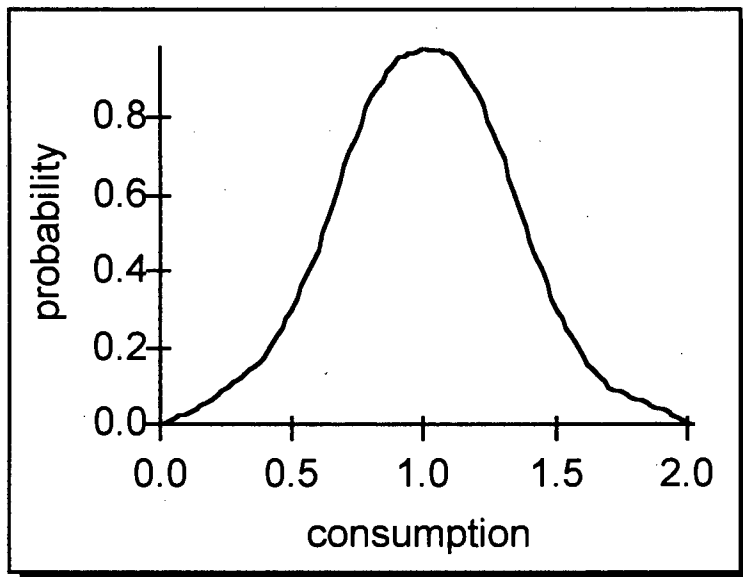


Figure 5.1: Probability Distribution of Actual Consumption of Resources

5.1.2.2 Determining Costs

The model is based on six activity pools, namely planning, sales, design, pre-production, sewing and finishing. The general model in Figure 5.2 is used to determine the actual and ABC estimated costs per pool.

First, the ABC-estimate is generated, which is then multiplied with the recovery rate to obtain the total product cost for the activity pool. Then the actual consumption of resources is determined by adjusting the ABC estimates by a factor X which is obtained from a normal distribution with a mean of one and some variable standard deviation. X simulates the variance between actual and ABC estimated resource consumption. The actual cost per activity pool is then calculated by multiplying the actual resource consumption by the recovery rate.

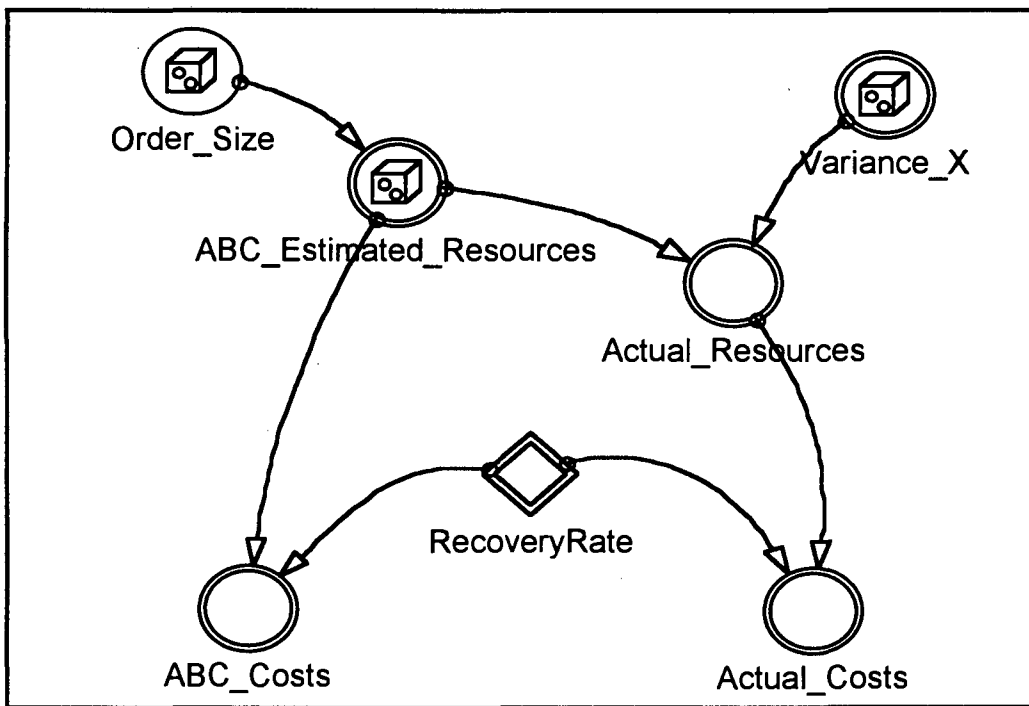


Figure 5.2: Sub-Model to Simulate Actual and Activity Based Cost per Activity Pool

For the sewing activity pool, a random number is generated, which is subsequently used to determine the SMV from the accumulative probability

distribution shown in Figure 5.3. The SMV is the amount of resources (activity) consumed as estimated by the ABC-system. This is then multiplied with the recovery rate for the sewing floor.

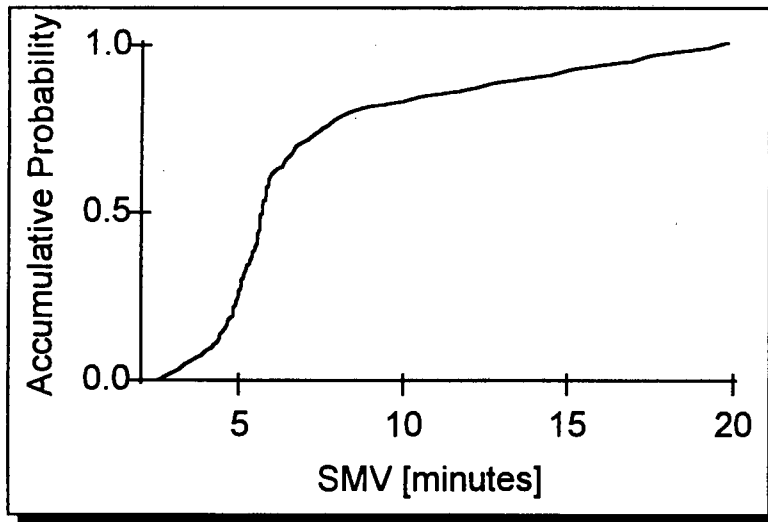


Figure 5.3: Accumulative Probability Distribution of Order Size

Only 77% of the orders are processed by the sales and design department. The Monte Carlo² function is used to simulate this. For planning, pre-production and finishing it is assumed that resources consumed are constant and hence a fixed value is used in these cases. All order related costs (i.e. sales, design and planning) are divided by the number of units per order. The units per order (order size) is determined from a probability distribution obtained from the above mentioned sample of 110 orders.

All ABC estimated costs are summed to give the final product cost as estimated by the ABC system. Similarly, all actual costs are summed to give the actual final product cost.

The cost estimations of the current (standard) costing system are obtained by multiplying the SMV (standard minute value) with the CPM (cent per minute)

² A built-in function which generates a series of ones and zeros based on as specified probability.

rate. The part of the model simulating the current costing system is shown in Figure 5.4.

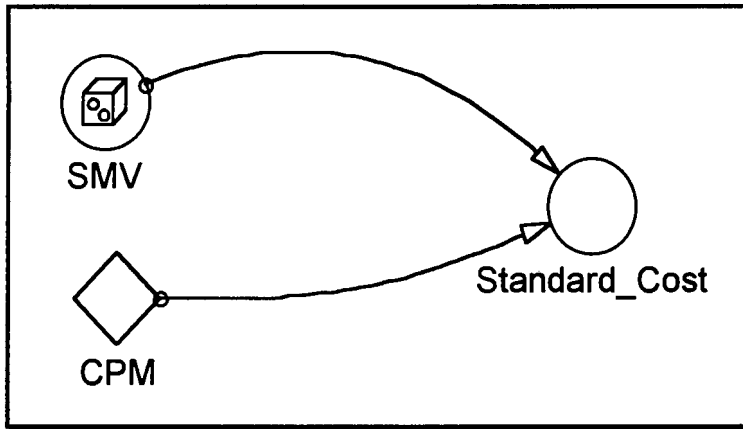


Figure 5.4: Simulation of Standard Costing System

Although actual data is used to determine recovery rates and outputs of activity pools, the total costs recovered by the current and the ABC system does not exactly match the actual costs occurred. It is therefore necessary to balance these in order to compare the two costing systems.

5.1.3 Balancing the Model

The model is balanced by comparing the total consumption of resources per simulation run with the budgeted estimates of the output of an activity pool. The budgeted estimates are obtained from the actual ABC-system.

Since the consumption of the planning resources are estimated to be constant and equal to one 'planning activity', this activity pool is used as a benchmark. The ratio of planning activities consumed during one simulation run to the total of 676 planning activities per year is 0.88.

The ratio of sewing minutes consumed per simulation run to total sewing minutes produced over a year is less than 0.88. The probability distribution of the SMV is manipulated until the ratio is equal to that of the planning ratio. Similarly, all other ABC estimates are adjusted such that the total cost recovered by the ABC system are equal to the actual costs. Only this allows an unbiased comparison of the error involved in the two different costing methods.

5.1.4 Comparing the Two Costing Systems

In order to compare ABC and the standard costing system, the error involved in these systems has to be determined. This is done by comparing the actual costs with the estimates of the two systems.

The absolute difference between the estimates and the true costs is the measure of the accuracy of the respective costing system.

