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A NEW PRODUCT DEVELOPMENT PRACTICES MODEL FOR SMALL
AND MEDIUM ENGINEERING ENTERPRISES

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Doctor of Philosophy

in

Engineering Management

Faculty of Engineering and the Built Environment

University of Cape Town

South Africa

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2010

DECLARATION OF ORIGINALITY

I, the undersigned, declare that the work contained in this thesis is my original work and has not previously been submitted to any other institution for assessment purposes. Further, I have acknowledged all sources used and cited in the bibliography.

SIGNATURE:

DATE:

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A NEW PRODUCT DEVELOPMENT PRACTICES MODEL FOR SMALL, MEDIUM ENGINEERING ENTERPRISES IN SOUTH AFRICA

KEITH JACOBS

2010

ABSTRACT

The work presented here describes the development and validation of a diagnostic New Product Development Practices (NPDP) Model for the sustainability of Small and Medium Engineering Enterprises (SMEEs).

A review of the literature regarding the sustainability of SMEEs, supported with the data gathered through the case study of a sample of SMEEs, led to the creation of a model. The model consists of unique elements such as the Innovative Engine and an environment called the Innovative Space. This model was used to shape further data collection instruments since it represented the ideal status in terms of sustainability potential or a measure of a particular SMEE. Comprehensive data relating to the various components of the NPDP model were gathered from 18 SMEEs. The SMEEs were chosen from a governmental database of small enterprises in the manufacturing sector of the Western Cape.

Analysis of the data yielded a classification of these SMEEs in terms of their sustainability potential. This depended on the level of their NPDP as compared with the ones indicated by the proposed model. On the assumption that proof of sustainability of a SMEE is in its "growth", the 18 SMEEs were re-visited after a period of three years, i.e.: from the original data collection that informed the model and subsequent classification. Data regarding their growth was collected. Analysis of this latest set of data revealed that most companies performed as expected, based on their potential for sustainability within a range of "growth factor" values.

The resulting model has value for SMEE owners who are able to measure the health of their own companies. The model is also useful for funding organisations such as banks and government departments which need an indication of a firm's health before assisting them financially.

Although the NPDP model proved to be a very reliable mechanism to measure a firm's "health", it is time consuming. It is for this reason that a "snap shot" mechanism was introduced so that companies are able to measure their "health" in a short period. Thus such measurement could be done on a continuous basis.

TABLE OF CONTENTS

DECLARATION OF ORIGINALITY	ii
ACKNOWLEDGEMENTS	iii
ABSTRACT	iv
CHAPTER 1	1
BACKGROUND OF THE STUDY	1
1.1 INTRODUCTION	1
1.2 STATEMENT OF THE PROBLEM	2
1.3 PROBLEM IDENTIFICATION.....	3
1.4 RATIONALE	4
1.5 PROBLEM AREAS IN SMMEs.....	5
1.6 SIGNIFICANCE OF THE RESEARCH	6
1.7 RESEARCH QUESTIONS.....	7
1.8 CHAPTER OUTLINES	8
CHAPTER 2.....	9
NATURE OF THE RESEARCH CONTEXT	9
2.1 INTRODUCTION	9
2.2 DEFINITION OF SMMEs.....	9
2.2.1 Micro Enterprises	9
2.2.2 Small Enterprises	10
2.2.3 Medium Enterprises	11
2.3 NATIONAL SMME STRATEGY.....	12
2.4 GENERATING KNOWLEDGE AND KNOWLEDGEMANAGEMENT	12
2.4.1 Generating Knowledge in SMEEs	15
2.4.2 Intensity and Sustainability in NPD Work Systems.....	17
2.5 SUMMARY	19
CHAPTER 3.....	20
INNOVATION AND PRODUCT DEVELOPMENT	20
3.1 INTRODUCTION	20

3.2.	NEW PRODUCT DEVELOPMENT	21
3.3	INNOVATION IN SMEEs.....	22
3.3.1	Reasons to Innovate	24
3.4	RESEARCH AND DEVELOPMENT (R&D)	24
3.4.1	Fundamental R&D: Large 'R' and No 'D'	26
3.4.2	Radical R&D: Large 'R' and often Large 'D'	26
3.4.3	Incremental R&D: Small 'r' and Large 'D'	26
3.5	INFORMATION CHANNELS	27
3.5.1	Internal Sourcing.....	27
3.5.2	External Sourcing.....	28
3.6	THE INNOVATIVE ROLE OF THE ENTREPRENEUR IN SMEEs.....	29
3.6.1	Idea Generating (The Role of).....	29
3.6.2	Entrepreneuring or Championing	30
3.6.3	Project Leading	30
3.6.4	Gate Keeping	30
3.6.5	Sponsoring and Coaching	31
3.7	COLLABORATIVE TRENDS CONCERNING NPD	31
3.7.1	Networking	32
3.7.2	Collaboration	34
3.7.2.1	Types of Collaboration	36
3.8	THE PILOT STUDY OF THE SIX SMEEs.....	38
3.8.1	Analysis of the data from the Six Companies.....	39
3.8.2	Sector Circumstances	42
3.9	CONCLUSION.....	42
CHAPTER 4.....		44
LITERATURE REVIEW AND THEORETICAL FRAMEWORK		44
4.1	INTRODUCTION.....	44
4.2	INNOVATION	44
4.3	FUNDAMENTAL KNOWLEDGE	46
4.4	NEW PRODUCT DEVELOPMENT (NPD).....	47
4.4.1	Strategy Associated with New Development Product Practices	49

4.5	STRATEGY	51
4.6	FLAT ORGANISATIONAL STRUCTURE	54
4.7	LEARNING ORGANISATION.....	57
4.7.1	Open/Direct Communication	59
4.7.2	Information Sharing.....	60
4.7.3	Empowerment of Individuals	61
4.7.4	Employee Responsibility	62
4.7.5	Enthusiasm.....	63
4.7.6	Morale	65
4.8	CUSTOMER REQUIREMENTS	66
4.9	AWARENESS OF EXTERNAL ENVIRONMENT	68
4.9.1	Information Scanning	69
4.10	IDEA GENERATION	72
4.11	INFORMATION CHANNELS AND NETWORKS.....	74
4.12	THEORY OF ACTION	76
4.12.1	Learning Systems	77
4.12.2	Single-Loop learning	77
4.12.3	Double-Loop learning.....	78
4.12.4	Deutero-Learning.....	79
4.12.5	Transformation from Single-Loop to Double-Loop Learning.....	79
4.13	QUALITY.....	81
4.13.1	Total Quality Management	83
4.14	INQUIRING CULTURE.....	84
4.14.1	Creativity and Inquiry	85
4.15	CONTINUOUS PROCESS IMPROVEMENT (CPI).....	85
4.16	GENERATING COLLABORATIVE KNOWLEDGE.....	88
4.17	THEORETICAL FRAMEWORK.....	88
4.18	CONCLUSION.....	89
CHAPTER 5.....		91
RESEARCH METHODOLOGY		91
5.1	INTRODUCTION	91

5.2	JUSTIFICATION FOR THE PARADIGM AND METHODOLOGY	92
5.2.1	Case Study Approach	93
5.2.2	Interpretive Paradigm	94
5.2.3	Positivist Paradigm.....	95
5.2.4	Mixed Method Approach	96
5.2.5	Pilot Study	97
5.2.6	The NPDP Model Development	98
5.2.7	Research Design.....	98
5.3	DATA ACQUISITION PLAN	102
5.3.1	Interviews	103
5.3.2	Observation.....	106
5.3.3	Documentation Analysis.....	107
5.4	DATA ANALYSIS	107
5.4.1	Analytical Framework	108
5.4.2	Analysis of Company Classification.....	109
5.4.3	Growth Analysis	109
5.4.4	Comparative Analysis.....	110
5.5	ETHICAL CONSIDERATIONS AND VALIDITY	111
5.6	CONCLUSION.....	112
CHAPTER 6.....		113
THE DEVELOPMENT OF THE MODEL		113
6.1	INTRODUCTION	113
6.2	INNOVATIVE ENGINE (IE)	115
6.2.1	Direct and Open Communication and Information Sharing.....	116
6.2.2	Information Sharing and Employee Responsibility	117
6.2.3	Employee Empowerment linked to Direct Communication and Employee Responsibility.....	118
6.2.4	Employee Responsibility linked to Communication, Employee Empowerment and Information Sharing	119
6.2.5	Morale	120
6.2.5.1	Empowerment and Morale	121

6.2.5.2	Commitment and Morale.....	122
6.2.5.3	Enthusiasm and Morale	122
6.3	INNOVATIVE SPACE (IS).....	124
6.4	INTEGRATING THE INNOVATIVE ENGINE INTO THE INNOVATIVE SPACE (IS).....	125
6.4.1	Inquiring Culture linked to Innovative Engine	126
6.4.2	Continuous Process Improvement Philosophy linked to Innovative Engine.....	128
6.4.3	Collaborative Knowledge Community linked to Innovative Engine.....	130
6.4.4	Fundamental Knowledge Shaping Strategy	132
6.4.5	Articulation Route 1 to the Innovative Space.....	133
6.4.6	Strategy for a Flat Organisational Structure	134
6.4.7	Flat Organisational Structure linked to the Innovative Space	136
6.4.8	Articulation Route 2 to the Innovative Space.....	137
6.4.9	The Management of People	138
6.4.10	People Management linked to the Innovative Space	139
6.4.11	Articulation Route 3 to the Innovative Space	140
6.4.12	Products and Processes	141
6.4.13	Product and Processes Influencing the Innovative Space.....	142
6.5	OUTPUTS FROM THE INNOVATIVE ENGINE	143
6.5.1	Collaborative Research and Development (CR&D).....	144
6.5.2	Innovative Engine Contributing to CR&D	145
6.5.3	Collaborative Research and Development Resulting in Well-Priced Quality Products.....	147
6.5.4	Well-priced Quality Products Reflecting Customer Requirements.....	148
6.5.5	Customer Requirements Affecting Collaborative Research and Development	149
6.5.6	The Influence of Collaborative Research and Development on Fundamental Knowledge.....	150
6.6	THE EFFECT OF THE MODEL.....	150

6.7	FRAMING THE MODEL	151
6.8	CONCLUSION.....	152
CHAPTER 7.....		154
DATA ANALYSIS (COMPLIANCE WITH THE MODEL).....		154
7.1	INTRODUCTION.....	154
7.2	COMPANY ANALYSIS (LEVEL OF COMPLIANCE WITH THE MODEL).....	154
7.3	DEFINITION OF CATEGORIES.....	156
	Category A.....	156
	Category B.....	156
	Category C.....	156
	Category D.....	157
	Category E.....	157
7.4	RESULTS.....	159
	7.4.1 The characteristics of a typical Category A company as expected by the Model	159
7.5	COMPANY ANALYSIS.....	160
	7.5.1 Company 1 (Category A).....	160
	7.5.2 Company 2 (Category C).....	161
	7.5.3 Company 3 (Category A).....	163
	7.5.4 Company 4 (Category B).....	164
	7.5.5 Company 5 (Category D).....	165
	7.5.6 Company 6 (Category B).....	167
	7.5.7 Company 7 (Category A).....	168
	7.5.8 Company 8 (Category A).....	169
	7.5.9 Company 9 (Category C).....	169
	7.5.10 Company 10 (Category D).....	171
	7.5.11 Company 11 (Category A).....	172
	7.5.12 Company 12 (Category C).....	173
	7.5.13 Company 13 (Category B).....	175
	7.5.14 Company 14 (Category E).....	176
	7.5.15 Company 15 (Category A).....	177
	7.5.16 Company 16 (Category C).....	178

7.5.17	Company 17 (Category E)	180
7.5.18	Company 18 (Category C)	181
7.6	CONCLUSION.....	182
CHAPTER 8	184
COMPANY ANALYSIS (GROWTH FACTOR)	184
8.1	INTRODUCTION	184
8.1.1	Growth Factor (GF)	184
8.2	GROWTH FACTOR VALUES	187
8.3	DATA COLLECTION	188
8.4	RESULTS AND DISCUSSION	189
8.4.1	Company 1	191
8.4.2	Company 2	191
8.4.3	Company 3	191
8.4.4	Company 4	191
8.4.5	Company 5	192
8.4.6	Company 6	192
8.4.7	Company 7	192
8.4.8	Company 8	192
8.4.9	Company 9	193
8.4.10	Company 10.....	193
8.4.11	Company 11.....	193
8.4.12	Company 12.....	193
8.4.13	Company 13.....	194
8.4.14	Company 14.....	194
8.4.15	Company 15.....	194
8.4.16	Company 16.....	194
8.4.17	Company 17.....	195
8.4.18	Company 18.....	195
8.5	CONCLUSION.....	195
CHAPTER 9	196
VALIDATION OF THE MODEL	196
9.1	INTRODUCTION	196

9.2	COMPANY ANALYSIS	197
9.2.1	Company 1 (Category A)	197
9.2.2	Company 2 (Category C)	197
9.2.3	Company 3 (Category A)	198
9.2.4	Company 4 (Category B)	198
9.2.5	Company 5 (Category D)	198
9.2.6	Company 6 (Category B)	198
9.2.7	Company 7 (Category A)	199
9.2.8	Company 8 (Category A)	199
9.2.9	Company 9 (Category C)	200
9.2.10	Company 10 (Category D)	200
9.2.11	Company 11 (Category A)	200
9.2.12	Company 12 (Category C)	200
9.2.13	Company 13 (Category B)	201
9.2.14	Company 14 (Category E)	201
9.2.15	Company 15 (Category A)	201
9.2.16	Company 16 (Category C)	202
9.2.17	Company 17 (Category E)	202
9.2.18	Company 18 (Category C)	202
9.3	FINDINGS	202
9.4	SNAP SHOT MECHANISM	203
9.5	CONCLUSION.....	206
	BIBLIOGRAPHY	207
	APPENDICES.....	232
	Appendix 1: Initial Questionnaire to Select SMEEs (Pilot study of 6 SMEEs)	232
	Appendix 2: Interview Questionnaire Protocol	236
	Questions.....	237

LIST OF TABLES

Table 3.1: Managing Innovation	21
Table 3.2: Summary of the 6 SMEEs	41
Table 5.1: Ethical Considerations and Validity Data Set	111
Table 7.1: Company Responses	158
Table 8.1 Growth Factor Questions	189
Table 8.2: Responses from the 18 Companies	189
Table 9.1: Prediction of Sustainability Potential and Growth Factor	196
Table 9.2: Snap Shot Questions	204
Table 9.3: Snap Shot Scoring Mechanism	205
Table 9.4: Outcome of Snap Shot Mechanism	205