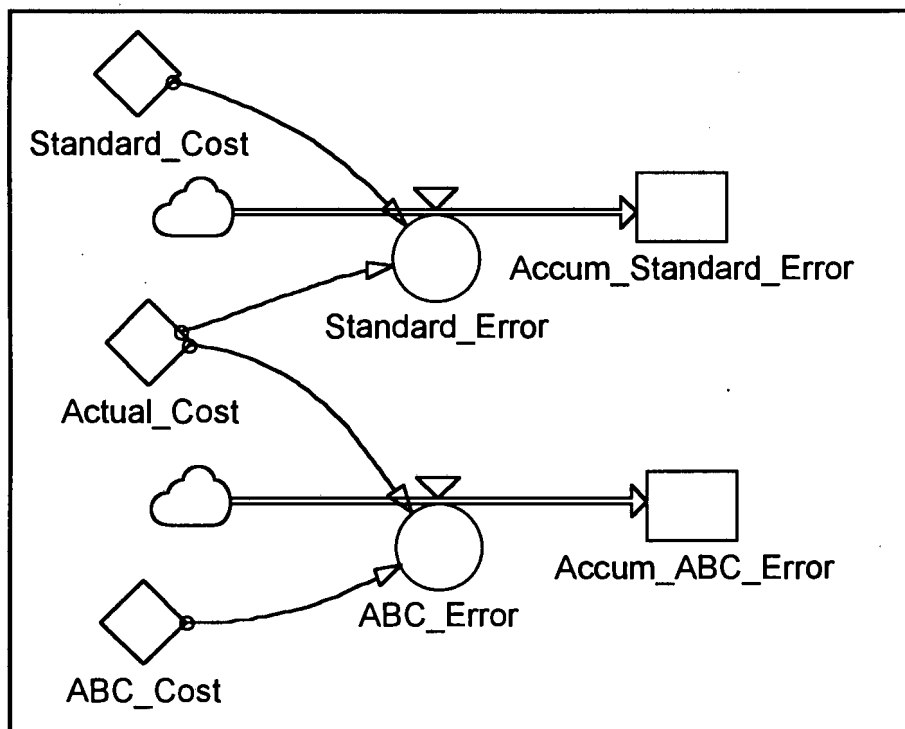


Figure 5.5: Comparing the Error in Cost Estimations

These absolute differences are accumulated over one simulation run of 100 orders. The sub-model which accumulates the variances of the two approaches is shown in Figure 5.5.

5.2 Costing with ABC

5.2.1 Design of the ABC Spreadsheet

A spreadsheet is used to automate the process of ABC. This is used for experimental purposes, but at the same time it can supplement the existing costing system until necessary changes are made. The ABC costs will be determined with the aid of this spreadsheet and the results will be transferred to the current system. Because the spreadsheet will be used by users not familiar with the details of the ABC system, it has to be automated to the extent that only the relevant information needs to be entered and the results read off.

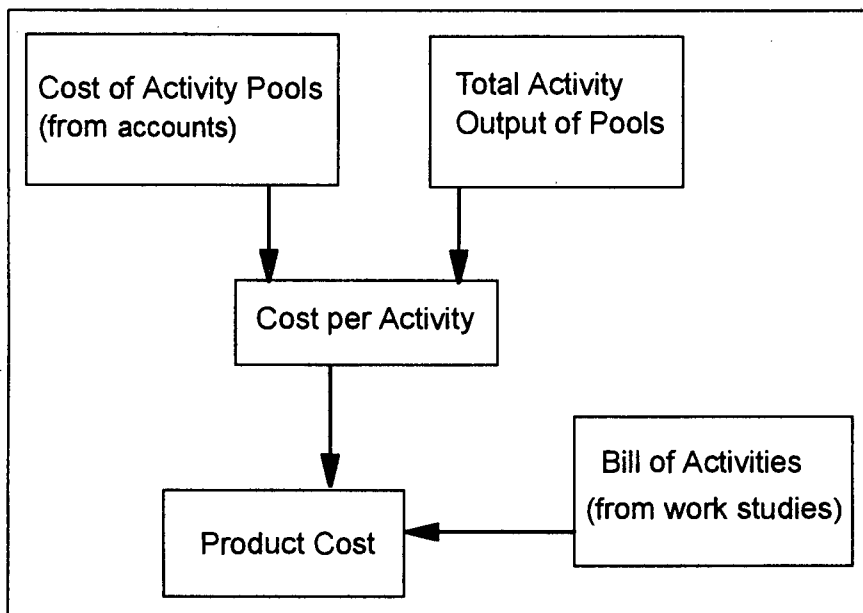


Figure 5.6: Information Flow of the ABC System

The flow of information of the ABC system is shown in Figure 5.6. The cost of the individual activity pools are obtained from the budgets prepared by the accounts department.

The output of the activity pools are forecasted, based on information from various sources. Forecasting of the anticipated production load (total number of sewing minutes) has been done in the past and these results are used for the output of the sewing floor. The output of the planning department is determined by counting the number of orders which were planned over the last year. Similarly, the output of all the other activity pools are estimated based on historical data.

The cost per activity pool is then divided by the output of that pool to determine the cost per activity. The bill of activities contains information on all activities that have to be performed to produce a specific product. Initially this information is not available but historical data will be developed as the system is used.

As an initial substitute the spreadsheet uses eight product groups, since products within a product group consume similar activities. The bill of material is only a guideline of the actual consumption of activities which have to be revised for each new costing. The final step in determining the ABC costs is to combine the information of the bill of activities with the costs per activity to obtain the cost of the product. This needs to be combined with the material costs which are calculated on the current system.

The structure of the spreadsheet is shown in Figure 5.7. It consists of three main elements. The bill of activities, the recovery rate (cost per activity) section and final calculation of the costs.

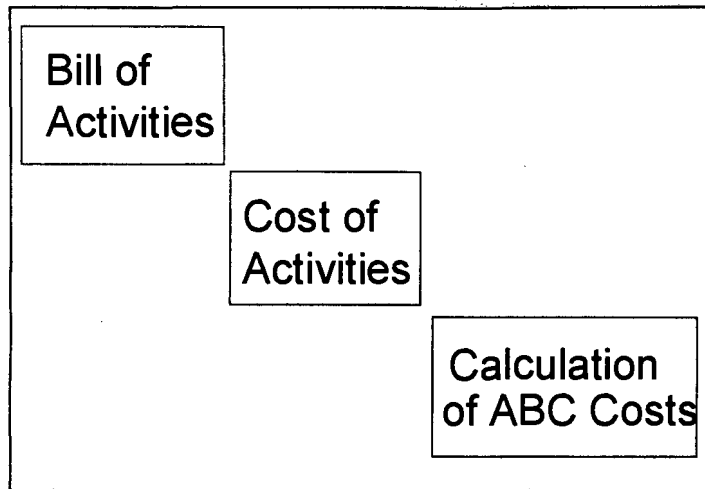


Figure 5.7: Layout of ABC Spreadsheet.

The three parts are arranged diagonally to maintain flexibility. Rows and columns can be added to any of the three sections without affecting other sections. This ensures that additional activity pools and cost drivers can be added at any time.

The information which needs to be entered into the spreadsheet includes the order number, the quantity ordered, the customer and the consumption of the various activities. The spreadsheet then calculates the ABC costs.

5.2.2 Testing the ABC System with Real Data

5.2.2.1 Product Profitability

The spreadsheet is used to test the proposed ABC system. All orders processed by the costing office over a period of two months are selected as a sample. The document prepared by the current system is used to obtain some of the required information. The additional information includes the number of samples and amendments made, the laying-up time and the type of finish required. The product profitability is determined from the ABC costs and the selling price.

5.2.2.2 Customer Profitability

Since the company is dealing with a limited number of customers, and each customer orders more than one type of product, there is often a situation where some orders for a particular customer are less profitable than others, but overall the profitability of the customer remains acceptable. It is thus not important to determine the product profitability, but rather the customer profitability. This analysis is also done.

5.2.2.3 Impact on Decision Making

A decision to accept an order is not based on profit alone. Other aspects like production load and strategic policies will also influence the decision. It is therefore important to assess the impact of ABC on decision making. This is done as follows. The general manager is asked to evaluate the cost estimations of the current system and make a decision on whether the order would be accepted. He is then given the cost estimation of the ABC system for the same orders and is asked to reconsider his decision. The result of both decisions are recorded and compared to quantify the impact on decision making.

The test results obtained from the two test in this section are presented and discussed in the following section.

6. Findings

The results of the two tests described in the previous section are presented in the following discussion. This essentially forms the second stage of the inductive phase (Figure B.1), where the deductions are either proved or disproved. The SDM model is an isolated model which was set up to prove the internal validity, whereas the trial with the real data on the spreadsheet was done to prove the ecological validity of the ABC system.

6.1 SDM Model of the ABC System at FCI

The SDM model is used to establish whether the ABC system is a more accurate costing system, but before this is done the impact of variances between estimated and actual consumption and the variation in output of activity pools need to be investigated.

6.1.1 Effect of Variance of Estimation of Resource Consumption

The value of any ABC system is dependent on how accurately the actual consumption of activities can be determined. In the case of FCI's ABC system, which is crude, the discrepancies between actual and estimated consumption are relatively high. This variance can impact significantly on the accuracy of the ABC system.

No information can be obtained on the accuracy with which the consumption of activities are established. Sensitivity analyses of X, which simulates the difference between actual and estimated consumption are done to establish to what degree discrepancies are acceptable. The deviation of the SMV from the actual time

required to sew a garment is relatively small, since these values are established through extensive work-study and backed by many years of historical data. The standard deviation will not be larger than 10% and the impact on the accuracy of the ABC system is insignificant.

However, the assumption that all orders require the same amount of 'planning time' is crude. A sensitivity analysis is therefore done, where the model is run for three different standard deviations (of actual planning time), varying from 10% to 50%, i.e. X is determined from a normal distribution with

mean = 1; std. div. = 0.1 for the first simulation, marked '1' in Fig 6.1,

mean = 1; std. div. = 0.3 for the second simulation, marked '2' in Fig 6.1,

mean = 1; std. div. = 0.5 for the third simulation, marked '3' in Fig 6.1.

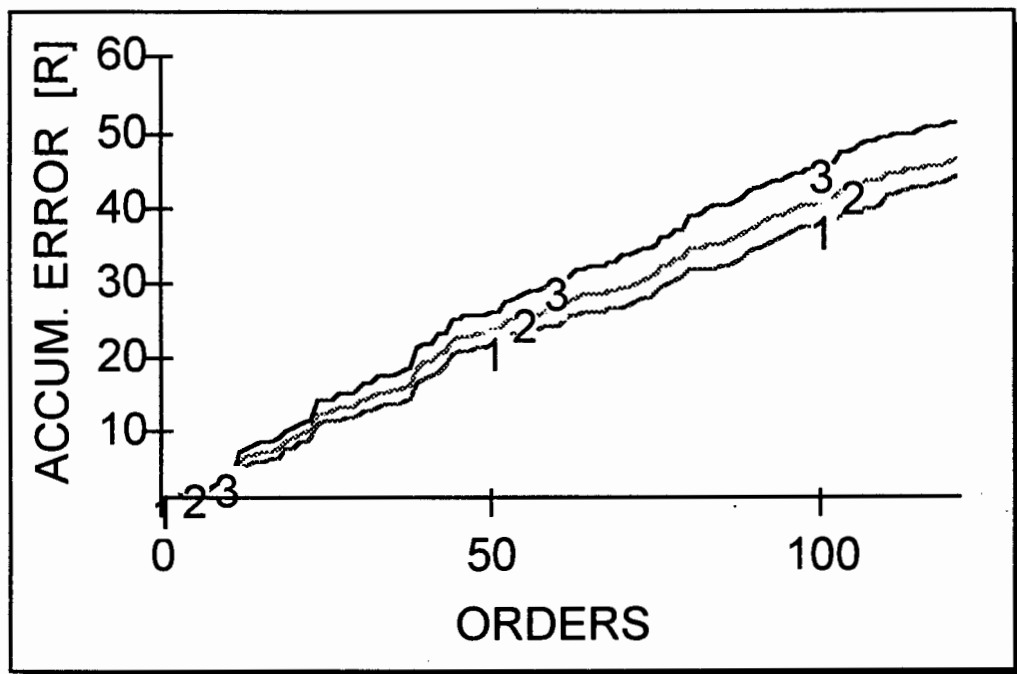


Figure 6.1: Effect of Variances in Consumption of Planning Activities

The impact of this on the accuracy of the ABC system is shown in Figure 6.1. The graph shows the accumulative error measured in Rand. The accumulative error for simulation '1' with a deviation of 10% is 44 Rand after 110 orders were costed. The error of simulation '2' with a deviation of 30% is 46 Rand and that of simulation '3' with a deviation of 50% is 52 Rand.

Similarly, the consumption of activities in the sales and design departments is determined from limited historical data and hence unreliable. The accuracy of these cost drivers is unknown and the same sensitivity analysis of X (standard deviations ranging from 10% to 50%) is done.

The error in consumption of sales activities is shown in Figure 6.2. The error in consumption of design activities is shown in Figure 6.3.

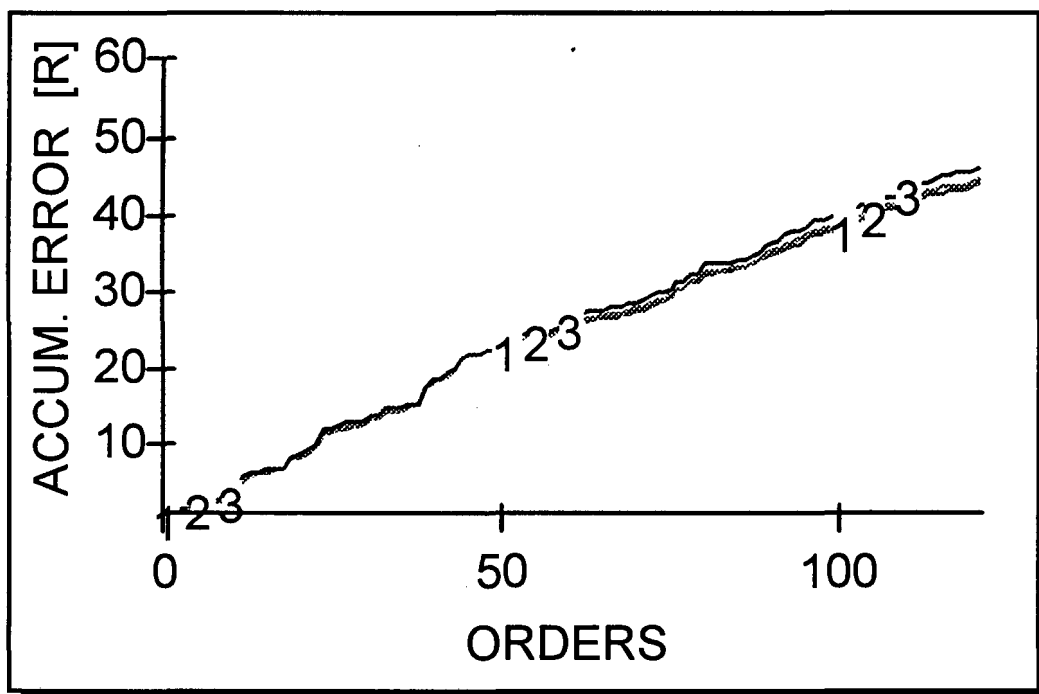


Figure 6.2: Effect of Variances in Consumption of Sales Activities

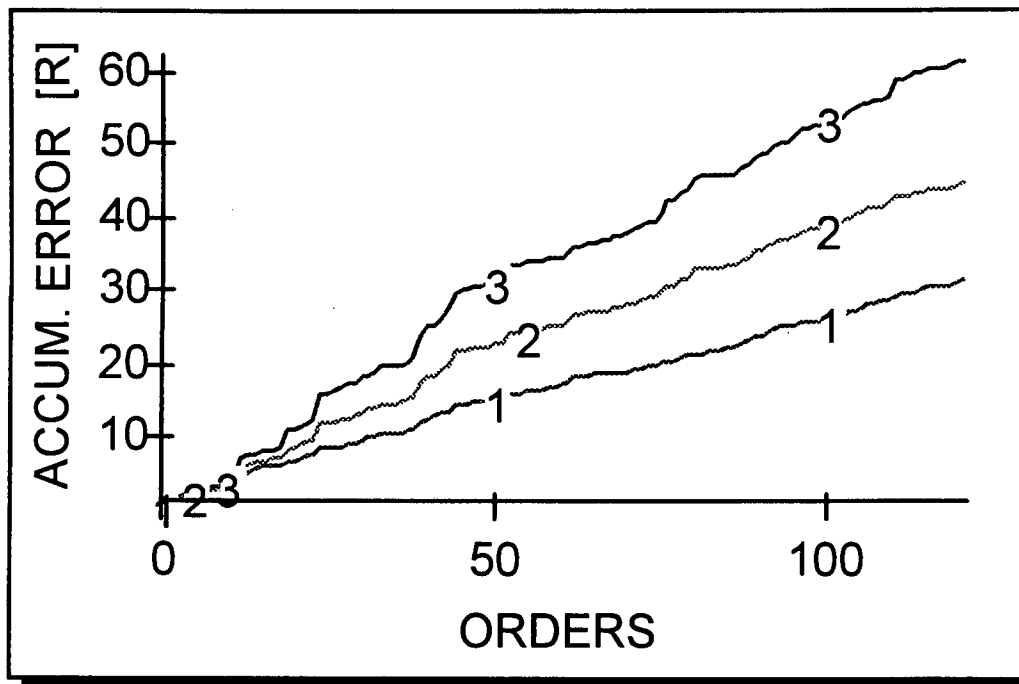


Figure 6.3: Effect of Variances in Consumption of Design Activities

Figures 6.1, 6.2 and 6.3 show that the error in determining the costs of a product with the ABC system, increases as the standard deviation, which is a measure of how accurate the consumption of activities is estimated, increases.

A comparison of these three figures shows that the accumulative error increases fastest for the design costs. The impact of inaccurate estimates of the planning activities is also significant, but inaccurate allocation of sales activities has little effect on the final product cost. In other words, the accuracy of the ABC system is most sensitive to the inaccurate allocation of design costs and least sensitive to the allocation of sales costs.

Therefore the leverage in improving the ABC system lies in determining the consumption of design activities more accurately. This could possibly be achieved by introducing time sheets where every employee has to keep a record of how much time was spend on which order.

The sensitivity analysis on the variances of pre-production and finishing show that these do not influence the accuracy of the ABC system significantly since the costs associated with these activity pools are small. In addition, the variance of both these activity pools is not large.

6.1.2 Effect of Variation of the Output of Activity Pools

Another important factor which determines the accuracy of an ABC system is the recovery rate of the individual activity pools, i.e. the cost of one activity. This rate is calculated from the total cost of the activity pool and the total number of activities performed by that pool. Inaccuracies in both numbers affect the final product cost.