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LIST OF FIGURES

Figure 4.1: Flat organizational structure.....	55
Figure 4.2: Information Management for the Intelligent Organization..	70
Figure 4.3: Ky'zen	86
Figure 6.1: New Product Development Practices Model	113
Figure 6.2: Innovative Engine	116
Figure 6.3: Direct and Open Communication and Information Sharing	117
Figure 6.4: Information Sharing and Employee Responsibility	118
Figure 6.5: Employee Empowerment linked to Direct Communication and Employee Responsibility	119
Figure 6.6: Employee Responsibility linked to Communication, Employee Empowerment and Information Sharing	120
Figure 6.7: Morale as a Result of “Employee Relationships”	124
Figure 6.8: Innovative Space	125
Figure 6.9: Integrating the Innovative Engine into the Innovative Space.....	126
Figure 6.10: Inquiring Culture linked to Innovative Engine	128
Figure 6.11: Continuous Process Improvement Philosophy linked to Innovative Engine	130
Figure 6.12: Collaborative Knowledge Community linked to Innovative Engine	131
Figure 6.13: Fundamental Knowledge Shaping Strategy	133
Figure 6.14: Articulation Route 1 to the Innovative Space	134
Figure 6.15: Strategy for a Flat Organisational Structure	136
Figure 6.16: Flat Organisational Structure linked to Innovative Space	137
Figure 6.17: Articulation Route 2 to the Innovative Space	138
Figure 6.18: The Management of People	139
Figure 6.19: People Management linked to the Innovative Space	140
Figure 6.20: Articulation Route 3 to the Innovative Space	141
Figure 6.21: Products and Processes	142

Figure 6.22	Product and Processes Influencing the Innovative Space	143
Figure 6.23	Outputs from the Innovative Engine	144
Figure 6.24	Collaborative Research and Development	145
Figure 6.25	Innovative Engine Contributing to a CR&D	147
Figure 6.26	Collaborative Research and Development Resulting in Well-priced Quality Products	148
Figure 6.27	Well-priced Quality Products Reflecting Customer Requirements	149
Figure 7.1:	NPDP Model (Indicating the Number of Questions)	156
Figure 7.2:	Company's (1) Non Conformance with the NPDP MODEL	161
Figure 7.3:	Company's (2) Non Conformance with the NPDP MODEL	162
Figure 7.4:	Company's (3) Non Conformance with the NPDP MODEL	163
Figure 7.5:	Company's (4) Non Conformance with the NPDP MODEL	164
Figure 7.6:	Company's (5) Non Conformance with the NPDP MODEL	166
Figure 7.7:	Company's (6) Non Conformance with the NPDP MODEL	167
Figure 7.8:	Company's (7) Non Conformance with the NPDP MODEL	168
Figure 7.9:	Company's (8) Non Conformance with the NPDP MODEL	169
Figure 7.10:	Company's (9) Non Conformance with the NPDP MODEL	170
Figure 7.11:	Company's (10) Non Conformance with the NPDP MODEL	171
Figure 7.12:	Company's (11) Non Conformance with the NPDP MODEL	172
Figure 7.13:	Company's (12) Non Conformance with the NPDP MODEL	174

Figure 7.14: Company's (13) Non Conformance with the NPDP	
MODEL	175
Figure 7.15: Company's (14) Non Conformance with the NPDP	
MODEL	177
Figure 7.16: Company's (15) Non Conformance with the NPDP	
MODEL	178
Figure 7.17: Company's (10) Non Conformance with the NPDP	
MODEL	179
Figure 7.18: Company's (10) Non Conformance with the NPDP	
MODEL	180
Figure 7.19: Company's (10) Non Conformance with the NPDP	
MODEL	182

University of Cape Town

CHAPTER 1

BACKGROUND OF THE STUDY

1.1 INTRODUCTION

The work presented in this document deals with an innovative space which was developed using a new product development practices (NPDP) model applicable to the small and medium engineering enterprises (SMEEs) sector. The SMEEs sector is in the field of operations of the small and medium enterprises (SMEs), which in turn forms part of the broader small, micro and medium enterprises, commonly called SMMEs. The reason for omitting micro enterprises in the engineering sector is discussed in Chapter Two. SMEEs have shown increasing interest in new product development (NPD) but have not been successful. New Product Development requires a specific environment that is created by the necessary skills, strategy and the involvement of people, idea generation and the management of people. In other words, this environment must conform to New Product Development Practices (NPDP).

In organizations, there are many obstacles to fundamentally sound NPDP. Some of these obstacles are caused by mistrust of sharing information inside and outside of the company, ambiguous communication, if there is communication at all and a lack of a structure of incentives system or internal competition. There is a widely held view that South Africa's growth potential is being retarded by insufficient support for technology and innovation. In order to be successful in innovation, collaboration is essential, although entrepreneurs are sceptical about collaborations or "partnerships". Most of them do have strong ties with academic institutions in order to access new information on technological developments, skilled staff etc. Some of them are involved in consortia or fora.

Coupled to the above, it is important for SMEEs to engage in competitive initiatives such as improving customer satisfaction, developing new

products and markets and providing faster response to customer needs. The author is mainly interested in researching the manufacturing sector on ways of getting information, why they need to innovate and what are the problems in NPDP. This thesis will deal with all these issues.

1.2 STATEMENT OF THE PROBLEM

All over the world SMMEs (small, medium and micro enterprises) are playing a critical role in absorbing labour, penetrating new markets and generally expanding their nation's economy in creative and economical ways. In South Africa, almost half of the GDP and employment comes from SMMEs that are flourishing all over the country. This is not different for the SMEE sector in South Africa.

Government studies have indicated that up to 80% of new businesses in South Africa fail within one year. One of the reasons is that SMEEs in South Africa have problems in remaining regionally, nationally and globally competitive. The problems are not only of financial nature such as a lack of start-up financing or upgrading finances. Other problems include a lack of innovation, knowledge and skills to turn a good business idea into a profitable one in a quality-oriented environment. A further problem is ignorance of the importance of developing products in SMEEs. The government estimates that the economy must achieve growth at a minimum of 6% to offset unemployment, which is estimated to be about 30%, although unofficial sources put it as high as 38%. In an effort to boost economic growth and spur job creation, the government is working to encourage small and medium enterprise development.

The big failure rate that is observed in the various sectors of SMMEs has prompted the government to provide support to new businesses in the following key areas:

- Access to advice,
- Favourable amendments to legislative and regulatory conditions,
- Access to marketing and finance,

- Access to infrastructure,
- Access to training,
- Access to appropriate technology and encouragement of inter-firm linkages
- Access to educational institutions for assistance to improve the competitiveness of SMMEs in several sectors.

Despite these efforts many SMEEs still lack the necessary access to information channels. A significant part of this thesis will explore ways of obtaining and absorbing information from internal and external information channels.

This study seeks to investigate the mindset of entrepreneurs at SMEEs regarding an innovative space at their companies. The research will also investigate management's approach and the quality tools required when developing new products. The integration of an inquiring culture (IC), continuous process improvement (CPI) and generating collaborative knowledge (GCK) will also be looked at in this study.

1.3 PROBLEM IDENTIFICATION

Salient problems in SMEEs are perceived to be lack of access to information and knowledge, lack of access to a networking environment, lack of access to markets and lack of access to consultancy. (Visagie, 1997) also mentions the lack of government protection of propriety rights and lack of comprehensive training. Both improved education and a culture of entrepreneurship are prerequisites for success.

This work attempts to create a sustainability model by investigating the mindset of SMEEs regarding the importance of the role of practices which would lead to NPD and how these practices could be effectively implemented.

1.4 RATIONALE

The first democratically elected minister of Trade and Industry in South Africa, Mr. Trevor A. Manuel, said the following when presenting the White Paper on the National Strategy for the Development and Promotion of Small Business in South Africa: “Throughout the world one finds that SMMEs are playing a critical role in absorbing labour, penetrating new markets and generally expanding economies in creative and innovative ways.”

In accordance with section 1 of the Small Business Act, small business is defined as: ‘a separate and distinct business entity, including co-operative enterprises and non-governmental organisations (NGO’s), managed by one or more owners.

In general a medium enterprise may have a maximum of 200 employees, a maximum turnover R40 million per annum and a total gross asset value of R18 million. A small enterprise may have a maximum of 50 employees, turnover of maximum R25 million and asset value of R4, 5 million.

The SMME sector contributes roughly half of South Africa’s GDP and employment opportunities. This explains the effort that is put into stimulating the development of SMMEs in the different sectors. About 10% of all SMMEs in South Africa are based in the engineering sector and as such are labelled SMEEs.

Since the elections of April 1994 the issues of economic empowerment and growth have been placed high on the agenda of the South African government. Small, medium and micro enterprises are perceived to play a fundamental role in job-creation, economic growth and equity in South Africa. The stimulation of SMMEs for all sectors can be seen as part of an integrated strategy to transform the country’s economy into a knowledge-based economy. The challenge facing South Africa is to boost economic growth and to increase productivity particularly in the SMEE sector through

policies that promote skills development, co-operation and flexibility within the enterprise.

(Hodgetts and Kuratko 1995) suggest that small businesses do not only create employment but are the economic engines driving the global quality of life. Researchers claim that small companies and entrepreneurship undoubtedly play a major role in the world economy. This can also be derived from the fact that more and more researchers are seeking to understand the practices and activities of these enterprises. (Hill and McGowan, 1999)

In the last three decades several East Asian countries have achieved spectacular economic growth. Japan has emerged as the world's industrial superpower (Oslo, 1994). Small to medium-sized companies called "Chu-Sho-Kigyo" make up more than 99 per cent of the Japanese industry and form the real foundation of the Japanese economy. Small to medium-sized enterprises employ over 80% of the national workforce (Vosloo, 1994).

The success of the Japanese industry after the Second World War was, to an extent, due to their adoption of the ideas of the statistician, Edward Deming, for what is now termed statistical process control. This enabled them to drive down costs and to improve the quality of their products hence increasing competitive advantage which allowed them to take over markets until the North Americans adopted similar policies in the 80's. Quality management is thus an essential part of the development of the individual enterprise as well as the economy as a whole.

1.5 PROBLEM AREAS IN SMMEs

Although Bagshawe (1995) believes that more businesses are required in the new South Africa to help boost the economy and provide more employment, Carlson (1994) maintains that only one out of five businesses

is successful. Wright (1995) identified the following reasons and constraints for their failure:

- Poor management skills
- Poor record-keeping
- Poor money management
- Too little effort to market the business
- Poor planning
- Poor pricing practice
- Poor human resources management
- The entrepreneur's inability to adapt to the changing demands of a business.

Other constraints cited (Riley 1993) are insufficient access to finance and markets, inadequate staff skills and education and a scarcity of adequate business premises.

Managing the growth of a small business is a difficult and traumatic process, with the entrepreneurs often having to learn harsh and expensive lessons as their ventures move through the business life cycle (Cope & Watts, 2000). Mentors could be useful to entrepreneurs in creating effective business structures and practices, such as effective accounting practices, computing infrastructure and marketing. Most small businesses fail because they do not have enough resources. When making use of a mentor, who provides expert advice based on his own experiences, small businesses could learn from the mentor's previous mistakes. The failure rate of small businesses could be minimized if they were prepared to learn from the mistakes of others (Karlson 1994). There would be less hardship, since entrepreneurs would waste less of their capital, personal energy and self-esteem.

1.6 SIGNIFICANCE OF THE RESEARCH

The main aim of this study is to determine how SMEEs can sustain their existence and what they need to do to become innovative. The study also

looks at appropriate support intervention for the entrepreneurs. If entrepreneurs are successful, this could have a positive impact on the South African economy as more money will be spent on local goods and services.

The aim of this work is to engage with individual SMEEs, seeking to improve their competitive advantage through CPI techniques as well as to study the employee involvement in the improvement of processes. This study will introduce to the SMEE management techniques aimed at changing their focus and the focus of the enterprise towards the vital aspect of production in a competitive global economy.

1.7 RESEARCH QUESTIONS

The research questions to be answered by this study are:

- Why is knowledge generation, a culture of inquiry and continuous process improvement needed for SMEEs to remain sustainable?
- Which are the NPDP that are needed for SMEEs to remain sustainable?
- How can SMEEs measure their “sustainability potential”?

The purpose of conducting this study is to find answers to the research questions in order to develop a model. This model will be used as an innovation instrument in SMEEs when developing new products which will give them sustainability and, in time, this will enrich the economy.

In order to find answers to the research questions, an analysis will be done of a pilot study of six SMEEs in the Western Cape conducted in chapter 3. The study also involves the analysis of answers to interviews and questionnaires as well as data from observations during visits to these SMEE companies. The six companies are based in the Western Cape and are currently involved with some form of NPDP.

1.8 CHAPTER OUTLINES

This thesis consists of nine chapters. Chapter One introduces the thesis with the problem statement, rationale, significance of the research, and research questions. Chapter Two is a review of the context in which the study is located. It looks at the role of SMEEs in the economy and introduces in more detail the notion of SMEEs in the thesis. Chapter three describes the pilot study of six companies which together with an initial literature survey attempts to emphasise the significance of innovation and new product development practices that are key to the “sustainability potential” of SMEEs. The study was used to compile the questionnaire in appendix 1. Chapter Four reviews the literature covering the important aspects of NPDP. In the same chapter the framework is presented in which the model is constructed. Chapter Five is an explanation of the research methodology used in this research. Chapter Six describes the key aspects of the model. These aspects include the pillars, components, elements and links of the model. Chapter Seven presents the results of the analysis of each of the eighteen companies’ responses to a questionnaire and interviews aimed at benchmarking them relative to the model. Chapter Eight describes the “growth factor” of the companies which was determined by their responses to four pertinent questions relating to Turnover, Infrastructure Growth, Product Development and Employee Growth. Chapter Nine will conclude this thesis by presenting the results from the attempt to validate the model, accomplished through the “growth factor”, as detailed in chapter 8.

CHAPTER 2

NATURE OF THE RESEARCH CONTEXT

2.1 INTRODUCTION

This chapter deals with the phenomena of Small and Medium Engineering Enterprises (SMEEs) and in the context, the importance of knowledge generation and management as a component of New Product Development Practices (NPDP).

As previously stated, small and medium enterprises (SMEs) in South Africa are perceived to be vital for the nation's international competitive advantage, as well as the nation's economy. Although the South African government is focusing on stimulating entrepreneurs to set up their own businesses, many problems are still relevant in this complex SME sector.

NPDP are seen as one of many essential drivers of success in SMEs. In the manufacturing sector of the Western Cape, problems (not primarily of a financial nature), include a lack of innovation in the company, lack of the entrepreneur's external awareness, lack of own distinct product lines, lack of needed marketing skills, low-levels of education of the workforce and, most importantly, a lack of knowledge generation and management. It is the aim of this study to empower entrepreneurs so that they can become involved in NPDP.

2.2 DEFINITION OF SMMEs

2.2.1 Micro Enterprises

In general, micro enterprises employ fewer than 10 employees. They operate in the formal market and usually have no access to modern technology. The smallest of these enterprises, namely, craftspeople and

professionals are self-employed owners with no employees. Very small (micro) enterprises make up an estimated 19.7% of all enterprises recorded and account for 13.3% of employment. The largest concentrations of very small enterprises are found in the Gauteng (42%), Western Cape (16%) and KwaZulu-Natal (15%) regions of South Africa.

Micro enterprises are often considered to be formal enterprises and have access to formal financial institutions like commercial banks. They often benefit from a debt and equity combination but their equity requirements are generally too small for equity financiers. The only source of finance in the business is therefore generally the owner's own contribution. Thus micro-enterprises are most often established as a result of an entrepreneur's savings from a previous employment.

2.2.2 Small Enterprises

A small enterprise (repeated here for context), may have a maximum of 50 employees, turnover of maximum R25 million and asset value of R4.5 million. Small enterprises are more “established” than micro enterprises and have more complex business practices. Usually, the owner does not manage the enterprise directly as a secondary co-ordinating mechanism has been put in place. Growth from a small to a medium-sized enterprise requires an accumulation of resources as well as incentives appropriate for expansion. Small enterprises constitute an estimated 7.6% of all enterprises and contribute 19.9% of employment. Forty six percent of small enterprises are located in Gauteng, a further 16% and 12% are located in KwaZulu-Natal and the Western Cape, respectively.

Small enterprises when compared to micro-enterprises have greater financial needs for equipment and working capital. They rely upon leasing finance and factoring. However, long-term outlays for machinery and equipment are often required, as are overdraft facilities and suppliers' credit for working capital. Companies in this sector also require equity

injections but as with micro-enterprises, the equity amounts required are often too small, below R5 million, for equity financiers to consider. Loan finance requirements of small enterprises range from R20000 to R5 million.

2.2.3 Medium Enterprises

Medium-sized enterprises (repeated here for context), may have a maximum of 200 employees, a maximum turnover R40 million per annum and a total gross asset value of R18 million. Although an owner usually controls these enterprises, the ownership and management structure is more complex. Often the decentralisation of power to an additional management layer and a greater division of labour are the main differences between small and medium-size enterprises. A more complete separation of ownership and management is often the natural barrier between medium and large enterprises. Medium-sized enterprises make up 1.4% of enterprises recorded and account for approximately 13.8% of employment. Medium-sized enterprises are concentrated in the metropolitan areas of Gauteng, KwaZulu-Natal and the Western Cape.

These companies generally have established relationships with their bankers and equity financiers target those which exhibit growth potential. A range of institutions serves their financing needs. Medium-sized enterprises are also likely to seek a listing on the stock exchange.

This study will deal with only small and medium engineering enterprises (SMEEs) since there are very few engineering micro-enterprises. SMEEs are a subset of SMMEs and face similar challenges; therefore they need the same guidance and assistance.

2.3 NATIONAL SMME STRATEGY

The government developed a national strategy aimed at encouraging and building an entrepreneurial culture in South Africa. At a national SMME workshop the lack of economic growth in South Africa was discussed. It was agreed and acknowledged that entrepreneurship is a main driver for economic growth and prosperity and therefore it is imperative to develop a strategy that will encourage an entrepreneurial culture in South Africa's society. At the same workshop a strength, weakness, opportunities and threat (SWOT) analysis of the current state of affairs was conducted by the Trade and Industry Ministry and published in the 1995 White Paper on the National Strategy for the Development and Promotion of Small Business in South Africa (RSA, 1995). A SWOT analysis is a tool used to develop a strategy for an organisation. The results of the SWOT analysis on the National Strategy for the Development and Promotion of Small Business in South Africa assisted with the implementation of the strategy component in the NPDP. The strategy aims to promote an entrepreneurial culture by creating entrepreneurial opportunities aimed to increase employment and ultimately an improved quality of living. The main purpose is to assist current entrepreneurs to expand their business and to assist new entrepreneurs in the start-up phase. This strategy benefits companies in retail, wholesale and manufacturing sectors in the South African economy. It also benefits academic groups, government, labour unions and entrepreneurs.

2.4 GENERATING KNOWLEDGE AND KNOWLEDGE MANAGEMENT

In order to find the answers to questions on how SMEEs can generate the desired knowledge in an effective manner, we must first take a look at what knowledge actually is. Usually knowledge is regarded as an intangible company's asset. As (Bhatt 2000) indicates: "its real value is only realised when it brings a meaning into a context. Without meaning knowledge is inert and static". Others, like (Nonaka 1991) and (Raelin

1997), stress that knowledge is 'a justified belief system' that can be interpreted differently, depending on the time and situation.

There are two dimensions of knowledge namely, explicit and tacit. Explicit knowledge is easy to define, codify and transfer throughout an organisation. Tacit knowledge like experience, interactions and craftsmanship is more difficult to transfer throughout an organisation because they are mostly informal. Tacit knowledge and the transfer of it are of great importance. The kind of knowledge an organisation is interested in illustrates the strategic intentions with regard to target markets, technological innovations and economic trends.

Companies can either choose to focus on developing knowledge inside the company or obtain it via external channels. Even in external channels, awareness of fundamental knowledge inside the company is essential to identify the right strategic knowledge useful to fulfil the strategy. In a market that has low entrance barriers and is weakly protected by government regulations, external sources play an important role to obtain knowledge and to set up R&D activities.

Small and medium engineering enterprises (SMEEs) have shown increasing interest in new product development (NPD) but in general have not been successful. In SMEEs, there are many obstacles to knowledge being used effectively, such as the structure of incentives systems, lack of funds, lack of strategy or internal competition. There are personal and organizational beliefs that hinder knowledge from being exploited optimally, e.g. too strong reliance on regulations and reports, or a simplified view of knowledge as a "thing" that can be stored, moved and managed.

This largely stems from personal and organizational beliefs that knowledge should not be shared but stored and used when necessary by a few people only. Another hindrance is unreflected action and routines (Cyert & March, 1963). This study looks at how this behaviour can be changed in

SMEEs so that information and knowledge can be shared in a non-threatening environment. People in organizations are often trapped by implicit theories of behaviour (Argyris, 1991) that guide their decisions and actions. Since these theories are unconscious, they are not open to new influences or change, and almost impossible to share with others. Nevertheless, they influence individual and group action.

Learning must occur continuously in the face of environmental change and must therefore become an integral part of the organization's day-to-day activities (Brown & Duguid, 1991). Even with this understanding SMEEs find it difficult to share information and empower their people to make decisions and become part of the innovation process. Simultaneous to the great attention paid to knowledge in organizations, theorists are proclaiming that knowledge is one major source of competitive advantage (Grant, 1996; Spender, 1996; Teece, et al., 1997). Despite these efforts to apply and understand the management of knowledge, there seems to be a growing discontent among managers regarding practices used in trying to manage knowledge (De Long & Fahey, 2000). In addition, the literature on knowledge and knowledge management that gives guidance for managers is scarce. Explanations for the gap between the theory and the application of knowledge management constitute an issue which is frequently discussed in the literature (Liebowitz, 1999; Stacey, 2001). In trying to capture the debate, the normative under-socialized models of how knowledge could be administered and developed are on one side of the chasm, while the other side recognized the social, political and emotional aspect of knowledge (Collins, 2000). It is the author's view that in theory, both sides are complementary but show very few examples of experimental research regarding how to convert knowledge and about creating, sharing and managing knowledge into action.

It is argued that the complexity of the modern organizational structure is requiring new ways of studying and analysing organizations (Lowendahl & Revang, 1998). This complexity is compounded in SMEEs when there is no open communication culture. Traditional, disciplinary, university-based

knowledge production is not sufficient for the demands and the problems that arise in SMEEs. A new type of knowledge production is claimed to be emerging which is more interdisciplinary and highly context-based (Gibbons, et al., 1994). This form of knowledge production is performed by temporary interdisciplinary teams in which theoretical and practical outcomes of research are reflected in iteration by a wide range of specialists (Dodgson, 1999). One practical result of the increasing emphasis the industry is putting on knowledge, and the emergent knowledge society in general, is an extended reliance on academia-industry partnerships as important sources for the creation of economic value (Jacob & Hellstrom, 2000). Therefore, new researchers' roles and new ways of developing the interface between practice and academia are needed (Coghlan & Brannick, 2001).

2.4.1 Generating Knowledge in SMEEs

There is a need for research into how knowledge is created and disseminated in complex organizations such as SMEEs, but more to the point is, how is this knowledge shared and can it be converted into value adding activities within a firm? There is also a lack of practical tools that are grounded in experimental research, tools for managers who want to convert knowledge into action, thereby creating results for their organizations. In addition, more research is needed to explore how action research in collaboration between industry and academia can contribute to knowledge production in both the organizational setting and in the academic world.

Therefore, managing the creation of knowledge is one of the most important management tasks today. However, knowledge is thought to arise in the individual's mind, largely in tacit form, which creates significant management problems (Baumard, 1999; Pfeffer & Sutton, 1999), and takes up a great deal of literature space. The focus is on extracting knowledge from individual minds and converting it into explicit knowledge

(Nonaka & Takeuchi, 1995). In this form, it is easier to control knowledge if it can be stored and manipulated using information technology. A second problem to be faced in the management of knowledge is that individuals, are reluctant to share what they know because of power relations (Downs, 1967), due to the lack of interest in knowledge derived from elsewhere (Katz & Allen, 1982) and due to individuals only acting upon what is measured within the organization (Thompson, 1967). The solution to this problem requires management styles that encourage and persuade people to share knowledge and spread it around the corporation.

Investment in innovation management tools is on the increase and new roles, such as the knowledge management officer, are being introduced into organizations (Abell & Oxbrow, 1999). However, problems arise in organizations where the gap between fundamental knowledge and the knowledge in use is large. Pfeffer and Sutton (1999) call this the “knowing-doing gap” where efforts are made to replicate “best practice” into “another practice” which is too different (Beer & Nohria, 2000). Although these innovative management tools are successful in certain companies and countries, they are not specific enough for the South African environment.

During the 1990's, considerable attention was also given to knowledge management and knowledge creation during the NPD process. Improving knowledge management, in order to integrate fragmented and distributed knowledge sources, has become a critical ingredient for success in the knowledge creation process. Recently, Nonaka & Konno (1998) introduced the Japanese concept of *Ba*, which roughly translates into “space”, to argue that knowledge creation is embedded in *Ba*. “*Ba* can be thought of as a shared space for emerging relationships. This space can be physical (e.g., office, dispersed business space), virtual (e.g., e-mail, teleconference), mental (e.g., shared experiences, ideas, ideals), or any combination of them”. What differentiates *Ba* from ordinary human interaction is the concept of knowledge creation. *Ba* provides a platform for advancing individual and/or collective knowledge. Yet, the increasing

emphasis on knowledge creation as an integral part of NPD seems to increase work intensity.

2.4.2 Intensity and Sustainability in NPD Work Systems

The author's review of the literature reveals that, while increasing attention is being given to the role of the context, design configurations, resources, knowledge management and physical space, little is given to sustainability. NPD work has been characterized as "an intensive work" that tends to drain resources (Lewis, et al., 2002). Intensive work systems have major consequences at the individual, unit and organizational levels. At the individual level, work emerges from an imbalance between an individual's resources and work demands, the individual's needs and work opportunities. This eventually leads to the consumption of psychological and physical resources, the potential to work and derive happiness from the work. The emotional and psychological erosion is a process that leads from initial exhaustion to cynicism and detachment from work and ultimately ends up in ineffectiveness (Maslach and Leiter, 1997).

Consequently, the erosion at the individual level leads to serious negative consequences at the work group, unit and organizational levels. The negative consequences of work intensity at the organizational level relates to both an individual's behaviour and actions deriving from his/her exhaustion, as well as to the collective downward spiral of a social system. Thus, rather than striving to fulfil their primary tasks and goals, individuals and groups tend to turn inward and concentrate on defences meant to collectively constrain experiences and anxieties. Kira (2002) argues, for example, that in intensive work systems, productive and creative ways to operate are replaced by rituals and irrational norms. While the understanding of complex emotional and cognitive relations between people and their work is beyond the scope of this manuscript, it is critical to note that imbalances must be addressed to achieve a sustainable work system (Kompier and Cooper, 1999).

In the context of NPD work, the author views the potential for sustainability as the firm's strategic and design choices, regarding the continuous investment in the development of resources (i.e., human capital), design configurations, processes, practices and outcomes that yield long-term success. Therefore, there is a need to develop a framework that takes into account the strategic nature of NPD, the design configurations of this study and its outcomes in predicting a firm's sustainability. Strategic management, coupled with sociotechnical system thinking, provides the basic language and analytical framework that can advance the exploration of the relationship between NPD and the potential for a firm's sustainability.

In a recent study, MacCormack, Verganti, and Lansiti (2001) argue that the NPD field lacks a holistic, integrative, theoretically based framework. Their study of 29 NPD projects illustrated the need for a guiding conceptual framework. Shani & Sena (2001) conducted a study that focused on sustainability issues of NPD projects in a software development firm. They recognized the need for interdisciplinary conceptual integration of contextual factors, management system factors, the NPD process, practices and outcomes, and system sustainability. The holistic foundation of socio-technical system thinking, coupled with a strategic-based view of the firm, provide an arena for an interdisciplinary theoretical integration around the theme of sustainability of NPD work systems.

Business sustainability is embedded in the firm's ability to manage the New Product Development process. The essence of New Product Development is the creation, utilization and exploitation of new knowledge. This study explores the complex relationship between the organizational context, New Product Development Practices and knowledge management.

Moreover, as the organisation aligns itself to implement changes, everyone must have an opportunity to be involved in planning, decision-making, taking calculated risks, making mistakes without fear of punishment and receiving fair reward and recognition for performance. In forward-looking organisations, the management of such pertinent knowledge should go beyond knowledge management, to idea management (Liebowitz, J. 1999). The long-term survival of any company is dependent on its ability to generate and exploit innovative ideas. These ideas are most valuable when generated and applied by the people from within. The author agrees with the theorists that fundamental knowledge is a key aspect of NPDP.

2.5 SUMMARY

It is our task and responsibility to enable entrepreneurs of SMEEs to become successful by providing guidance and support to these individuals. We must undertake to ensure that these companies have the necessary NPDP in place. The management and generation of knowledge form an integral part of this NPDP and therefore it is of importance. Our focus at all times should be to transform our inputs, such as capital, resources, information, marketing, managing risks, etc. into outputs such as new products in the most efficient manner through the implementation of NPDP.

The model that is being developed is an innovative tool that can be used by SMEEs to develop new products and thus remain viable. It aims to create an innovative environment that will allow SMEEs to develop new products, be they from old, existing, modified or new processes. The model will take into account the importance of people in the innovation process.

CHAPTER 3

INITIAL LITERATURE REVIEW AND A PILOT STUDY OF SIX SMEEs

3.1 INTRODUCTION

This chapter focuses on investigating the relevance and importance of new product development practices (NPDP) in small and medium engineering enterprises (SMEEs). It examines what NPD actually is, why it is important, through what means it can be achieved, how collaboration can play a part in NPD and what factors and problems are of importance when being involved with NPD activities. Using theory from literature and observing the reality of the progress with NPD in SMEEs will accomplish this task. The relevance of innovation and NPD will be understood as well as the manner in which they can be linked within the company's NPDP, for example as strategy and internal structures.

An investigation to establish the relevance of innovation and NPDP in SMEEs as well as the problems they encounter when engaging in NPDP was conducted at six small manufacturing companies in the Western Cape. The information collected from the companies, together with the more specific information on NPDP in the literature, will result in recommendations for the SMEE sector. The data from this study will be combined with data from an extensive literature survey to inform the development of an innovative "new product development practices model" at the end of the thesis.