The error in the cost of an activity pool is relatively small, since these are determined by forecasting based on historical data. In addition, management is focused on maintaining the cost of a department within the limits of the budgets. The inaccuracies introduced by the variation in the total cost of an activity pool is thus small.

The output of an activity pool is much more difficult to determine. In the case of planning, sales and design, it varies with production load, without any significant increase in the cost of the activity pools. The SDM model is used to analyse what the effect of a 10% discrepancy between the estimated and the actual output of an activity pool is. The impact is most substantial for the design activity pool which is shown in Figure 6.4. The graph shows that the impact of a variation in the output of the design activity pool is not significant.



Figure 6.4: Effect of Variation of Output of Activity Pools

6.1.3 Comparison of the Costing Methods

Having established the impact of inaccurate consumption of activities the costing systems can now be compared. The value of a costing system is determined by how accurately it can calculate the costs of a product. The smaller the difference between actual and estimated costs is, the better is the system. The criteria for evaluating the two systems would thus be the error involved in the cost estimations.

Therefore the (absolute) difference between actual and ABC estimations and actual and traditional estimations are accumulated over an entire simulation run.

Figure 6.5 shows the results of the simulation. From this graph it follows that the accumulative error for the ABC system is lower than that of the traditional costing system provided that the standard deviations as discussed above are below 50%.



Figure 6.5: Comparison of the Accumulative Costing Error

6.1.4 Discussion

6.1.4.1 Quality versus Number of Cost Drivers

The SDM model shows that the accuracy of a costing system is dependent on the accuracy with which the actual consumption of resources can be determined. The accuracy is again dependent on the amount of detail with which a costing system attempts to estimate the actual consumption of resources. In ABC this means that the number of different activity pools, but more importantly the number of cost drivers, determine the accuracy of the estimations.

However, the accuracy of a costing system is also dependent on the quality of the cost driver, i.e. the accurateness with which a cost driver predicts the actual consumption of resources. If a cost driver is absolutely accurate in determining the actual consumption of resources, no error is introduced. This is however, an ideal

situation and in practice the discrepancies between cost driver and the actual consumption of resources impact on the accuracy of ABC.

The quality of the cost driver is again dependent on the amount of information required to maintain it. A cost driver like the number of orders planned only requires a record of the number of orders processed by planning. A cost driver like the standard minute value of a garment requires a team of three to four people to maintain an accurate record of the work studies and to establish the SMV of each garment. Similarly a cost driver like the number of samples made per order requires much more effort to maintain than the number of styles designed.

In the case of SMV, it is certainly justifiable to maintain such an expensive cost driver since 41% of the costs are allocated based on SMV. Whether a cost driver like the number of samples per order, which allocates only 10% of all costs, is justifiable depends on the effort required to maintain it.

With the development of any good ABC system, the balance between the number of cost drivers and the effort of maintaining them has to be found. The effort to maintain a cost driver often determines the quality of it and the trade-off is thus between the number of cost drivers and their quality.

For the purposes of the simulation the quality is reflected by the standard deviation of the normal distribution which simulates the difference between actual and estimated consumption.

The model shows that even for large discrepancies¹ between actual and estimated consumption, the estimations of the ABC system are better than those by the current system. This indicates that the balance between the quality and the number of cost drivers has been found in the case of FCI.

¹ Standard deviations of 30% to 50%.

An important aspect which impacts on the quality of cost drivers and the effort to maintain them, is the nature of the information system. In organisations with advanced information systems much more detail can be included into an ABC system without losing accuracy. In organisations, lacking a good information system the number of activity pools should be reduced to a minimum.

6.1.4.2 Leverage to Improvements

The sensitivity analysis of the impact of inaccurate allocation of activities on the ABC estimations shows which activity pools would benefit most from an improved cost driver. This is dependent on two factors, namely the total cost of the activity pool and the quality of the cost driver.

The sewing floor is the largest activity pool in terms of cost, but the SMV is an accurate cost driver and it will be difficult to improve on it.

Preproduction and finishing are small activity pools with relatively good cost drivers. Further improvements would only be justifiable for management purposes, but would not improve cost estimations much.

Planning is also a small activity pool, but the cost driver is relatively crude. Here improvements would be possible but would not impact significantly on the overall performance of the system. Sales is a small activity pool with a good cost driver. The potential to achieve better cost estimates is rather small. Design is a relatively large activity pool with a weak cost driver. Improvements to the ABC system should therefore focus on this activity pool.

6.2 Testing the ABC Spreadsheet

The ABC spreadsheet was used to determine ABC costs of all orders over a period of two months. This is equivalent to a sample of 110 orders. The results of the test are confidential and therefore not disclosed in this thesis.

6.2.1 Analysis of the Difference between the Two Costing Systems

The list of orders in Table 6.1 is an extraction of the results after these were multiplied with some constant factor to ensure confidentiality. The results reveal considerable differences between the two costing systems. The discussion focuses on the most significant differences. These are related to the cost drivers of design, sales and production.

Table 6.1: Comparison of ABC and Standard Cost Estimations

	Style No.	Order Quantity	SMV¹ [min]	No. of Samples	No. of Amend.	ABC Estimate [R]	Old Estimate [R]
1	RSP44A	1600	9.1	8	3	7.28	7.51
2	L2Z081K	6000	11.05	7	4	6.52	7.51
3	L2Z128D	1200	18.4	15	6	13.25	17.58
4	AD1859	400	10.4	0	0	7.60	5.90
5	AD1686	330	21.5	0	0	12.33	12.47
6	AD1688	3430	7.7	0	0	4.35	4.35
7	AD1879	280	7.4	0	0	8.11	4.59
8	M3E173	3200	21.75	10	5	11.34	17.59
9	L7Z055AG	938	4.5	9	4	6.27	4.33

¹ standard minute value

6.2.1.1 The Average Order

The first example of Table 6.1, Style RSP44A, is an 'average' style. The order size of 1600 units is close to the average orders size of 1700. The SMV of the garment is close to the average of 9.7 minutes. The amount of design and sales activity consumed is also close to the average consumption.

A comparison of the ABC estimation with that of the current system shows that the difference is less than 2%. This means that if all orders were 'average' orders, the ABC system would give the same results as the current system. This is expected since the current costing system was developed to allocated cost accurately in less complex organisations, where the variety of products and order sizes were smaller. In other words, the orders were all close to the 'average' order.

The fact that the two cost estimates are close to each other for such an 'average' order indicated that ABC absorbs as much of the costs as the current system. This is a very important aspect of any new costing system. It has to recover the same amount of cost as the previous system over a period of a year.

6.2.1.2 The Effect of Large Order Quantities

The second example in Table 6.1, Style L2Z081K, is similar to the first one. It requires equal design and sales effort. The SMV does differ by 2 minutes, but will not impact significantly on the estimations. However, the order quantity is much higher.

The ABC cost estimation is 12% less than that estimated by the current system. This can be explained as follows: Currently the costs are determined by multiplying the SMV with a recovery rate (CPM¹). This recovery rate contains all expenses,

¹ 1 cent per minute

including all order related costs, like planning, sales and design costs. The current system thus absorbs order related costs on the basis of SMV, which means that the larger the order is, the more order related costs are absorbed. ABC allocates these costs as one total sum to the order and then divides them by the order quantity, which means that the larger the order quantity is the smaller the design, planning and sales cost per garment. It thus passes the benefits of large orders on to the customers and hence encourages them to order larger quantities.

Comparing Example 1 and Example 2 in Table 6.1 shows that the cost estimates of the current costing system are equal for both orders, although the SMV's are different. This is because a correction factor had already been introduced after the validity of the old costing system was questioned earlier. This correction factor attempts to compensate for low efficiencies of short production runs and all other negative effects of small order quantities. The effect of the correction factor is similar to that of a learning curve. The CPM value is reduced for orders with larger order quantities and increased for orders with small order sizes. The higher SMV of Example 2 is compensated for by a lower CPM rate because of the larger order quantity.

6.2.1.3 The Effect of Small Order Quantities

Example 4 in Table 6.1, Style AD1859, consumes very similar activities to the first two styles. However, no sales and design expenses are charged for this order, since an agency places these orders directly with the planning department. The sales and design departments do not process these orders. Both costing systems take this into account and this will thus not be discussed any further.

But Style AD1859 differs from the other two in that its order quantity is only 400 units. With the ABC system, the planning expenses of approximately R700 have to be absorbed by only 400 garments. The planning costs per garment are thus

R1.75. With the current costing system only 45 cent of the total R5.90 are planning expenses. This shows that the effects of order related costs are much stronger than the current system compensates for by the introduction of the correction factor. In this extreme case of low order quantity the current system is not capable of estimating costs accurately. This is in accordance with cases studied by Kaplan (18) and Innes (22) and discussed in Section 3.5.7.

6.2.1.4 The Effect of High SMV

Example 3 in Table 6.1, Style L2Z128D, is a garment with a high SMV and a design input of twice that of an average style. The two cost estimation differ by 25%. The estimate of the current system is high because every additional minute to the SMV includes design, planning and sales costs. The current system assumes that a garment with twice the average SMV also requires twice as much planning, design and sales effort. This is a crude assumption because there is only a weak relationship between the SMV of a style and the design and sales input. Furthermore, the planning activities are independent of the SMV of the garment. The second reason for the high estimation of the costs is the high CPM value due to the small order size.