Knowledge is important for competitive initiatives such as improving customer satisfaction, developing new products and markets and providing a faster response. This is a key chapter in the thesis because it looks at how SMEEs can find ways of obtaining information, why they need to innovate and the problems experienced with NPD.

3.2. NEW PRODUCT DEVELOPMENT

Wheelwright and Clark (1992) suggest that there are three potential benefits associated with product and production process development. These benefits are, market position, resource utilisation and organisational renewal and enhancement. They are of the opinion that in most cases these benefits are seldom realised because most companies have problems integrating technology strategy with product-market strategy. (Burgelman et al. 1996)

Increased competition in almost every market sector around the world signals the importance of R&D. To maintain market share and revenues, product and production process innovation are important because high quality, innovation and cost effectiveness have become key success factors. A further reason for effective R&D is the growing limitation on the availability of technical talent. In the manufacturing sector there is a need to improve quality and, at the same time, reduce costs and development times.

In their work, Tidd et al. (1998), describe the strategic advantages that can be achieved through innovation as shown in the table 3.1 below.

Table 3.1: Managing Innovation

Mechanism	Strategic advantage	Example
Novelty in product or service	Offering something no one else can	Introduction of the camera, dishwasher, walkman, etc
Novelty in process	Offering it faster, with lower costs and more customized	Internet banking, online booksales
Complexity	Offering something that others find difficult to master	Aircraft engines, NASA
Legal protection of	Offering something that is	Product names like

intellectual property	legally protected	Aspirin, Prozac
Add/Extend competitive factors	Move basis of competition by adding new customer values	Japanese car manufacturers, systematically increasing factors from price to quality, to flexibility, to shorter lead times, etc.
Timing	First-mover advantage or fast follower advantage	Amazon.com, Others can follow, but are left behind
Robust design	Offering something on which variations and generations can be built	Boeing 737 is still being adapted after 30 years
Rewriting the rules	Offering something by using a totally new concept that makes the old ones redundant	Electricity vs. oil, typewriters vs. computers

Source: Managing Innovation, Tidd, Bessant and Pavitt. (1998)

3.3 INNOVATION IN SMEES

A study performed by Lefebvre and Lefebvre (1993) show that SMEEs holding a strong competitive position in terms of costs, quality and diversity, generally have a more developed innovative culture.

Too often SMEEs are seen as large companies on a smaller scale. In fact, SMEEs cannot be compared with large enterprises since these enterprises are generally managed and owned by entrepreneurs who are the driving force behind all the enterprises' activities. Although SMEEs can be more flexible, they are more likely to lack the specialised assets such as specialist skills and research equipment that can help them exploit new technologies. It is because of this that SMEEs are often forced to incur

expenses by either trying to build them or trying to develop coalitions with competitors or owners of these specialised assets.

The possibility of external sourcing of information depends on the type of market the SMEE is in. If the market is characterised by weak legal protection such as patent licensing, know-how licensing, co-production and zero transaction costs, then external sourcing might be a good option. In a situation where there is strong legal protection, innovation as a comparative advantage is probably very important and external sourcing incurs high transaction costs. In all cases, Cohen and Levinthal stress the importance of the link between absorptive capacity, internal, and the ability to recognise outside sources of technology. (Burgelman et al, 1996)

Large companies, including multinationals, cannot always undertake major innovations alone and, because of this, there has been a trend toward strategic collaboration. This takes the form of joint ventures, joint R&D activities and strategic alliances. SMEEs face the same situation. If they cannot rely on their own capabilities and resources, they have to use their 'embedded' roles in 'socio-economic networks' as Granovetter puts it. (Tidd et al. 2001)

The type of innovation adopted by a firm depends on the link between organisational characteristics such as centralisation and size and the different dimension or level of innovation (Utterback, 1994). These dimensions include the:

- Radical, fundamental and incremental types
- The process and product type and
- Technological and administrative innovation

Technological innovation involves the adoption of an idea that directly influences the basic output processes. Administrative innovations include changes that affect the policies, allocation of resources and other factors associated with the social structure of the firm (Cooper, 1998). The two most important aspects of these links are strategy and executive power.

For instance, Porter (1980) argued that companies having a strategy of cost-leadership are often more involved in process innovations, while a differentiation strategy depends on the firm's ability to generate new product ideas. The type of innovation is often correlated with the interests and technical orientation of the innovator. In small companies, innovators have dominance in making decisions concerning strategy and the type of innovation (Cooper, 1998). Multi-dimensional innovation helps entrepreneurs to understand and analyse what innovation and R&D activities are, and to see the link between internal structure, strategy, executive power and innovation.

3.3.1 Reasons to Innovate

As indicated before, strategy and executive power plays an important role in the choice of innovation. Different strategies are required for different types of innovation. In general, the basic reasons for any company and especially SMEEs to innovate are to:

- enter an advanced market position
- reduce lead times and time-to-market
- reduce production costs
- gain an advantage through proprietary rights
- add new customer value criteria
- develop a future core competence

Besides these advantages, innovation and especially new product development in most cases, remains resource intensive, expensive and notoriously risky.

3.4 RESEARCH AND DEVELOPMENT (R&D)

Both quality and innovation are considered to be successful management philosophies when seeking out ways of increasing competitiveness. In

order to understand the importance of R&D when applied to SMMEs, one must first establish what innovation, and consequently R&D, actually is.

Drucker (1985) defines innovation as “the means by which the entrepreneur either creates new wealth-producing resources or endows existing resources with enhanced potential for creating wealth” (McAdam et al., 2000).

Roussel (1991) makes a broad distinction between Research and Development. “The purpose of research is to develop new knowledge and the purpose of development is to apply scientific or engineering knowledge, to expand it, to connect knowledge in one field to that in other fields”. Therefore, development tries to refine and prepare product or production process concepts for commercial exploitation. The result of R&D is just one product, namely knowledge.

Tidd and Pavit (1998), define innovation as “the process of taking new ideas effectively and profitably through to satisfied customers.” They also state that there is a fundamental difference between radical and incremental innovation. Besides radical and incremental, there is also fundamental innovation.

R&D plays an essential role in a company’s strategy. In the first place its purpose is to defend, support and expand the existing business. An example of this is the modification of products to meet the customer’s acceptance, or market standards, or the development of new products and production processes to improve the competitive position within an existing market. Secondly, its purpose is to drive new business using existing and new technologies. Thirdly, it’s purpose is to broaden and deepen technological capabilities perceived as core capabilities in the future (Roussel et al. 1991). The three types of R&D are explained below.

3.4.1 Fundamental R&D: Large 'R' and No 'D'

Fundamental R&D is reaching into the unknown and has two goals. Firstly, to develop a depth of research competence in a field that a company is convinced will bear fruit or is at least persuaded that there is potential in future technology. Secondly, it must create a strategic impact in the long term and has "to prepare for future commercial exploitation of these fields" (Roussel et al 1991). Fundamental R&D goes hand in hand with high levels of uncertainty, has a long time to completion (4 to 10 years or more) and offers long-term competitive advantages often protected by patents.

3.4.2 Radical R&D: Large 'R' and often Large 'D'

The goal of this type of R&D is to apply the discovery of new knowledge to a useful application. There is never any certainty whether there is enough technical knowledge to become commercially successful. The decision to enter the development stage is only done when the level of uncertainty is perceived to be acceptable by management. This type of R&D has a medium (2 to 7 years) period to completion and offers a long durable competitive advantage.

3.4.3 Incremental R&D: Small 'r' and Large 'D'

According to Roussel (1991), the goal of incremental R&D is to create small advances in technology. This is typically based on an established foundation of scientific and engineering knowledge. The task therefore focuses on creative applications of existing knowledge. Small incremental changes often have a modest, but competitive impact with a high likelihood of technical success and a short completion period. Competitive advantages gained are likely to last only a short while.

Technological knowledge cannot always be developed inside a SMEE's own R&D department. It simply doesn't have the resources or capabilities and is too costly. In these instances, a company can use external sourcing to acquire new technologies instead of developing these themselves. A study by Cohen and Levinthal (1990) found that 'internal R&D capability is also an important determinant of a firm's so-called absorption capacity, that is, the firm's ability to recognise the value of new, external information, assimilate it, and apply it to commercial ends.' External sourcing of information can be done more easily in markets where legal protection is weak because this offers the opportunity to develop co-specialised assets. Ways of both internal and external sourcing of new technology are discussed later on.

3.5 INFORMATION CHANNELS

As mentioned before, information and knowledge can be derived through looking at channels from inside or outside the organisation. It is also important to note that companies must develop an external awareness.

3.5.1 Internal Sourcing

In order to make appropriate decisions, entrepreneurs or managers must search for accurate information. The intellectual capital, fundamental knowledge or the so-called 'knowledge workers' in an organisation must have adequate training, technical experience, creativity and motivation to seek out innovation.

According to Allen (1987) and Roberts, (1987) typical internal information channels or expert knowledge channels are:

- Technical staff comprising of engineers and scientists who are not assigned directly to the project considered, but can provide useful knowledge
- Company research, previously researched work

- Personal experience, 100% of the engineers tacit knowledge used in previous projects.

3.5.2 External Sourcing

Mosey (2002) conducted research on the external awareness of the British manufacturing SMEs. He expected successful innovative companies to effectively collect and analyse information about competitive threats and opportunities. In practice, this was difficult to do, because small companies have markets that are often poorly defined and lack published data. He identified the following activities that are used to attain new knowledge:

- Purchase and analysis of competitors' products
- Attendance at trade shows
- Internet search
- Formal market research; namely, questionnaires and focus groups

In his article about information channels, Allen (1987) mentions more typical external information channels. The channels mentioned below are lightly adjusted for relevancy and complemented with external sources derived from research done by Donna Berry (2002) into R&D activities in the food-industry.

- Literature, books and industry, trade magazines and other publicly accessible written information
- Conferences and seminars; relevant to industry's products, processes and trends
- Suppliers' sales people, representatives or potential representatives
- Suppliers' literature, documentation from suppliers or potential suppliers including Web sites
- Customers, representative or potential customers
- Customers' literature, documentation from customers or potential customers including Web sites
- Other external sources; paid or unpaid consultants or outside contractors

- Catalogues, directories
- Industry Internet Web sites

3.6 THE INNOVATIVE ROLE OF THE ENTREPRENEUR IN SMEEs

SMEEs involvement in internal or external information sourcing depends on the strategic intent of the entrepreneur. The kind of information channels used is linked to the type of innovation with which the SMEE is involved and could be product or production process, incremental, radical, fundamental, technological or administrative. The strategic intent and the power to choose the type of innovation in a SMEE are, in the majority of cases, in the hands of the entrepreneur.

In the literature much attention is devoted to the different critical roles necessary in the innovation process. Roberts and Fusfeld (1981) are particularly interested in these roles and stress that an innovation team requires five different roles depending on the stage of the innovation's development. In small businesses, the entrepreneur normally performs these roles. More than one individual normally performs roles such as generating ideas. In other cases, only one person performs these roles. The five critical roles according to Roberts (1987) are as follows:

3.6.1 Idea Generating (The Role of)

It involves the analysis and synthesis of information about markets, technologies, approaches, from which an idea is generated for a new or improved product, service or production process. The person assuming this role is likely to have an innovative mind and to be an individual contributor. In order to do so, this person needs to control the information channels described earlier in order to have external awareness. If one of the entrepreneurs has a technical background, more often he/she is likely to perform this role. Besides the expertise required, the company's idea

generation strategy will dictate whether an idea should come from inside or outside the organisation.

3.6.2 Entrepreneuring or Championing

This role includes recognising, proposing, pushing and demonstrating new technical ideas. The person championing this role has, in all probability, a strong interest in commercial applications of ideas, is generally broad-minded and must be resolute. In an SMEE, the entrepreneur has to convince other associates as well as personnel before an idea is approved. In this case the internal communication must ensure the 'internal awareness' of staff.

3.6.3 Project Leading

This role involves planning and co-ordinating the diverse sets of activities and human resources in order to put the "idea" into practice. Sensitivity to the needs of others, a clear view of the company's organisational structure and an interest in various fields are characteristics of a project leader. In many cases, someone other than the idea generator or the entrepreneur can perform this role. Commitment and the awareness of personnel are important characteristics for this role.

3.6.4 Gate Keeping

This involves collecting and channelling information about important changes to the internal and external environments. There must be a focus on markets and technologies and therefore the gatekeeper should have a high level of technical competence. Changes and other information must be forwarded to people who are responsible for certain activities inside the organisation.

3.6.5 Sponsoring and Coaching

This role includes guiding and developing less experienced personnel in their critical roles, behind the scenes personnel support, protection and funding of personnel development initiatives. If the entrepreneur fulfils this role he keeps control of the innovation process but delegates responsibilities with an eye on the long term. He must be relatively objective and have experience in the company as well as the concept of idea developing. The implementation of continuous learning becomes an important issue in the innovation process.

Many more informal roles such as information transfer, information integration are also important. However the five mentioned above are regarded as critical, as each role is unique and demands unique skills. Deficiencies in any of the critical roles will inhibit the innovation process. Very few SMEEs have individuals to cover all the roles so specific individuals often carry out dual and even treble roles. When such individuals leave the process, it is often very difficult to replace them.

The biggest weakness of SMEEs is the lack of information-sharing throughout the firm. Even though the roles are handled by individuals, other workers are also able to contribute if given an opportunity to do so.

3.7 COLLABORATIVE TRENDS CONCERNING NPD

Lawton Smith et al. (1991) define collaborative new product development as the co-operative relationship between companies aimed at innovation and the development of new products. (Parker, 2000) says that collaboration on innovation has been an increasing trend over the last decade. This is because of the increasing complexity and the faster rate of product obsolescence as well as the need to gain faster access to markets.

According to Allen (1987) company boundaries are normally clearly defined in terms of the internal and external environment however there is a trend towards the social embeddedness of companies. In an attempt to overcome resource barriers to innovation, there has been an increasing trend in strategic collaboration. This goes beyond transactions or project-based co-operation but includes joint ventures, strategic alliances and also joint R&D activities. Besides Allen's (1987) informal and formal links, companies can also make use of networks with external organisations that have appropriate resources and knowledge.

3.7.1 Networking

A network perspective often gives a fuller picture of a firm's innovation activities and how the strategies and activities of others in the network affect that 'firm's' innovation strategy. Furthermore, it could be argued that network relationships that are intentionally developed and managed by a firm will have a more noticeable effect on innovation performance than less intentionally and more informal network relationships' (Dickson & Hadjimanolis, 1998).

By generating, processing and sharing information through networks, companies create a spiral of positive feedback, brainstorming, dialectical thinking and continuous experimenting. (Bath, 1998) Although the importance of networking is well known to entrepreneurs and managers, they do not always realise the disadvantages. As noted by Biemens(1992), the following disadvantages when taking part in networks are:

- Increased dependency for weaker partners
- Higher co-ordination costs
- Increased management time
- Potential loss of secrecy over innovative development (Dickson & Hadjimanolis, 1998)

Therefore, network relationships must be based on trust and co-operation and, in all cases, there must be equilibrium between partners. For positive results in collaboration, all partners must have invested an equally perceived amount of assets or capabilities. Weaker partners, in terms of technology or equipment, must compensate for this weakness with other assets such as money, marketing skills, customer databases etc.

Essentially, there are three types of networking (Dickson & Hadjimanolis, 1998):

- Vertical, collaboration with suppliers of components of raw material distributors and customers. Often customers and suppliers are involved in new product development from the concept stage to the manufacturing stage, leading to customised products and services.
- Horizontal, collaboration with companies in the same trade even competitors. This leads to rapid diffusion of improvements in production process innovation and possibly imitation and improvement of new products.
- Lateral, collaboration with non-competing companies from other sectors, technological institutions, etc. This often leads to a reduction in product development cycle times.

Dickson (1998), in his research on collaboration between SMEEs found that the rate and type of collaboration with customers, suppliers and competitors depends greatly on economic circumstances, sector circumstances, social factors such as attitudes, the behaviour of the owner/manager, family connections and proximity of other companies. However, he omits the importance of collaboration between workers and the management of the firm. Often companies do not use their workers optimally thus very creative workers are frustrated because they do not have an opportunity to share their knowledge.

Previous research has shown that SMEEs are not more innovative than large companies. In most cases the innovation done in SMEEs involves small incremental steps in the development of a new product or the

development of production processes. This includes IT-investments, new machinery and better education. Most innovation does not come from the SMEEs own R&D but from suppliers, customers and the entrepreneur's own personal experience. Most small companies are supplier-dominated companies (Tidd et al., 2001). This means that their suppliers are the main sources of new technological information. There are only a small number of so-called specialised suppliers. These companies design, develop and build specialised inputs into production lines. These come in the form of machinery and instruments and they interact closely with their, often technically progressive, customers. These companies generally do not do much formal R&D, but nonetheless significantly contribute to innovations.

3.7.2 Collaboration

SMEEs should collaborate for a number of reasons, namely:

- In response to key customer needs or market needs
- In response to technological changes in environment and competitors
- To broaden the range of products and improve the product development of other products
- To reduce the cost of R&D
- To reduce the risk of R&D
- To reduce the time taken to develop and commercialise new products

The choice of a partner should depend on the maturity of the partner's technology, the firm's own technological position and the strategic significance of the technology. However, in the case of mature or simple technology, market transaction, like sub-contracting and licensing, are more appropriate than collaboration.

The following prerequisites are essential for collaboration:

- Mutual trust

- Shared technological and business information
- Existing personal links
- Strict agreements on the sharing of benefits
- Frequent consultation between participants
- Consultation between the various technical and marketing departments

When these prerequisites are not carefully implemented in the collaboration, the following problems might emerge (Parker, 2000):

- Leakage of skills, experience and information, not only used in the company's collaborative activities but also used in their 'own' businesses (Hamel et al., 1989)
- Loss of control and ownership over the product development process (Ohmae, 1989). This happens when perceived benefits are not equally shared or inputs are not equally rewarded.
- Frustration and conflicts caused by frustrations due to a lesser commitment of one partner because the other company's emphasis is no longer the same as at the beginning of the partnership. Conflicts can cause more hurt by means of legal action, damaged image in the long run, etc. (Tidd et al., 2001)
- Costs, financial and time, incurred in managing the collaboration process may in reality offset any gain.

To overcome these problems, both in networking and other types of collaboration, both partners must pay attention to the following questions:

- How is the membership of the collaboration defined and maintained, i.e. what infrastructure and resources are provided and by whom?
- Who takes which decisions?
- When and where are decisions taken?
- What solutions can be made in advance to resolve future conflicts?
- How does information flow and how is it managed and transferred?
- How can the commitment of all parties be guaranteed?

- Are the innovation strategies, culture and the vision of the companies compatible?
- How are risks and benefits shared?

3.7.2.1 Types of Collaboration

The most common form of collaboration in the normal supplier relationship is subcontracting. An enterprise decides to outsource activities to a more specialised firm in order to save costs and obtain economies of scale. Traditionally this type of relationship implies a short-term cost focus with little or no input into product and production process development by the supplier. However, suppliers involved in the development of new products base the 'partnership' model on long-term relationships and significant contributions. This offers the advantage of even more cost-performance trade-offs, reduced time to market and better integration of component technologies.

A second form of collaboration is Technology Licensing which is the use of the intellectual property of another firm in return for the payment of royalties. The advantage of licensing is lower cost, less market and R&D risk and faster time to market. This advantage is important especially in order keep ahead of competition in a very competitive environment. Disadvantages are the high cost in seeking the suitable technology and licensor, and restrictions by the licensor on pricing and quality.

A third form of collaboration is the research consortium. This is a number of organisations working together and sharing the risks and costs of a well specified project. In most cases it involves co-ordinated research inside each collaborating firm, but may sometimes involve using pooled expertise and resources from a separate research facility. Companies operating in competitive markets can choose partners in non-competitive markets in order to set standards, complement technical capabilities and influence government regulations. Companies in competitive markets are only likely

to co-operate with competitors in order to develop pre-competitive technologies, mostly fundamental, that both can use and develop in-house at a later stage. In many cases they also include projects that are funded by the government.

The fourth form of collaboration is the strategic alliance. This is an agreement between two companies to co-develop a new product or technology. In most cases these projects have a specific end goal and timetable. More formal and longer-term alliances are called joint ventures and involve a newly set up company. A joint venture is more appropriate in the case of a clearly defined and mature market and when the technology is tacit.

The last form of collaboration is the innovation network. This is a hybrid organisation that consists of 'a number of positions or nodes occupied by individuals, companies, business units, universities, governments, customers, other actors, and has links or interaction between these nodes'. A network can influence the participants in two ways, namely, through the flow and sharing of information within the network and through differences in the position of the partners in the network. The issues that normally cause power and control imbalances are technology, expertise, trust, financial strength and legitimacy. (Tidd et al., 2001) These causes are listed and expanded upon below:

- **Technology:** The rate of technology change together with the increasingly complex nature of new technologies determines the need for sharing technological knowledge.
- **Expertise:** There must be a balance in competencies and skills. These can be of a technological or organisational nature and could include product or production process knowledge and the performance of the critical innovator roles and managerial skills.
- **Trust:** There must be a certain measure of trust between partners. The bases of trust can be contractual, goodwill, institutional, network, competence and commitment. In a contract, legal rules of exchange must be agreed upon. Trust based on goodwill involves

mutual expectations of commitment beyond the contract. Institutional trust is based on formal structures and hierarchies. Networking involves trust inherently because of personal or social ties. Competence involves trust that is based on a reputation of skills. Knowledge and commitment too are also based on trust because they involve mutual self interest and commitment to the same goals.

- **Finance:** Both investments and benefits must be divided based upon a formal agreement. In some cases a lack of expertise has to be compensated with more investment.
- **Legitimacy:** Legal contracts and legal rules can give power to those who have secured legal insecurities.

A network is appropriate when the benefits of co-specialisation such as sharing of joint infrastructure, standards and other network externalities, outweigh the cost of network governance and maintenance.

Networks evolve from existing long-term relationships with universities, suppliers, customers, distributors and competitors. Social bonds, decreased costs and trust make sure that the exchange of information is likely to be done with these partners. Examples of networks in practice include Japanese (Keiretsu's and Zaibatsu's 1998) and component networks in Italy.

Besides these types of collaboration, other ways of acquiring technology are industrial espionage, acquisitions, reverse engineering, benchmarking and contract R&D.

3.8 THE PILOT STUDY OF THE SIX SMEEs

South Africa has many small and medium-sized companies in the manufacturing sector. Since the fall of apartheid in the early nineties, many people who had been disadvantaged in the past were given the opportunity to start their own enterprises. Young 'previously

disadvantaged' entrepreneurs own most of the companies used in this investigation.

Six SMEEs were selected from a database found on the Department of Trade and Industry's website. The investigation consisted of interviews with the owners of the SMEEs. The owners were contacted for a meeting to discuss aspects of their organisations and particularly the subject of innovation and NPD in their companies. They were sent the interview questions (Appendix 1) before the meeting. Information regarding innovation and NPD in the literature, combined with the results from the interviews, will assist the researcher in formulating a NPDP model with relevance of NPD for SMEEs in the Western Cape.

3.8.1 Analysis of the data from the Six Companies

The answers to the questions per company were coded into the sub sections as per the questionnaire. Comparisons were made between the answers of the companies; similar answers were grouped together and discussed.

The six companies chosen are young companies in the fields of steel and aluminium products, plastic components, conveyor systems, medical equipment etc. Some are also involved with services such as installation, maintenance and consultancy work. Four of the six companies (A-D) were established in the 1990s. Companies E and F were established in the 1980s.

Each of the six small companies have a workforce of between 10 and 20 people who work on the assembly floor, in the workshop or in the tool making room. Although only a few of the staff have a Bachelors degree, they have a lot of technical experience. Most of the workers' skills are transferred through on-the-job training. This is considered to be a very important way of educating workers in all the companies. Motivated

workers with potential are given an opportunity to become apprentices and some of them are sent to complete their education including higher degrees. Most entrepreneurs try to stimulate workers by giving them more responsibility so that the company and the workers benefit mutually. Much time, effort and money are put into developing employees because they are regarded as valuable assets.

Most of the production involves turning, milling, welding and, in the case of company D, the plastic company, injection moulding. Depending on the company's strategy, it could be involved in mass-production, small-batch production or services. Mass producing companies, like company C and D, have automated CNC machines. The small-batch manufacturers, like A, B and E, have manually operated machines. Company F is involved in the mass-production of ladders with all the work being done manually.

Most of the customers are involved with the design of the parts or components that have to be manufactured. They send design drawings or samples of the parts or components that have to be machined. With the exception of company F, the companies have a shared responsibility in the design process. The work is either produce-to-order or design-to-order and some are produce for stock. Even though most of the work is produce to order, the companies take full responsibility for the effectiveness of the production process. Costs, quality and delivery times are the most important competitive advantages and remain the particular company's responsibility.

Companies A, B and E, offer maintenance, installation and repair services together with the products. These companies often have some influence when it comes to 'product' design.

In the short term, the majority of entrepreneurs want to draw new customers, maintain a good cash flow, move to a bigger facility with cheaper rent, and in some cases to change the entrepreneur's role from production manager to general manager with marketing function. If this

happens, a new production manager or a marketing person must be employed and this often poses a threat to the entrepreneur's ideas and innovations.

In the long term all the companies wish to grow in a controlled manner in order to guarantee continuity and job opportunities. All entrepreneurs believe that their companies shouldn't grow too big because having a small scale business ensures that they stay in touch with the business, that have better control, more flexibility and that they have a more efficient problem solving business. They believe that the prerequisite for growth is more effective use of workers through education and training, and increased capacity. In order to increase their capacity, they are considering the purchase of new CNC machines and have immediate plans to develop their own product or production line. Most of them are looking at ways to export to African or European countries. Collaborations with international companies are considered by all entrepreneurs essential for the future. All six entrepreneurs have plans for the innovation of new products and or production processes. Most of them have had some experience in product innovations. Entrepreneurs A, D and E have completed samples of new product innovations. Entrepreneur F has already successfully marketed a new product and is busy with another new product as well as the development of a new ladder-making machine. Entrepreneurs B and C have completed designs of their new products.

Table 3.2: Summary of the 6 SMEEs

Company	Products	Designs	Production	Machinery
A	Future	Customer and Company	Small Batch	Manual
B	Future	Customer and Company	Small Batch	Manual
C	Future	Customer	Mass	Automated

D	Future	Customer	Mass	Automated
E	Future	Customer and Company	Small Batch	Manual
F	Yes	Own	Mass	Manual

3.8.2 Sector Circumstances

The entrants in the SMEE sector are increasing since the barriers to starting-up one's own business have been lowered. No large start-up investments are required, proprietary rights are not very important and legislation stimulates the setting up of businesses. The big barrier is the required bank loan. Banks are still sceptical about granting loans to people who were previously disadvantaged. They also require that people have the necessary technical expertise, the experience to do business and the ability to train others. Companies must also acquire quality standards like ISO, which is very costly. Companies A, B and C have acquired an ISO 9002 certificate. Presently, it is too costly for D and E and in the case of F is not yet a requirement.

3.9 SUMMARY

This chapter reveals that innovation and NPD are key factors in ensuring the success of an SMEE. After an initial literature review there was an investigation into six companies in the form of a meeting with their owners who were asked questions. The results of the questions, as well as subsequent discussion, established the outcome. The general outcome was that the companies firmly believed that innovation and NPD were vital factors for SMEEs not only to remain sustainable but also to grow their profits.

It was interesting to note that only company F had an established product line and all the other companies were at various stages in their product

development plans. They are not willing to co-operate or collaborate with competitors on innovation or on anything else. This is because of bad experiences in the past, together with the fear of losing their business to competitors. The word 'partnership' has a bad undertone in the SMEE-sector. Horizontal or lateral collaboration with companies in a separate international market would be considered. Less threatening forms of external linkage like forums, consortiums and educational institutions were favoured.

The entrepreneurs' awareness of the importance of innovation activities and R&D is generally good. Most of them perceive a distinct difference between production process and product innovation. Their main reasons to innovate are: Firstly growth, so that there is an increase in job creation opportunities, skills and the customer database. Secondly, that they earn a reliable profit in order to ensure the company's continuity. Thirdly, that they want to spread risk over more products or product lines, and finally that some of them want the company to be innovative for future technologies.

One of the glaring shortcomings of this initial investigation was omitting to interview the workers as well. This will be done in the next phase. Other than that, this was a worthwhile exercise in that it showed the importance the six companies attached to innovation and NPD. This chapter is key in that it will inform the development of an innovative new product development practices model for SMEEs.

CHAPTER 4

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

4.1 INTRODUCTION

This chapter presents a very distilled and selective literature review related to the development of an innovative New Product Development Practices (NPDP) model for small and medium engineering enterprises (SMEEs). It also outlines the framework informing this study. In its very selective and hopefully “to the point” form, as presented here, it covers probably most of the aspects required and used by the author to create a NPDP model with a view to assisting SMEEs so that they remain sustainable and viable.

4.2 INNOVATION

Innovation and more importantly an environment where innovation can take place is key to new product development (NPD). There are hundreds of definitions of innovation, and they are mostly true but not always complete. In this study innovation must result in new products that meet customer requirements. Therefore a likely definition for innovation in this study could read, “Innovation is the ability to deliver new value to a customer” because it cannot be innovation until the customer says it is. While most people have traditionally associated innovation with technological advance, in a free market innovation can be as simple as a new way of doing things or a new way to create customer satisfaction. Tidd and Pavit (1998), define innovation as ‘the process of taking new ideas effectively and profitably through to satisfied customers.’