The ABC estimate is lower because the SMV is not multiplied by the whole CPM value but only with the recovery rate of the production floor which is only 41% of the CPM used in the old system. The effect of a high SMV is therefore not as significant as in the old system. Although the additional design and sales efforts increases the ABC estimate by approximately R1.50, the impact on the final product cost is not as significant as the old system estimates it to be.

6.2.1.5 The Effect of Low SMV

Style L7Z055AG on Table 6.1 is an order with a low SMV. But the consumption of activities of all the other activity pools is similar to the first two examples. In this case the current costing system underestimates the cost of a garment because it assumes that the consumption of all other activities is also low. The ABC cost estimate is 50% higher as the ABC system charges the order with the full amount of all order related costs. This is then further aggravated because the order quantity is only half of the average order size. The order might be quick to produce, but all other processes require as much effort as other orders. The old system tends to neglect this. ABC highlights that the production of the garments is not the only process. The order also has to be sold, designed, planned, etc.

6.2.1.6 The Combination of Low Order Quantity and High SMV

Example 5 in Table 6.1, Style AD1686, is a small order with a high SMV. The cost predictions of both systems are very similar. Two trends which compensate for each other can be identified. Firstly, the high SMV causes the current system to overestimate the costs. Secondly, the order related costs are not absorbed fully, because of the size of the order. The two errors in the current system negate each other and produce a similar result to the ABC prediction.

6.2.1.7 The Combination of Low SMV and Larger Order Sizes

The Style AD1688 is an example of a large order with a low SMV. The two systems again estimate very similar costs. The same two trends which were discussed above are compensating for each other, but in this case the low SMV causes the current system to underestimate the costs and the error is compensated for by not having taken full advantage of the benefits of the order size.

6.2.1.8 The Combination of Low Order Quantity and Low SMV

Example 8 in Table 6.1, Style AD1879, is a small order with a low SMV. The ABC estimation is 76% higher than the estimation of the current system. This can be attributed to two factors. Firstly, the small order size results in very high planning costs per garment. The cost of one planning activity is only spread over 280 units. Secondly, the low SMV of the garment causes the current costing system to underestimate the costs since it does not fully absorb the order related costs.

6.2.1.9 The Combination of High Order Quantity and High SMV

Style M3E173 is a large order with a high SMV. The ABC estimation is 35% below the estimation of the current system. Again two factors contribute to this extreme difference. Firstly, the large order size reduces the order related costs per garment and ABC will therefore estimate a lower cost. Secondly, the high SMV causes the current system to overestimate the order related costs.

6.2.2 Product Profitability

Since the product costs are determined more accurately with ABC, the profit made on a particular order can also be determined more accurately. An analysis of the orders shows that the profit is not constant. Figure 6.6 is a graph showing the profitability of the sample of 110 orders in descending order.

The profitability is determined by dividing the difference between selling price and cost by the cost to produce the product. To ensure confidentiality the results are then divided by their average to arrive at a profit index.

The graph shows that some products are highly profitable. The majority of the products have an acceptable profit margin. But some orders are produced at a loss.

This is a typical result anticipated by Glad et al (12) and reported by Kaplan (18). Although the loss made on these orders is not substantial, these loss-making orders account for approximately 25% of the total orders. Further analysis show that the majority of the loss-makers are small orders.

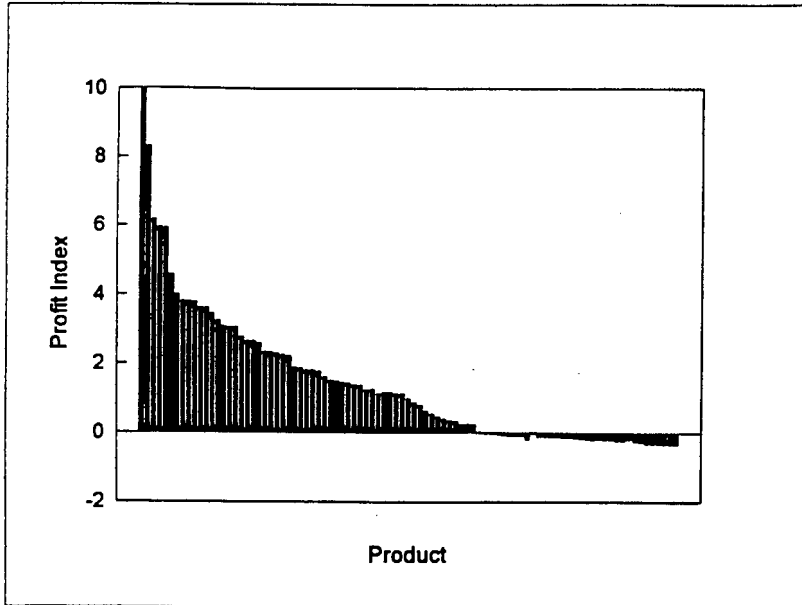


Figure 6.6: FCI 's Product Profitability

This is an indication that the concerns which gave rise to the development of the ABC system are valid. The cost estimations of the current system are distorted and hence the profitability of the products is not equal. A revision of the costing system is therefore justified.

6.2.3 Customer Profitability

Identifying the less profitable products is not sufficient to improve the overall profitability, because the company is dealing with only a limited number of customers. Furthermore, customer service forms an important aspect of the competitiveness. Discontinuing a product, or rather not producing a less profitable order might mean losing an otherwise profitable customer. It is therefore important

to analyse the profitability of the customers. Decisions can then be made based on the profitability of the customer and not only on the profitability of the products.

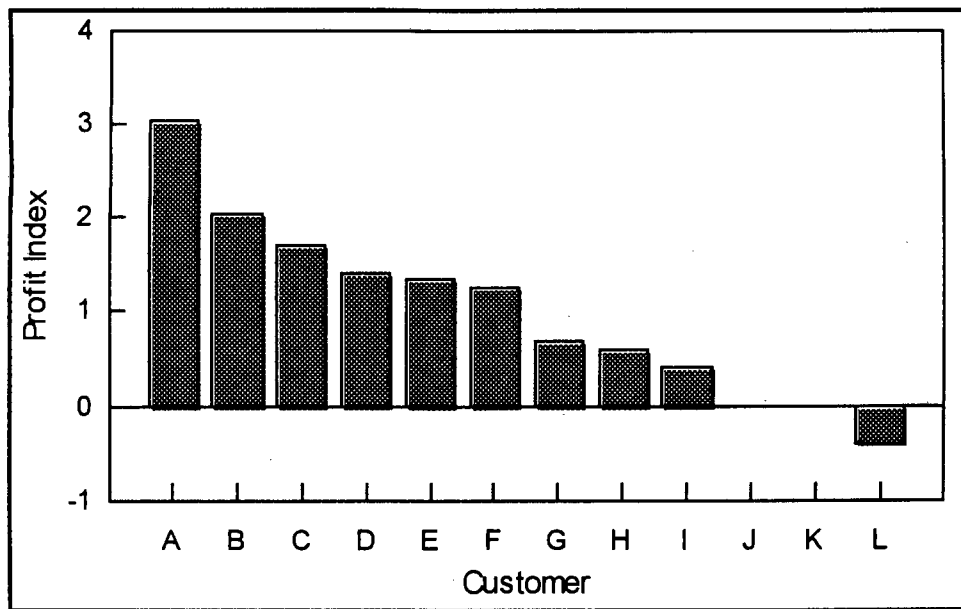


Figure 6.7: FCI's Customer Profitability

Figure 6.7 shows the results of the customer profitability analysis. The general trend of this graph is similar to the trend of the product profitability graph in Figure 6.6. It clearly shows that customer profitability is not constant, although the profitability does not fluctuate as much as the product profitability. One of the smaller customers even shows an overall loss. This, again, is what was expected from the analysis and further reinforces that a new costing system is needed.

6.2.4 The Impact of ABC on Decision Making

Having identified the less profitable customers, a decision has to be taken on whether the profit is acceptable. If it is not acceptable, it should be adjusted until it becomes acceptable. This process of improving the profitability of customers should ideally be based on a long term strategy using the results of both product and customer profitability. Because the sample of orders costed with ABC was too

limited to form the basis of a strategy, the decisions on whether to accept an order based on the ABC estimations was taken in the absence of such a strategy. Nevertheless, the impact on profit due to more accurate information is still apparent as Figure 6.8 indicates.

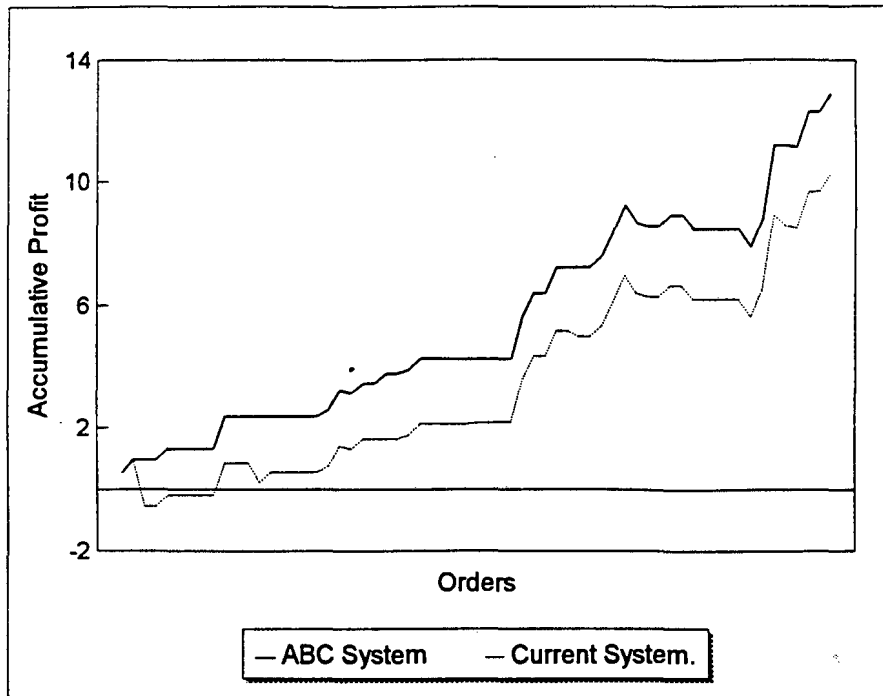


Figure 6.8: Impact on Decision Making

The graph plots the accumulative profit for the sample of orders. The accumulative profit which would be achieved if the decision were based on the ABC estimations is larger than that achieved with decisions based on the current cost estimations. This indicates that ABC will not only determine product costs more accurately, but these more accurate estimations will also impact on the decision to produce an order and hence on the overall profitability.