Innovation can be divided into four categories, namely, architectural innovation, market niche innovation, regular innovation and revolutionary innovation (Ettlie, 2000). Architectural innovation defines the configuration of product and process and establishes the technical and marketing

agendas that will guide subsequent development. Market niche innovation opens new market opportunities through the use of existing technology, the effect on production and technical systems being to conserve and strengthen established designs (Lawson 1990). Regular innovation involves change that builds on established technical and production competence and that is applied to existing markets and customers. The effect of these changes is to entrench existing skills and resources. Finally, revolutionary innovation, although it disrupts and renders established production competence obsolete, is applied to existing markets and customers. The choice of the correct type of innovation is crucial as the decisions taken thereafter depend upon it.

Quality is 'doing things better' while innovation is 'doing things differently'. Innovation is considered to be the new way of delivering quality to the customer both consistently and with economic viability in mind. (Zairi, 1994) Both are needed. In the short-term, quality processes can produce incremental innovation that will maintain a firm's leadership position. In the long term, companies need to push ahead relentlessly, always innovating. (Samaha, 1997) The entrepreneur or person involved in ensuring quality can be of great help to the individual responsible for innovation in SMEs. In fact some of the dimensions of total quality management (TQM), such as customer focus, training, empowerment and teamwork, rationality in the analysis of processes and benchmarking can assist in being more innovative. Innovation roles and quality roles can be integrated in one individual, but one must keep in mind that quality is a process that changes dramatically over time, while innovation is more long-term and involves every core process in the organisation, not just the production process. The individual, however, will have to be able to differentiate between the roles and not treat them as a single one. This information will be included in the various aspects of the model.

4.3 FUNDAMENTAL KNOWLEDGE

Fundamental knowledge resides in the people at the company. The success of the business depends on people and their abilities, skills, knowledge and commitment (Baumard, 1999). Fundamental knowledge from outside the company can be acquired through consultation with the relevant people, these people include innovation consultants and customers. Internal knowledge comes from everyone in the organisation including the research and development (R & D) department of the company.

There are several benefits that a market analysis will bring to an organisation that is forward thinking. The organisation will be able to identify new product ideas which can be done by liaising and by questioning customers in order to extract much-needed information from them. Sometimes the customers do not know what they want so it is the responsibility of the company to gather this information and to identify opportunities that are available to serve customers in new and exciting ways. In addition, another advantage of market analysis is the reduction of market uncertainty of new products.

Knowledge is a human, highly personal asset and represents the pool of expertise and efforts of networks and alliances. Knowledge seems invisible but it clearly drives the bottom line. The key value of knowledge is increased when it has a key purpose and focuses on mission, core values and strategic priorities. Knowledge assets, like money or equipment, exist and are worth cultivating in the context of the strategy used to apply it (Blacker, 1995).

Moreover, as the organisation aligns itself to implement changes, everyone must have an opportunity to be involved in planning, decision-making, taking calculated risks, making mistakes without fear of punishment and receiving fair reward and recognition for performance. In forward-looking organisations, the management of such pertinent

knowledge should go beyond knowledge management to idea management (Liebowitz, J. 1999). The long-term survival of any company is dependent on its ability to generate and exploit innovative ideas. These ideas are most valuable when generated and applied by the people from within. The author agrees with the theorists that fundamental knowledge is a key aspect of NPD. It will therefore become part of the model and the questionnaire.

4.4 NEW PRODUCT DEVELOPMENT (NPD)

New product development plays an increasingly important role in determining the success or failure of many new innovations. In addition, increased competitive rivalry is driving companies to commercialize their new products more quickly (Cooper, 1998). To meet these pressures, new strategies are being used to supplement the conventional new product development process that consists of strategy formulation, idea generation, screening and evaluation, development, testing and launch.

Companies need to understand how product requirements evolve across the product lifecycle and the impact that these changes will have on product design, as well as the impact that design changes will have on the product's requirements. This can be achieved by considering the following (Utterback 1994):

- Organisations must understand what the target market and customer base wants in terms of documented expectations, preferences, standards and regulations and capture this information from multi sources as product requirements.
- The linkage of these requirements to fine-grain design elements that can be traced across the product configurations and definitions that describe the product's various lifecycle states.
- Recognition when program constraints are in danger of being violated, when changes to product requirements and design elements occur and what impact design change has on product requirements as well as the impact on product design.

These capabilities make product requirements flow throughout the product development process and operate as a base for decision-support that directly acts upon (Lawson 1990):

- Machine tool design and factory layout decisions
- Man-machine interface or ergonomic decisions
- Upgrade planning and product family management decisions
- Assessing the impact associated with proposed design or product requirement changes
- Evaluating the changes made against actual product models.

SMEs should concentrate on increasing the revenue potential of products while validating new ideas against market opportunities. The products and service innovations will enable the new products to “hit the ground running” and thus stay ahead of their competitors, hence improving the likelihood that customers will buy these products (Parker, 2000). Quality initiatives can be supported where the early definition of quality measures facilitates product developers to “design out” defects and thus improve quality. Product testing, integration and design validation are also supported by decision making to verify product compliance through linking individual requirements into their test and integration processes. This decision- making can also be supported using strategic outsourcing where procurement teams inject component requirements and their related design definitions into automated bid processes (Allen, 1987). Prospective suppliers must fully understand the development needs so that companies can effectively assess potential suppliers in terms of design capabilities, quality and cost considerations.

In business and engineering, **new product development processes**, is the term used to describe the complete process of bringing a new product or service to the market. There are two parallel paths involved in the NPDP. One involves the idea generation, product design, and detail engineering; the other involves market research and marketing analysis. Companies typically see new product development as the first stage in

generating and commercializing new products within the overall strategic process of product life cycle management used to maintain or grow their market share (Tidd et al, 2001). Idea generation is all of those activities and processes that lead to creating broad sets of solutions to consumer problems. These techniques may be used in the early stages of product development to generate initial product concepts, in the intermediate stages for overcoming implementation issues and in the later stages for planning the launch and finally in the post-mortem stage to better understand success and failure in the marketplace.

4.4.1 Strategy Associated with New Development Product Practices

The goals of a company should reflect the nature of the company and they should be realistic. Therefore before developing a strategy for a particular objective, managers should make sure that they understand the context in which they operate and what their position is in the playing field, relative to other players. By employing the strengths, weakness, opportunities and threats (SWOT) technique, a company would be able to audit its capabilities and environment. From this audit the leadership team would be able to address several important questions:

- What are we good at?
- Where are we vulnerable?
- Why have we succeeded in the past?
- Where are our major products in the life cycle?

In essence, this process should enable the company to address the underlying issues such as what business they are in and what their goals are. Once the context and positioning have been established, the company's overall strategy can be developed. From the company's overall strategy, other functional or process strategies such as: strategy encompassing innovation, collaboration, knowledge-generation, total quality management, funding and managing the project can be developed

(Cooper, 1998). In short, NPDP must reflect the mission, overall policy and strategy of the organization.

Four different types of strategies (offensive, defensive, imitators and traditional) exist, each of which requires a different approach, structure and tactics to realize its respective ambition. These can be grouped into two categories (Stamm, 2003):

- Proactive Strategy: This explicitly allocates resources to pre-empt an undesirable future and to achieve goals
- Reactive Strategy: This is based on dealing with the initiating pressures as they occur.

Each strategy is appropriate under certain circumstances. Research has shown that most products do not fail at the end, they fail at the beginning (Zhang & Doll, 2001). This is because the process often lacks direction, focus and purpose. Therefore the real key to product development success lies in the successful performance of the front-end activities (Khurana & Rosenthal, 1998). The benefits resulting from improvement in the front end are likely to far exceed those that result from improvements aimed directly at the design engineering process. Through case studies it has been documented that unclear product strategy is one of the most common problems in NPD (Cooper, 1993). As strategic planning and new product development strategy formulation precede the NPDP, the failure to formulate a clear new product strategy spells disaster for the NPD.

New products and associated technology have an integral bearing on a company's decision to define their range. For many companies, new products have become the leading edge of corporate strategy, opening up new markets and new business opportunities. The companies that are most likely to succeed in the development and launch of new products are those companies that implement a company-specific approach driven by company objectives and a strategy at its core (Cooper, 1993). Literature dictates that new product development is crucial for the sustainability

potential of SMEEs. The model will attempt to create an environment where NPD can take place.

4.5 STRATEGY

Strategy is a very broad term which commonly describes any thinking that looks at the bigger picture. If SMEEs do not have a clear picture of what to do, then success will be impossible to achieve. Strategy is defined as an action plan designed to move an organisation toward achievement of its vision (Ireland et al, 2006). It is a plan that an organization formulates to gain a sustainable advantage over the competition. The vision comprises of at least two components namely a mission and the picture of the organisation as it sees itself in the future. The mission of the organisation would include, but is not limited to, the core information and characteristics necessary for the firm to function. It focuses on the markets it serves and the products (either goods or services) it provides.

Strategic planning is the overall process that facilitates good management and the direction to be taken. It gives clarity regarding the goals an organisation wants to achieve and how to go about achieving them, rather than a plan of action for day-to-day operations. It enables an organisation to be proactive rather than reactive. It takes cognisance of the internal and external dynamics of an organisation. A Strength weaknesses Opportunities and Threats (SWOT) analysis is one tool that is used to explore these dynamics. This tool will point the way to the richest business opportunities that are available to the enterprise. The strategic plan should also identify new skills, methods and tools that are needed and highlight business processes that must be developed or overhauled. Patterson and Fenolio (1999) suggested that the strategic planning process encompasses the following aspects:

- Analysis of markets and customers
- Analysis of competition
- Purpose statement of the business unit
- Required products and services

- Required capability and adjustment
- Long-range objectives, financial analysis, assumptions
- Recommendations and plans for the coming year.

In addition, Rainey (2005) pointed out that competition analysis depends on identifying latent or existing customer needs and wants. It includes examining how competitive products fulfil or fail to meet customer requirements or expectations. It also examines solutions that other entities might offer which could satisfy the customer needs.

The concept of strategy is more complex than it might at first appear and has a number of aspects. The following are some definitions of strategy by different theorists and researchers. Establishing a **strategic direction** for the enterprise and outlining the major steps that it must take to achieve long-term goals is a critically important application of the management knowledge base (Patterson & Fenoglio, 1999). These plans will establish in broad terms the following:

- Which markets the business will pursue
- Which technology investment it will make
- How broadly or narrowly it will focus its new product efforts.

A good **strategic plan** will reflect an in-depth understanding of the shifting business terrain as well as where the competition is both strong and vulnerable. It will point the way to the richest business opportunities that are achievable to the enterprise. The strategic plan should establish the “theatre of operations” for the product family plan that follows.

A strategic plan should identify capabilities that (Patterson & Fenoglio, 1999):

- Are to be developed as core competencies
- Will be acquired through strategic partnerships with other companies
- Will perhaps be eliminated over time

It should also identify new skills, methods and tools that are needed as well as the business processes that must be developed or overhauled. Most successful businesses provide a kind of leadership for their customers, and leadership is largely articulated through a firm's strategic plans. Corporate strategy defines the business in which the company will compete, preferably in a way that focuses resources to convert distinctive advantage into competitive advantage (Campbell & Luchs, 1997).

Strategy is the pattern of major objectives, purposes or goals and essential policies or plans for achieving those goals, stated in such a way so as to define what business the company is in, or is to be in, and the kind of company it is, or is to be (Andrews, 1971). In this definition, strategy is concerned with both purpose and the means by which the purpose will be achieved. It implies that strategy must address the fundamental nature of the business in the future. This suggests that strategy will be sensitive to the values and culture as well as to the business opportunities of the company. It also implies that managers are able to, and responsible for making deliberate choices about the future nature and scope of their business (Macmillan & Tampoe, 2000).

Strategy plays an important role in the choice of innovation. Different strategies require different types of innovations. In general, the basic reasons for any company and especially SMEEs to innovate are (Tidd *et al.* 2001):

- To enter an advanced market position
- To reduce lead times and time-to-market
- To reduce production costs
- To gain an advantage through proprietary rights
- To add new customer value criteria
- To develop a future core competence

Besides these advantages, innovation and especially new product development, in most cases, remains resource intensive, expensive and notoriously risky for SMEEs. The financial aspect is one of the most crucial

aspects in strategic planning because it can lead to over-spending or under-spending by organisations or governments. Hence they fail to achieve their intended goals. Financial analysis includes long-range financial projections, outline of expenditures and long-range budgets for functional areas (Tidd et al., 2001). Budget planning, formulation and implementation take a holistic approach by involving everybody in various departments. Budgeting itself requires considerable effort in ensuring that every activity is catered for before implementation. Poor budgeting can nullify all the innovative efforts of an organisation. At this level, educated guesses are used to forecast expenditure, and people working in various departments provide such information. The departmental budgets among other aspects point to the type of organisational structure of the enterprise.

Communication is the key to successful strategic management (David, 2005). This communication should flow in all directions as managers and employees engage in discussions to map the way forward for the organisation. Understanding is the most important benefit of strategic management, followed by commitment. When managers and employees understand what the organisation is doing and why, they often feel that they are part of the firm and become committed to assisting it. This is especially true when employees also understand the linkages between their own compensation and organisational performance. Managers and employees become surprisingly creative and innovative when they understand and support the firm's mission, objectives, and strategies. A great benefit of strategic management is the opportunity that the process provides to empower individuals. SMEEs will not be able to engage in NPD if they do not have a strategic plan. This is often the downfall of SMEEs because without a plan they do not know where they are going.

4.6 FLAT ORGANISATIONAL STRUCTURE

The **flat organizational structure** is one of the most common. In flat organisations, decisions are made faster, entrepreneurial creativity of employees is released and ideas are managed better. A flat organisational

structure influences most aspects of NPD and information sharing to a greater extent. In developing an Enquiring Culture, there must be free flow of information with little or no distortion. Figure 4.1 below, is the diagram of a typical flat organizational structure.



Figure 4.1: Flat organizational structure

When Zaltman, Duncan and Holbeck summarised the work of Burns and Stalker (1973), they described two types of organisations, mechanistic and organic. Whereas the mechanistic organisation enhances vertical communication, many rules, knowledge and control of tasks are centralised at the top, the organic structure emphasises horizontal communication, few rules and a low hierarchy of authority and control.

If a flat organisation that is managed correctly, and where there is space for workers to contribute and to grow, the following happens:

- There is greater motivation because workers are appreciated for their own skills, values and work and all opinions are treated equally and with respect.
- The workforce is more flexible since they are allowed to learn skills and acquire knowledge beyond their specific job requirements.
- Workers are more creative because management shares information and gives them more opportunities to be creative. In this environment there is room for trying out new ideas without having to worry about mistakes.

- The social interaction and personal communication skills of people will improve.

Organizations are normally structured depending on their objectives and culture. The structure of an organisation determines the manner in which it operates and its performance requirements. Structure allows the responsibilities for different functions and processes to be clearly allocated to different departments and employees. SMEEs are normally single business enterprises managed by a small number of people. Management has the opportunity to have close daily contact with employees in each phase of operations. Employees report directly to the top manager and are empowered to make quick decisions when needed.