6.3 Discussion

6.3.1 Internal versus Ecological Validity

Referring back to Section 2, the dilemma of scientific research in a field like operations management is the difficulty of setting up experiments which have high internal validity as well as high ecological validity. Internal validity is achieved through the isolation of the experiment from uncontrollable influences. Ecological validity is gained from testing in an environment which is similar to the real world, the uncontrollable influences will thus affect the result. The two seem to contradict each other. To resolve this dilemma, two different experiments were done. The SDM model was used to test the internal validity of the proposed ABC system. This was done by isolating the model from any extraneous variables, which might blur the results. The ecological validity was tested by costing real orders with the ABC system. The full impact of all environmental influences were accepted, and the system was tested for its appropriateness in this specific environment.

Different aspects of the ABC system were tested in the two experiments. The SDM model showed the impact of inaccurate cost drivers and forecasting costs and output of activity pools. The SDM model also established whether the balance between the number of cost drivers and the accuracy of these cost drivers was achieved. Finally, the model was used to find the most effective areas for improvement. Overall, the SDM model tested the logic of ABC in the context of FCI.

The second experiment on the spreadsheet was aimed at testing quite different aspects. Firstly, it was established that the cost estimations of ABC do differ from those done with the current system. Combining this result with the results of the first experiment which showed that if there is a difference then the ABC estimate is the more accurate one, leads to the conclusion that the proposed ABC system does cost more accurately. Secondly, the results of ABC were analysed to gain an

understanding of how the differences in cost estimations come about and whether the ABC results can be understood in the light of the shortcomings of the old system.

6.3.2 Biases Introduced by ABC

ABC can introduce biases if an inappropriate cost driver is used. For example, it was suggested to use the 'number of designs processed' as a cost driver for the design department because no information was available about the design resources consumed for a specific design.

This cost driver would not distinguish between orders which consume significant design resources and those which consume minimal resources. But the difference in consumption proved to be substantial. Furthermore, it was accepted that a correlation exists between the design input and the product type.

Using this cost driver would have meant that a T-shirt which requires little design input is charged with the same amount of costs as a high fashion dress which consumed significantly more design resources. This would introduce a bias, namely easy-to-design products would be favoured above high fashion products. In a highly competitive environment this would mean that the company would sell less basic styles and more high fashion garments.

Such biases can be used to support a specific strategy (e.g. moving into high fashion business), but they need to be highlighted and the implication of the 'costing error' needs to be understood.

Generally however, these biases do not support a strategy and are often not recognised. The effect is the same as an error in the costing system - it impacts on the competitiveness of the organisation as discussed in Section 6.3.3 below.

A distinction has to be made between a bias and a random error. Charging some T-shirts with high design costs and others with little design costs would result in a random error. With random errors there is no relationship between the costing error and any characteristic of the order (like order size, SMV, etc.).

A good ABC system eliminates these biases by using accurate cost drivers. The final proposal therefore introduced the number of samples as a cost driver for design, which is more accurate and will eliminate this particular bias.

6.3.3 Impact of ABC on the Viability of the Organisation

Proper utilisation of the product and customer profitability can lead to a competitive advantage. This could be achieved as follows: Based on the customer profitability analysis, a decision needs to be made on whether the profit made on a customer is acceptable. If it is not acceptable the selling prices for the orders sold to the particular customers can be adjusted. It is the customer's decision to either accept the higher price or change to another supplier.

In both cases the company benefits. If the customer accepts the new price the profitability of that customer improves. If the customer does not accept the new price and changes to another supplier, that supplier which forms part of the competition gains a customer with a low profitability. The viability of that supplier thus decreases, because it has to produce an order with a small profit margin.

Taking this a step further means that in a context in which decisions are based purely on cost, a company which uses ABC and can determine product costs more accurately will attract more profitable customers and pass the less profitable customers on to its competitors who are less likely to distinguish between highly profitable and less profitable customers. The company with ABC thus gains a

competitive advantage and will improve its viability until the competitors are forced to improve their costing system (probably by introducing ABC). Consequently, it is not a question of *whether* to improve ones costing system, but of *when* to improve it. Doing so before the competition results in a competitive advantage. Doing it later will only ensure the survival of the organisation.

more readily. Simplicity reduces the resistance of those affected by the introduction of the new system and hence ensures its viability.

The proposed ABC system allocates 78% of all cost directly to the product. This is a substantial improvement on the current system which allocated only 41% directly to the product.

7.3 SDM Model

A SDM model was successfully developed and the following conclusions can be drawn based on the results of the simulation:

- a) The accuracy of an ABC system is determined by the quality of the cost drivers which is defined by the exactness with which the actual consumption of activities is predicted.
- b) The total output of the activity pools which is used to determine the cost per activity impacts on the accuracy of the ABC system. These expected output levels are forecasted, but unless the errors in the forecasts are larger than 10%, the accuracy of the ABC system is not seriously affected.
- c) The ABC system as proposed in Section 4 estimates costs more accurately than the current costing system, provided that the deviation¹ of the cost drivers are less than 50%. The first deduction (Deduction a)) is thus proven.
- d) The accuracy of the ABC system is best improved by refining the cost driver of the design activity pool.

¹ The standard deviation between the actual and estimated consumption.

7. Conclusions

7.1 Activity Based Costing versus Cost Reduction Systems

From the SSM analysis in Section 3 it can be concluded that activity based costing is better suited for this particular situation than the cost reduction system. ABC is preferred mainly because the cost reduction system requires an organisational culture of employee participation and continuous improvement, which is currently lacking. In addition, the nature of the clothing industry makes target costing difficult because products are 'made to order' with strict product specifications which leaves little room for value engineering - the basis for target costing. Furthermore, ABC can be introduced gradually without dramatic changes, which reduces the resistance to accept it.

7.2 The ABC System

The proposal of the ABC system takes the current limitations of the information system into account and attempts to address only the most critical shortcomings of the current costing system. The main objective of the proposal is to differentiate between order related costs and garment related costs. The new system includes three order related cost drivers (number of orders planned, number of samples made and the number of alterations requested by the customer) and three garment related cost drivers (preparation, production and finishing time per garment).

The emphasis during the development of the ABC system was on transparency and simplicity. Transparency facilitates a better understanding of the system and hence confidence in using the ABC estimations as a decision making tool will be gained

7.4 ABC Cost Estimations

Most of the process of ABC was automated with the aid of a spreadsheet, which was then used to test the ABC proposal by costing real orders and comparing the results with those of the current costing system. The following is concluded from the analysis of these test results:

- a) Cost estimations for orders with an average order size, consuming 'average' amounts of activities, are very similar to estimations by the current system.
- b) ABC estimates the costs of large orders to be lower than the current system predicts. The converse also applies, the costs of small orders are underestimated by the current system.
- c) Cost estimations by ABC of garments with a high SMV¹ are lower than those by the current system. And conversely, the new system predicts higher costs for garments with a low SMV.
- d) Small orders with a high consumption of order related activities (design, sales or planning) are estimated to be more expensive with ABC than with the current system.
- e) The trends a) to d) are independent of each other. In other words, two opposing trends will cancel each other, whereas two similar trends will reinforce the costing error.

Points a) to e) prove that the impact of the ABC system was correctly predicted, Deduction b) in Section 5 is thus proven.

¹ Standard Minute Value

The product profitability (Figure 6.6) which was determined using the ABC cost estimations shows the typical results, namely some orders are highly profitable, the majority of orders result in an acceptable profit margin, but some orders are produced at a loss. The customer profitability analysis (Figure 6.7) also shows the same typical results. This proves Deduction c) correct.

The impact on decision making was simulated. The results suggest that ABC will improve the overall profit, provided that confidence is gained in the accuracy of the ABC system.

In terms of proving the ABC proposal, internal validity was gained through the SDM model, which shows that the overall (absolute) error in cost estimations is smaller for the ABC system than it is for the current system. Ecological validity was gained through estimating the cost of real orders with the ABC system, which shows that cost estimations do vary particularly in cases with small order quantities or unusually high or low design inputs.

8. Recommendations

8.1 Activity Based Costing

From the comparison of activity based costing with the cost reduction system in Section 3, it is recommended that an ABC system is introduced to improve product cost estimations and to form the basis for activity based management. The new system will address the most critical shortcomings of the current system and will therefore differentiate between order related and garment related costs.

The introduction of the cost driver in the preproduction and finishing department will allow new and improved productivity measures for these departments. Planning and scheduling will be more accurate and hence wastage related to high work-in-progress levels will be reduced. The successful introduction of these new performance measures should be followed by revising the performance measures of other activity pools. Finally, ABC should be extended to include the management of capacity to further reduce waste and to facilitate production planning.