An incorrect organisational structure hinders the success of a business. Organisational structures should aim to maximise the efficiency and success of the organisation. An effective organisational structure will facilitate working relationships between various sections of the organisation. It will retain order and command whilst promoting flexibility and creativity. Internal factors such as size, product and skills of the workforce influence the organizational structure. Thus the chains of command and spans of control are not the same for different structures.

There are three major components of a structure in an organisation, namely, complexity, formalisation, and centralisation. The degree of complexity is determined by the number of goals that a company has. A business with only one goal will not be as complex as one with several goals. It's easier for management to communicate one goal instead of many diversifying ones. Hence, one goal in an organisation means that it will not need a high level of management hierarchy. Formalisation refers to the number of rules an organisation has and its reliance on these rules and procedures to direct behaviour. Centralisation enhances the organisational level in which the decision-making is carried out but has limited open communication. Some organisations choose to be highly centralised, which means that most, if not all decisions are made at the

highest level of management. If a problem occurs, the highest level of management will deal with it. In a decentralised organisation, the authority to make decisions is more widely spread to include all levels of management. This means more interaction, more open communication and a less of a dictatorial style of management.

The flat organisational structure is a move away from bureaucratic, hierarchal forms of management toward more flexible, flatter, leaner structures built on networks in which authority and decision-making are decentralized and distributed (Stacey, 2001). It is for this reason that the flat organisational structure is the one for the future and should therefore form part of the model and the questionnaire.

4.7 LEARNING ORGANISATION

A **Learning Organisation** is one in which people at all levels, individually and collectively; continually increase their capacity to produce results about which they really care (Richard Karash 1995). Organisations need to care because the level of performance and improvement needed today requires a great deal of learning. Learning enhances the possibility of achieving extraordinary performance together with satisfaction and fulfilment for the individuals involved. An organisation that learns and encourages learning among its people is a Learning Organisation (LO). It promotes exchange of information between employees hence creating a more knowledgeable workforce. This produces a flexible organisation in which people will accept and adapt to new ideas and changes through a shared vision.

The 'learning organization' has its origins in companies like Shell, where learning was described as the only sustainable competitive advantage (Arie de Geus 2001). It is seen as a response to an increasingly unpredictable and dynamic business environment because it has in place systems, mechanisms and processes that are used to continually enhance

its capabilities. A LO assists those who work for it to achieve sustainable objectives for themselves and the communities in which they participate.

The following are some definitions of LO's by key writers:

- "The essence of organisational learning is the organization's ability to use the amazing mental capacity of all its members to create the kind of processes that will improve its own" (Nancy Dixon, 1994)
- "A Learning Company is an organization that facilitates the learning of all its members and continually transforms itself" (M. Pedler, J. Burgoyne and Tom Boydell, 1991)
- "Organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free and where people are continually learning to learn together" (Peter Senge, 1990)

The important points to note about these definitions are that learning organizations:

- are adaptive to their external environment
- continually enhance their capability to change/adapt
- develop collective as well as individual learning
- use the results of learning to achieve better results.

For the purpose of this study, a Learning Organisation is defined as an organisation that gives the managers and the employees freedom to think and experiment. The employees therefore feel more responsible for their own jobs and therefore they do not feel that they are robots that just get orders and execute them. They have more responsibilities, take their jobs more seriously, and carry out instructions readily.

In a LO the employees and the managers can be more open and honest about their opinions and thoughts concerning their own work and the organisation itself. If they give their opinion about something there will not

be any reprisal. The opinions, values and ideas of the managers and employees are of value to the company so they are taken seriously. This helps to formulate a vision that is shared by everyone within the organisation. There are several key human factors that one derives from the learning organisation and they are discussed below.

4.7.1 Open/Direct Communication

Communication is the transfer of information from one party to the other. In order for the transfer of information to qualify as communication, the recipients must understand the information transferred to them. If the recipient does not understand communication has not taken place. There are several types of communication. Ribbens (2000) defined interpersonal communication as communication between two or more people and involves the transfer of information from one person to another.

The positive impact of **direct communication** methods is enhanced when combined with upward problem-solving techniques. Upward problem-solving alone is associated with poorer performance, suggesting that attempts to tap into worker knowledge and to elicit greater worker effort through employees involved in problem solving, can prove counterproductive if it is not combined with regular two-way communication between management and workers.

Managers can use regular direct two-way communication meetings to explain their plans for problem solving, while workers can use them to convey concerns and alternative approaches. This fosters mutual trust which, through organisational commitment and job satisfaction, has positive effects on a firm's performance. Regular and direct two-way communication leads to:

- Enhanced employee engagement and feeling of corporate connection

- Enhanced exchange and access to information among employees and other stakeholders inside and outside the organisation. Hence more information sharing

SMEEs can benefit from the regular use of **direct communication** methods such as team briefings, which have the potential for two-way communication between management and employees. In small companies, regular communication with decision-takers results in meaningful participation in decision-making and trust-based employee relations.

4.7.2 Information Sharing

Information sharing is a process or practice of creating, sharing and using knowledge, wherever it resides, in order to enhance learning and performance in organizations. Knowledge sharing is the process by which an organisation shares its knowledge and information among employees in order to promote learning and to produce new knowledge or understanding (Burrill & Ledolter, 1999). Information sharing allows businesses to ascertain customer needs accurately and meet those needs rapidly and efficiently which in turn leads to enhancement of customer convenience.

Knowledge sharing and transfer depend on the culture of the organisation. A culture of generating collaborative knowledge encourages people within an organisation to work together and share information. A great deal of what people learn and therefore what the organisation comes to know, is as a result of the interaction among and between team members. Organisations should enable employees with individual talents to network and collaborate with each other in order to produce collective achievements. When a proper communication system is in place **information sharing** between managers and employees becomes easy. This can be fostered by project-oriented tasks as opposed to individual

tasks. When employees work in a team, each member feels a sense of belonging to a particular group. Every member's contribution is valued. The group feeling is that "we are all in this together, and we will succeed or fail, based on the actions of each member of the team". This spirit of togetherness promotes creativity as group members exploit each other's talents and skills for the success of the project. Teamwork is also encouraged when rewards and recognition are based on group and not individual performance. Cross-pollination of ideas at different levels can drastically change the fortunes of the company.

In addition, information sharing should also take place with people from outside the company. It has been mentioned previously that customers, competitors, etc. are a potential source of new ideas. The sharing of information with competitors, for example, may help reduce the time taken to develop and commercialise new products.

4.7.3 Empowerment of Individuals

Empowerment of individuals is essential because of the constant change and learning that characterize today's global business environment. Employees must know that they have the support of management to make empowered decisions. Lashley (1999) suggests that employee empowerment has been hailed as a management technique which can be applied universally across all organizations as a means of dealing with the needs of modern global business. When individuals work in groups and each individual's contribution is valued, they feel empowered. **Empowerment** therefore means to give legal or moral power or authority to people thereby unleashing the human potential and enhancing human ability to nurture societal growth. The basic premise of empowerment is that the process is enhanced, and this is possible only in an environment where an individual can pursue personal growth and share ideas. Thus, empowerment is suspended and embedded in an environment of freedom and open communication. This could lead to **empowered knowledgeable**

workers who can participate more fully in the development of the organization, thereby enhancing the creativity of the organization (King, et al., 2001).

Empowerment is not an external event but an internal one. It is not something that one does to someone, but rather something that individuals decide to do for themselves. For individuals to be empowered through an organization, management must reach new levels of performance by means of participative work practices and the delegation of authority and responsibility. Empowerment is not something one does to people but with people. Therefore there must be a climate of trust at every level of the organization.

For the above to be effective the workplace should provide an environment of productive contentment. By creating such an environment the employees would work hard and be reluctant to leave. This can be achieved by knowledge of what employees require to successfully complete their tasks, creating the right environment, knowing what makes people happy and unhappy, developing a pleasant management style, promoting openness and trust, recognizing contributions, involving families, encouraging team identity and empowering specific employees, by giving them the authority and associated responsibility, to make decisions considered to be in the organization's best interests (David, 2005). It is with an empowerment such as this that NPD activities thrive.

4.7.4 Employee Responsibility

The **responsibility** of the employee can be more accurately defined as the ability of employees to make decisions that affect the outcomes of their jobs. Responsible employees innovate due to increased freedom, satisfaction, and personal accountability. To this end, it is crucial that SMEEs invest in advanced personal development opportunities for their

employees rather than boring, remedial training since this promotes innovation and not merely problem-solving.

Employee responsibility creates a culture of freedom to communicate, share information and knowledge and learn in an organisation of the self-managed. Some companies spend a considerable amount of money on motivational programmes for employees, but the most important source of energy at work remains largely untapped. Companies should concentrate their re-energising initiatives on helping their staff through knowledge transfer and other forms of participation that will improve the company's competitiveness. This knowledge also constructs production processes and controls the direction of innovation.

Financial rewards, such as performance bonuses and an equity stake in the financial results, do encourage people to conserve resources and produce results. However the kind of ownership that really generates energy is not economic, but emotional. It gives people a sense of responsibility and makes them feel that their actions make a difference. Responsible employees take responsibility for their actions. They are willing to go beyond the call of duty as they undertake day-to-day tasks and this leads to double-loop learning.

Thus the key to employee responsibility is the motivation to design work in such a way that it becomes a source of pride for the employee. Job satisfaction resulting from enthusiasm and responsibility are often considered to be a strong determinant of turnover, new ideas and creativity.

4.7.5 Enthusiasm

Enthusiasm is the force that energizes behaviour, gives direction to behaviour and underlies the tendency to persist, even in the face of obstacles. When enthusiasm is high, the employee is be motivated to

enhance his daily responsibilities. It should be taken into consideration that for enthusiasm to be instilled in employees, their physical, physiological and social needs must first be satisfied. Peer-group acceptance with the work force is often an important psychological need for the employee. Once this need is satisfied then the need for self-esteem takes precedence. Organizational factors such as job title, status, office size and level of responsibility become important to the employee. The highest need is self-actualisation where the employee seeks fulfilment through a useful life in the organization and in society. Thus employees seek challenges and creative jobs to achieve self-actualization. If any of the needs are not fulfilled the individual will continue to strive to fill that need, that is, the need becomes a motivation factor and this can be fulfilled outside the organization as well as within.

For an employee to be **enthusiastic**, joy must be found in whatever is being done. Poor working environments, such as lack of proper light and ventilation, unsafe plant and equipment can kill the morale and enthusiasm of employees hence they become dissatisfied. Herzberg *et al.* (1959) proposed a motivation-hygiene theory. He concluded that factors such as company policy, supervision, interpersonal relations, working conditions and salary are hygiene factors rather than motivators. According to the theory, the absence of hygiene factors can create job dissatisfaction, but their presence does not motivate or create satisfaction. On the other hand, motivators are those elements that enrich a person's job. Five factors that are strong determiners of job satisfaction are achievement, recognition, the work itself, responsibility and advancement. A successful incentive program will not only increase profits but also can raise morale and inspire staff loyalty. It is easy for employees who are enthusiastic to seek information that will eventually enable the company to succeed with NPD. The human factors are all necessary for successful NPD. Elements of these factors should therefore appear in the model and the questionnaire.

4.7.6 Morale

Morale comes from those special feelings shared with others of trust, usefulness, purpose, team loyalty and support, pride in own achievements and those of the group, faith in the organization's leadership and in the organization's ultimate success. High morale inspires people to be self-sacrificing and courageous, to go way beyond what is normally expected, to take extraordinary responsibility for their own work, and to be totally dedicated to the work of the team. Morale is closely related to teamwork and confidence in the leadership. It can be concluded that morale is the result of empowerment, through information sharing which in turn is due to the communication processes that result in teamwork that manifests itself in employee enthusiasm and commitment.

Enthusiasm is defined as the energy, the fuel, the blazing fire that brings about a successful result. A famous writer once said that nothing great ever happened without enthusiasm. He continued to say that if you want to accomplish great things, if you want to realize great goals, if you want to live a great life, you absolutely must possess enthusiasm for everything you. Two people with virtually the same amount of skill and talent can differ vastly in the amount of success they achieve, because of the level of enthusiasm. This simply means that the more enthusiastic one is, the greater the results. Enthusiasm is thus directly connected to morale. It makes a person want to do something but it depends on the level of accumulation. Enthusiasm and morale bring about confidence as does morale. It is an individual decision that one must make and of course will impact on other people in the group. Teamwork will never work if one member is not enthusiastic or if one's morale is down (Slecta R, 2009).

Webster (2006) views enthusiasm as people supporting each other by respecting what each person brings to the team as they harness each other. Enthusiasm is characterized by the following: communicating effectively with clear concise communication that will guarantee forward movement both individually and collectively; collaborating on how people

plan to work together to ensure cohesiveness; having fun and celebrating milestones also encourages and enhances enthusiasm in the workplace.

Commitment normally becomes visible when employees are enthusiastic and motivated to work hard. It normally happens when employees are enjoying what they are doing. That drive is caused by their inner peace which is closely linked with morale. It simply means that commitment is a by-product of morale or, in other words, no morale no commitment. According to Mowday, Porter and Steers (1982) organizations view commitment as a designed attribute, which means that every organisation has a way of determining commitment by the way their employees behave. Commitment at all times depends on the employees' well being at a given time. When employees are disappointed about something in the workplace it affects their output. That is why Werner, (1994) suggests that employee commitment is seen in on the job behaviour. Meyer, Paunanen, Gellatly, Goffin and Jackson (1989) supported this by saying that commitment is more visible when performance and participation are considered. Mowday *et al.* (1982) also added that absenteeism of employees is a function of commitment. Commitment can not be separated from communication, trust and teamwork. Commitment is more dependent on a state of mind that has to do with the morale of the employee. Commitment is directly proportional to the positive input and commitment of management to all the aspects of team building. Teamwork in this case is seen as the foundation of all activities.

4.8 CUSTOMER REQUIREMENTS

The **customer** is defined as the receiver of an output of a process, either internal or external to an organization or corporate unit. Burrill *et al.* (1999) defines **customer requirements** as a written statement of what the supplier thinks the customer wants. A customer could be a person, a department or a company. Customer requirements therefore refer to the needs of the customer. According to Burrill and Ledolter (1999), **customer requirements** are a written statement of what the supplier thinks the

customer wants. The process of converting customer wants into customer requirements is called 'specification' or sometimes 'analyses. Researchers and practitioners have identified many cases in which a customer's ideas and needs were unfulfilled because of the ineffectiveness of communicating what the true requirements were or the difficulty in translating the customer's needs into requirement form.

Meeting customer requirements is a significant phase in a new product development process across SMEEs. However, it is difficult to satisfy customers' requirements. (Ulwick 2003) says... "many managers believe they do a good job capturing their customers' requirements. In reality, they do not, and their failure to do so is preventing them from managing innovation as a key business process". In addition, current research has shown that more than fifty percent of all product introductions fail because they do not meet customer requirements. Ulwick (2003) further reported that the root cause of many failed product and service initiatives falls squarely on the manager's inability to capture customer inputs, development and marketing needs and thus successfully manage innovation. It was also found that managers, when collecting customer inputs, tend to capture four types of information namely: solutions, design specifications, customer needs and customer benefit statements. Technically, these are customer requirements. However, such types of input are not needed to successfully create new products and services or transform innovation into a manageable business process.