8.2 The ABC System

The proposed ABC system was tested and it was found that the cost estimations are accurate provided that accurate information on the consumption of activities can be established. The consumption of activities during production are determined relatively accurately, but no record is kept of the number of 'samples made' in design and 'changes requested' in sales.

It is therefore recommended to introduce a system which will monitor the number of samples made and the number of changes requested by the customer. This will provide better information and hence improve the accuracy of the system.

With more accurate information on the consumption of design and sales resources available, the ABC system should be implemented and cost estimations should be done on both the ABC and the current system. Using both costing systems simultaneously will help to gain confidence in the new ABC system. However, care needs to be taken when decision making is based on these cost estimations. If orders are accepted whenever one of the two estimations show a profit, there is a risk of under-recovery, because some of the orders would not have been accepted if only one system had been in use.

8.3 Improving the ABC System

Although the proposed ABC system addresses the shortcomings of the current costing system and the cost estimations are more accurate, the system should be refined continuously to maintain competitive advantage. Improvements should focus on two aspects - better information on the consumption of activities and more detail, i.e. more activity pools and cost drivers.

8.3.1 Improved Information

The quality of the input information determines the quality of the output of any system. Hence, with improved information on the consumption of activities and the expected output and cost of activity pools, the accuracy of the ABC system can be improved.

8.3.2 Activity Pools and Cost Drivers

The ABC system can also be improved by using better cost drivers. For example, the cost driver used for the planning (activity) pool could be replaced by a cost driver which recognises differences in consumption of planning resources.

Furthermore, the system can be improved by identifying more activity pools and introducing additional cost drivers. This will impact particularly on the allocation of administrative expenses.

8.3.3 Leverage to Improve the ABC System

Efforts to improve the system should focus on those areas which will yield the most benefit with the least effort, i.e. the long leavers for improvements should be identified. The improvements which will impact on the accuracy of the system most significantly are therefore listed below in descending order of importance.

- a) Determination of consumption of design and sales activities.
- b) Revision of work study of preproduction and finishing activities.
- c) Introduction of a better cost driver for planning activities.
- d) Separation of administrative expenses into activity pools and introduction of additional cost drivers to allocate these costs.
- e) Introduction of separate cost drivers for quality control and maintenance costs.

8.3.4 Revision of the ABC System

Apart from these continuous improvements, the system should be revised regularly and adapted whenever the conditions for which it was designed are changing. In other words, the validity of the underlying assumptions on which the ABC system is based should be examined. If these assumptions become obsolete the impact on the system should be identified and the necessary changes effected. This document can serve as a basis to uncover the underlying assumptions of the ABC system.

9. Reflection

Whereas the last two sections summarised the contents, this section is aimed at critically reviewing the approach which was adopted during the course of this thesis. This section reflects upon the research process and the use of the research methodologies.

9.1 The Research Process

After the identification of the need for a better costing system the research process was initiated with the immersion into the subject of ABC and the alternative cost reduction system. The immersion phase ended with the evaluation of these two approaches.

The rest of the research process consists essentially of two iterations of abduction, deduction and induction. During the abductive phase of the first iteration the first draft of the ABC model was developed. This model then formed the basis of the hypothesis: 'The proposed model of the ABC system will improve the accuracy of the product cost estimations.'

During the deductive phase the consequences of an ABC system were anticipated. The inductive phase constituted of the setting-up of two tests which were aimed at proving the hypothesis. The SDM was aimed at proving the internal logic and the trial costing on the spreadsheet was aimed at testing the ecological validity of the proposal.

These tests were run and showed that the accuracy of the costing system has improved, but the proposed cost drivers in the design and sales activity pools introduced unwanted biases towards high fashion garments.

This gave rise to the second iteration¹, where the ABC system was amended to include better cost drivers for design and sales. These cost drivers are capable of differentiating between high fashion and basic garments and hence eliminate the biases of the first proposal.

The same tests were used to test the second proposal and the evaluation of these tests showed that both requirements are met. The accuracy of the costing system is improved and the unwanted biases are eliminated.

The research process was facilitated by the scientific method by providing a framework which clearly identified different stages. Defining objectives of the different stages provided a focus which improved the efficiency of the study.

9.2 Using SSM as an Evaluation Tool

Soft systems methodology was essentially developed to deal with different cultural backgrounds and hence different worldviews of stakeholders of a problem. It was developed to identify the different views of a particular problem in order to establish a common understanding and hence find solutions.

However, in this thesis SSM was used to evaluate two different solutions to a problem. Here it was assumed that the need of the organisation (an improved costing system) has been agreed upon by all stakeholders. What remained was an evaluation of two possible solutions. SSM was thus not used to identify the different worldviews within the organisation but to match the underlying worldviews, on which the management accounting approaches are based, with that of the organisation.

¹ Only the second iteration is documented.

Whether SSM was intended to be used as an evaluation tool is not known. But its application in this particular situation showed that it is capable of revealing the underlying worldviews and hence allows the evaluation of alternative solutions.

9.3 SDM to Model the ABC System

SDM is a useful method to complete the inductive phase of the scientific method for problems of a technical nature which are, however, too complex to describe in mathematical form. The behaviour of the model is logical when interpreted in the light of its structure and the assumptions on which it is based. This allows at least qualitative conclusions to be drawn. However, the trial and error approach during the development of the model makes quantitative results meaningless.

The development of the model showed that SDM is a powerful tool to simulate 'hard' systems like costing systems, where many relationships can be quantified. However, many assumptions about the real system had to be made, partially because no quantitative data was available but also to reduce the complexity of the model. Nevertheless, through what-if analysis the SDM model gave insight into the dynamics of the ABC system, which allowed the conclusion to be drawn that ABC is more accurate than the current system.

Furthermore, some of the issues discussed under *Critique* in Section 2.3.6.4 were confirmed. It was found that the development of the model is time consuming and hence not practical for everyday use. In addition, a rigorous procedure as suggested by Flood and Jackson (11) should be followed because much time is wasted if the purpose and assumptions are not stated initially.

Reference

1. Checkland P B; Systems Thinking, Systems Practice; John Wiley and Sons; Chichester; 1981.
2. Ross Ashby W; An Introduction to Cybernetics; Methuen; London; 1956.
3. Reilly F E; Charles Peirce's Theory of Scientific Method; Fordham University Press; New York; 1970.
4. Nagel E; Charles S. Peirce's Guesses at the Riddle; Journal of Philosophy, XXX; 1933.
5. J Gill, P Johnson; Research Methods for Managers; Paul Chapman Publishing Ltd; London; 1991.
6. H.W. Smith; Strategies of Social Research: The Methodological Imagination; Prentice Hall International; London; 1975.
7. Checkland P B; Soft Systems Methodology; Human Systems Management, 1989.
8. Beer S; Brain of a Firm; John Wiley and Sons; Chichester; 1981.
9. Ackoff R L; Creating the Corporate Future; Wiley; New York; 1981.
10. Jackson M C; Systems Approach for Managerial Problem Solving; International Conference on Systems Thinking and Progressive Social Change; Cape Town; 1994.
11. Flood R L and Jackson M C, Creative Problem Solving - Total Systems Intervention; Wiley; Chichester, 1991.
12. Glad E, Becker H; Activity Based Costing and Management; Juta & Co; Ndabeni; 1994.
13. Porter M E; Competitive Advantage; Free Press; New York; 1985.
14. Monden Y; Cost Management in the New Manufacturing Age; Productivity Press; Cambridge; 1992.

15. Monden Y, Sakurai M; Japanese Manufacturing Accounting - A World Class Approach to Profit Management; Productivity Press; Cambridge; 1989.
16. Maskell B H; Performance Measurement for World Class Manufacturing; Productivity Press; 1991.
17. Kaplan R S; Relevance Lost: The Rise and Fall of Management Accounting, Harvard Business School Press; 1987.
18. Kaplan R S; Measures for Manufacturing Excellence, Harvard Business School Press; 1990.
19. Cooper R and Turney P B B; Internally Focused Activity Based Costing Systems; Harvard Business School Press; 1990.
20. Drury J C; Management and Cost Accounting; Chapman and Hall; 1992.
21. Kofman F; in 'The Fifth Discipline Fieldbook'; Doubleday; 1994.
22. Innes J and Mitchell F; Activity Based Costing - A review with Case Studies; The Chartered Institute of Management Accounting; 1993.
23. Monden Y; Cost Reduction Systems; Productivity Press; 1995.
24. Bailey J; Implementation of ABC Systems by UK Companies; Management Accounting; February 1991.
25. Ackoff R; Social Change and Systems Thinking; International Conference on Systems Thinking and Progressive Social Change; 1994
26. O'Guin M C; The Complete Guide to Activity-Based Costing; Prentice Hall; Englewood Cliffs; 1991.
27. Brimson J A; Activity Accounting; John Wiley & Sons; New York; 1991.

Appendix A: Stage 5 of SSM Analysis - Comparing Models with Reality

Table A.1: Activity Based Costing and Management

Activity	Is Activity Performed?	How? Why not?
Determine cost of activity centre	Cost are only determined per department.	Financial accounting
Determine total activity output	Only output of sewing activity is known.	Forecasting based on historical data.
Determine capacity	Only activity of sewing operation is well established.	Workstudies backed up by historical data.
Determine cost per activity	Only for sewing operation	Total cost of organisation divided by total capacity of sewing operation.
Determine waste	Material waste: Yes Capacity waste: No	Percentage fabric utilisation
Determine cost per product	Yes, but estimations are distorted.	Standard costing method
Determine cost per customer	No	
Bill of Activities	No	
Product and customer profitability	Yes, but based on distorted cost estimates	Sales analysis
Plan for capacity	No	
Strategic management decisions	Yes, but based on unreliable data	Estimated capacity; financial accounting data; efficiency of sewing operation.

Table A.2: Cost Reduction System

Activity	Is Activity Performed?	How? Why not?
Target costing	No	
Estimated costing	Yes, direct material costs and direct labour costs	Standard costing system:
Actual or final costing	Yes	Similar to the above, except that material costs are updated.
Cost control	Yes	Accounting function, but only after the event.
Continuous improvement through quality circles.	Yes, but only at management levels.	T.Q.M. program
Employee participation	Not at machine operator level	Change to new management style is slow.

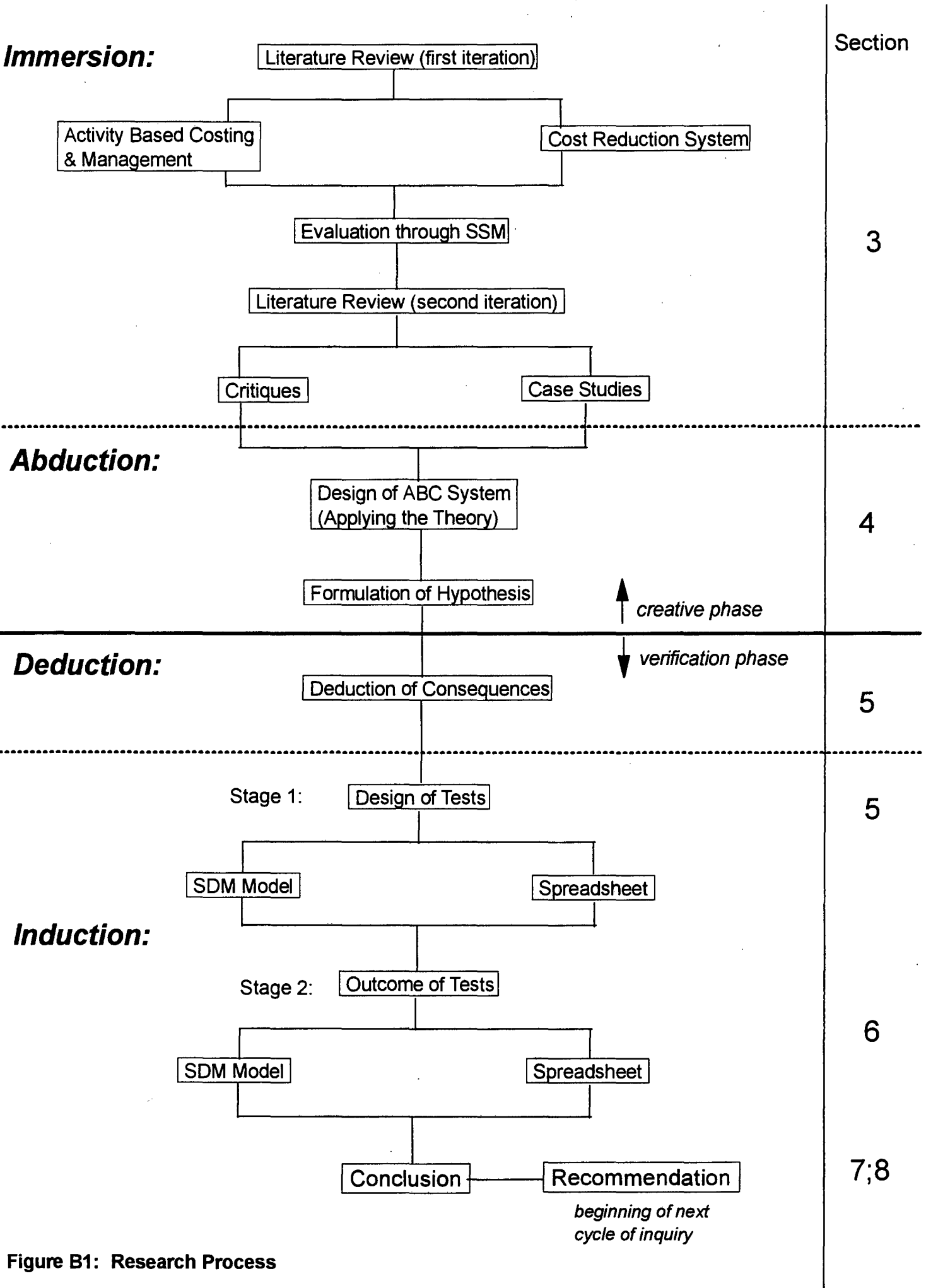
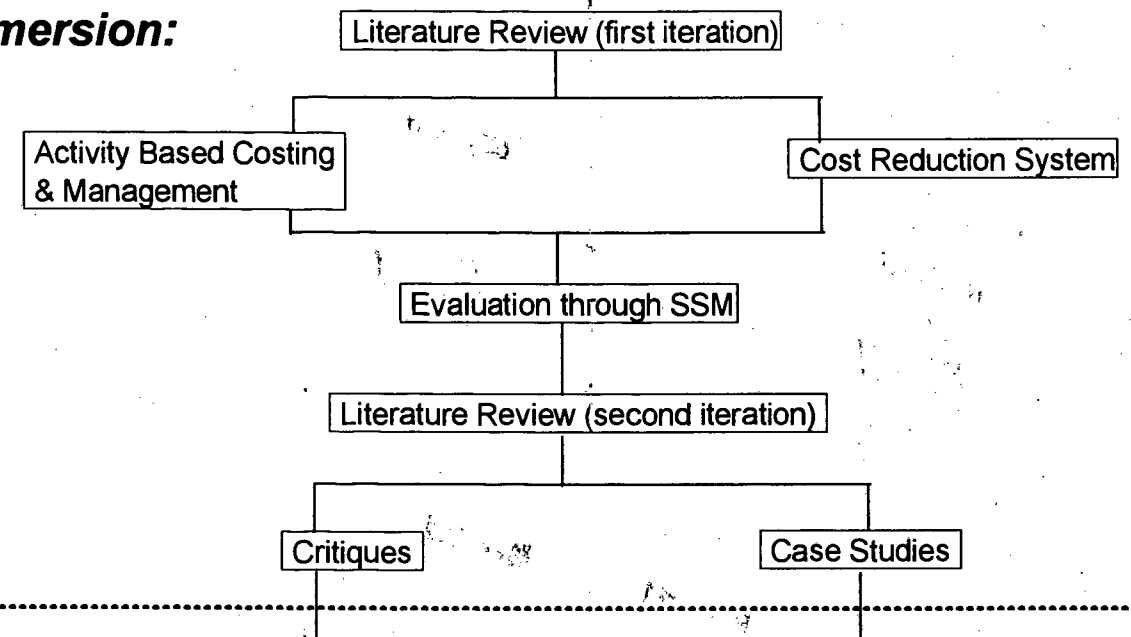


Figure B1: Research Process

Appendix B: Graphical Representation of Research Process

Appendix B: Graphical Representation of Research Process

Immersion:



Section

3

Abduction:

Design of ABC System
(Applying the Theory)

Formulation of Hypothesis

↑ creative phase

Deduction:

Deduction of Consequences

↓ verification phase

4

5

Stage 1: Design of Tests

SDM Model

Spreadsheet

5

Induction:

Stage 2: Outcome of Tests

SDM Model

Spreadsheet

6

Conclusion

Recommendation

*beginning of next
cycle of inquiry*

7;8

Figure B1: Research Process

Proman Management Services

EMPLOYEE DETAIL & CONTACT LIST (Updated: 01 MARCH 2000)

EMPLOYEE'S NAME	DESIGNATION	EXTENSION	CELL NO.
BOARDROOM	n/a	13	n/a
DALAN COHEN	Project Manager	38	082-870 3372
DESIGAN MADURAMUTHU	Assistant Project Manager	28	083-441 8183
EUGEN VAN JAARSVELD	Project Manager	31	083-412 3325
FAWZIA GYDIEN	Financial Manager / Admin. Manager	22	082-871 7634
GABRIELLE GAWLOWSKI	Projects Administrative Assistant	26	n/a
HAYLEY FORTUNE	Personal Assistant to the General Manager	21	083-398 1631
JAN SEEMAN	Project Manager	35	082-499 0990
LESTER SMITH	Document Controller	17	083-412 8061
MALCOLM ABRAHAMS	Assistant Project Manager	23	n/a
MARCO ALDERA	Senior Project Manager	24	082-376 4290
MEETING ROOM	n/a	18	n/a
PATRICIA NOLAND	Bookkeeper	15	082-344 5817
PHAETHON PAYIATIS	Project Manager	27	083-299 6898
RAMEEZ NOORDIEN	Pen. Tech. Student (In-Service Training-Constr Mngt)	33	n/a
SONI MTSHAZO	Senior Project Manager	37	083-452 4840
SPARE OFFICE	n/a	32	n/a
TASNEEM GYDIEN	Receptionist	9	082-474 2410
TONDERAYI MATOPODZI	Trainee Project Manager	34	083-339 5986
WARREN CONRAD	General Manager	14	083-708 2006
YOLANDA LOUW	Junior Project Manager	36	083-406 0015

Fleetway Take-Aways: 421 7661 / Have-A-Bite Take-Aways: 425-4237