Internally, every next step in a certain process is the "customer" of the previous process. This internal customer focus stimulates communication and cohesion of all phases of the process. Externally, it is the customers who eventually buy the product or consume the services. The development towards being a customer-orientated company can be seen as a process in itself. The process starts with the establishment of a customer focus internally within departments or sections of the company and results in the development of a final product the customer requires.

Companies that have successfully established internal customer focus, share the following characteristics:

- The customer is considered in everything the company does.
- Continuous identification and elimination of the customers' problems results in a continuous improvement all the products and processes.
- The usage of customer information, e.g. customer feedback is communicated to the ones who can do something about it. They are given any necessary training and resources to do so.

Most organisations need effective solutions that will enable their products to meet customer needs. As a result, to evaluate customer requirements they start product research and development programs that cross multiple disciplines, organisational boundaries and geographical borders. These researched requirements enable customers to determine how to address costs, quality, schedule, performance and constraints that come out during product development. They further allow the customers to determine the best time in arriving at the best product design, manufacturing solution or serviceable product. Considering these requirements could lead to a quantifiable way of determining the quantities of product content which then establishes the end points of product life cycle.

Since strategy development encompasses the creation of a vision, selection of a mission, setting of goals, and development of a strategic plan, all the initiatives discussed must be geared toward fulfilling customer requirements. An enterprise that keeps its customer satisfied will survive because there will always be a market for its products. No NPD is successful if it does not meet customer requirements. It is therefore necessary to include it in the model and the questionnaire.

4.9 AWARENESS OF EXTERNAL ENVIRONMENT

It is essential that companies are aware of the **external environment** so that they are always able to give their customers the best products as well

as know what they are up against. (Choo and Auster 1993) reported that organisations examine the environment in order to understand the external forces of change so that they may develop effective responses that will secure or improve their position in the future. The environment is examined in order to avoid surprises, identify threats and opportunities and gain competitive advantage, as well as improve long term and short term planning. Organisations can only adapt to the external environment once the external changes that are taking place are known and interpreted. Scanning of the environment includes both viewing and searching for information. This could range from a casual conversation at the lunch table or an observation of an angry customer to a formal market research programme or a scenario planning exercise.

4.9.1 Information Scanning

Choo (2001) explained that scanning or browsing behaviour is influenced by external factors such as environmental turbulence and resource dependency. Organisational factors like the nature of the business, the strategy pursued, information factors such as the availability and quality of information, and personal factors such as the scanner's organisational knowledge or cognitive style are important. Thus, many research studies on scanning investigate the effect of situational dimensions, organizational strategies, information needs and personal traits on scanning behaviour (Figure 4.2).

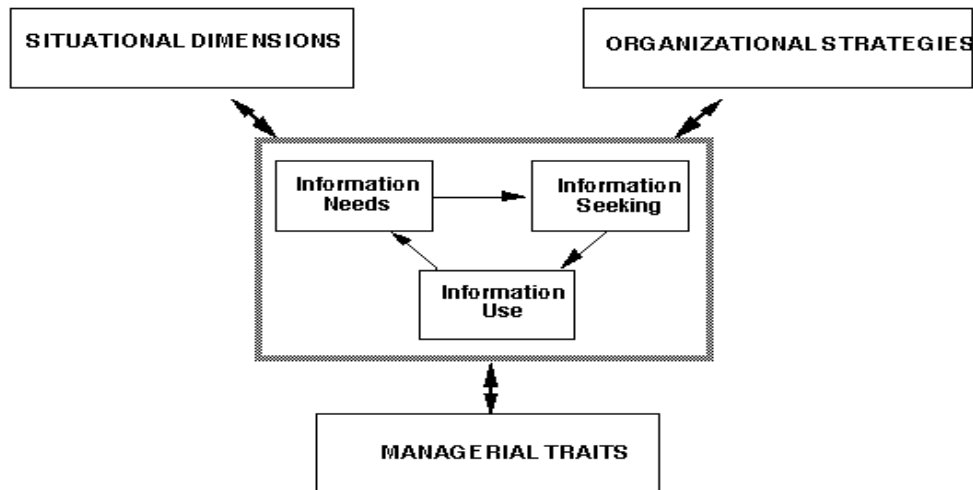


Figure 4.2: Information Management for the Intelligent Organization.

Source: Choo (2001: 86)

Situational dimensions are often examined by measuring the perceived uncertainty of the external environment, typically in terms of the complexity and the rate of change of the environment. Managers who perceive the environment to be uncertain tend to scan more. Environmental uncertainty is indicated by the complexity, dynamism, and importance of the sectors inside the **external environment**.

Organisational strategies refer to the pattern of organisational actions vis-à-vis the outside environment. An organisation's overall strategy is related to the sophisticated scope of its scanning activities. Scanning of the environment must be able to provide information and information processing required for developing and pursuing the elected strategy.

Managerial traits incorporate these parameters such as manager's functional speciality, hierarchical level and cognitive style. Upper level managers seem to scan more than lower level managers while functional managers scan beyond the limits of their specialisations. Scanning as a form of information behaviour is composed of needs, information seeking and information use.

In the context of environmental scanning, information needs often refer to the focus and scope of scanning, particularly the environmental sectors where scanning is more intense. Business organisations focus their scanning on market related sectors such as customers, competitors, suppliers, technology, social, political and economic conditions of the environment.

Information seeking is examined in terms of the sources that are used to scan the environment as well as the organisational methods and systems deployed to monitor the environment. Managers prefer to scan using personal sources to formal, impersonal sources, especially when seeking information about developments in the fluid, market related sectors. Further, organisations prefer to scan using a variety of modes, depending on the organisation's size, dependence and perception of the environment, experience with scanning and planning, and the industry that the organisation is in.

Finally, information use is usually looked at in relation to decision making and strategic planning reduction. Information from environmental scanning is used to drive the strategic planning process. Research suggests that effective scanning and planning are linked to improved organisational learning and performance (Aguilar, 1967, Choo & Auster, 1993).

The exploration of new-product opportunities requires an extensive study of external business conditions and trends including understanding market needs and wants, and stakeholder expectations. It also requires a thorough assessment of the internal strengths and weaknesses with respect to the existing product portfolio and capabilities. Many NPD opportunities originate from customers and markets that have difficulties with existing products or have needs that are not being addressed. Customers want solutions to their problems. They seek better value from the products and services they buy. Therefore, it is essential that customers and market-related forces play pivotal roles in identifying the opportunities for new products. Solving the defects of an existing product

presents an opportunity to create a new one for SMEEs. Like customer requirements, NPD is a failure if it does not take into account the external environment. This will also form part of the model and the questionnaire.

4.10 IDEA GENERATION

Idea generation is everyone's job and no one's responsibility. According to Cooper (1993), the first step in setting up an idea generating system is to assign one person the responsibility of stimulating, generating and receiving new product ideas. This person identifies the sources of ideas both inside and outside the company and then sets about establishing flow lines or mechanisms to generate or solicit ideas from these sources. Further responsibilities of this person are to move an idea through the screening process and provide feedback to the originator of the idea to encourage further submissions.

Idea generation includes activities and processes that lead to creating broad sets of solutions to consumer problems, which in turn results from an awareness of the external environment. According to (Wikipedia 2006), **idea generation** is defined as: "Ideas for new products can be obtained from customers employing user innovation, the company's research and development (R&D) department, competitors, focus groups, employees, salespeople, corporate spies, trade shows or through a policy of open innovation". Ethnographic discovery methods, which mean searching for user patterns and habits, may also be used to get an insight into new product lines or product features. Formal idea generation techniques can be used, such as attribute listing, forced relationships, brainstorming, morphological analysis and problem analysis.

Idea generation is the process of finding and articulating new ideas that may lead to new products or services. Idea generation is, in reality, a much specialized extension of the market research process. It has become a unique subset of market research due to the nature of its intent, namely, to generate specific new product ideas that can later be screened

for all the factors that determine whether or not the new product will succeed in the market (Ribbens, 2000). According to Rainey (2005), idea generation represents the genesis of the NPD process. The idea generation phase is the formal starting point of the NPD process where ideas are identified, assessed, evaluated, ranked and screened. New-product ideas are obtained from every facet of the business and the organization.

Companies use a variety of processes to choose the products they will develop in the future. In smaller companies, where resources are scarce, this selection process is usually less formal. Larger companies usually have the resources to formalize this process but are easily bogged down by bureaucracy. Despite these hurdles, all technology companies must understand the role and value of new product ideas in their future (Cooper, 1993).

Possible sources of new ideas are both internal and external. Internal sources include research and engineering, production, sales, marketing and planning, and a board of directors, to mention a few. External sources include customers, research organisations and consultants, technical publications, competitors, universities, inventors, unsolicited sources, advertising agencies and suppliers. Customers represent a huge and often untapped potential source of ideas. An organisation can use many ways of soliciting information from the customers. For example, undertaking group discussions with customers and identifying the problems customers are facing with the organisation's products, setting up customer panels that meet regularly, customer surveys and working with lead users of the organisation's products.

Competitors also represent another source of new product ideas. The objective is not to copy competitors but to gain ideas for new and improved products from them. Carrying out a competitor analysis is important if an organisation intends to gain competitive advantage. Rainey (2005) mentions that it is critical to have a profile of the competitors and an

understanding of their expected actions and responses to any NPD initiative.

The management of information obtained from all these various sources is of importance if an organisation is to benefit from NPD initiatives. Many companies develop their own products internally, with input from workers, customers, suppliers, and outside consultants. Some companies choose to obtain new technology through mergers with, and acquisitions of other companies. If generation of ideas that are beneficial to the firm is to occur, the exercise must be conscious of the external environment and what the competitors are doing. The needs of the customer are usually complex and therefore there should be careful planning to meet these needs. If careful planning is not done then some products may not last long on the market. If there are no ideas, there will not be any new products. The poor management of ideas will also lead too few or incorrect products. These are the reasons why idea generation should be an integral part of the model and therefore the questionnaire.

4.11 INFORMATION CHANNELS AND NETWORKS

An “information channel” is any data stream provided by, used by or exchanged between network applications (Muzur, 1994). On the other hand, (Afuah 1998) defines information channels as the sources to which a firm turns for ideas. Important information must be communicated to all the stakeholders in a manner that is easy and efficient. There are many possible delivery channels that can be used to provide information or news.

Information channels and networks get knowledge to people timeously, whilst connecting people across boundaries. This has made it easier for companies to gather, assimilate and evaluate information. This is a widening range of global services and information resources. Within a company, well-tuned information channels and networks can enhance the

company's collective knowledge and sharpen its ability to act on what people know in time to be effective (Dickson & Hadjimanolis, 1998). This kind of network is critical to an organization.

Information channels and networks grow from the personal interactions of people over time, as well as from the technological infrastructure that connects them. This means that growing a successful online network requires social know-how as well as technical expertise. Interactions include those that take place face-to-face, via telephone, online, and even via items we send each other in the post. Thoughtfully planned and knowledgeable implementation of information channels and networks can enable an organization to (Biemens 1992):

- Create an early warning system.
- Ensure knowledge reaches people who can act on it in time.
- Connect people and build relationships across the organization.
- Provide an ongoing context for knowledge exchange that can be far more effective than memoranda.
- Create a community memory for group deliberation and brainstorming that stimulates the capture of ideas and facilitates finding information when it is needed.
- Amplify innovation, this is when groups get turned on by what they can do online, they go beyond problem-solving and start inventing together

Nobody is an expert on everything at the beginning, so we must rely on the expertise of others. But getting the right answer in time is not easy. First, you need to know "who knows who knows what" in order to ask the question. When your network includes hundreds of people who have a productive relationship with the online social network you share and feel favourably inclined to answer questions within the network and this means that your ability to get questions answered quickly multiplies exponentially (Ettlie, 2000).

As has been mentioned before, the responsibility of generating new ideas lies not only with R & D but with everyone in the organisation. This internal information is usually not enough if the firm is to remain on the competitive edge, hence it has to turn to the outside world. The acquisition of pertinent information may be in the form of formal or informal networks. Formal networking must be encouraged which may be with universities, consultants and competitors to mention a few. Informal networking with peers, inside and outside their own company, helps to benchmark personal efforts and their company's competitiveness. One can therefore not separate the sources of information and the generation of new ideas. The challenge of SMEEs in the developing countries is the establishment of such strong networks with the external world. One way of promoting these networks is through subcontracting external R & D service providers to work with the internal R & D department. One of the reasons for the failure of SMEEs is that they are so interested in reaping early benefits, which is not always the case. On the other hand, those with whom they enter into partnership with need to benefit from the collaboration. According to Tidd et al (2001), companies should consider alliance partners with complementary technology, products or markets. Since SMEEs often lack fundamental knowledge capacity, it is important for them have information channels and networks and will therefore be included in the model and the questionnaire.

4.12 THEORY OF ACTION

This theory was developed by Argyris and Schön (1974) and describes the learning process of organisations. They define an organisation as a collection of individuals who act according to the 'theory of action', which means every individual acts on a cognitive basis that is reflected in notions, norms and strategies. Changes in values, behaviour, leadership and assistance to others are all part of, and informed by, the individual's theory of action. The theories of action of individuals differ and are not static. Individuals try to change their theory of action according to the

theory used by the whole. The actual practice of the organisation is dependent on the theory of action of the individuals.

4.12.1 Learning Systems

Organisational learning occurs when employees experience a problem and inquire into it on the organisation's behalf. This experience is a mismatch between the expected and actual result of their action, which triggers a process of thought. It leads them to modify their images of the organisation and change their activities in order to bring expectations and outcomes into line. It is possible to investigate and measure organisational learning if one knows and understands the way that people jointly construct their theory of action in an organisation. For organisational learning to occur, discoveries, inventions and evaluations must be embedded in the organisational memory. If this is not encoded in the images that individuals have and the views they construct with others, only an individual will have learnt and not the organisation.

Argyris and Schön (1974) distinguish three types of learning systems.

4.12.2 Single-Loop learning

This is the detection and correction of deviations that can be achieved without changing underlying strategy values or company goals and by continuing with the company policy in place. The values of the theory of action are therefore unchanged. At times this is also called instrumental learning. For example, quality control inspectors who identify a defective product may pass that information on to the production engineers who, in turn, may change production methods to correct the defect. This single-loop, initiated by the organisational inquiry, connects the detected error to organisational strategies of action and their underlying assumptions. These strategies or assumptions are changed to keep organisational

performance within a range which is set by existing organisational values and norms. The values and norms could, for example, be product quality that does not change and therefore the theory of action does not change.

Single-loop learning is sufficient when deviations can be detected and corrected by changing organisational strategies and assumptions within a constant framework of values and norms for performance. However, in some cases double-loop learning is required because the correction of error requires inquiry through which organisational values and norms themselves are modified.

4.12.3 Double-Loop learning

When an inquiry leads to the conclusion that the reality and the organisational theory of action do not match, **double-loop learning** is required. The detection and correction of deviations, accompanied by change in the organisation's underlying norms, values, strategy and policy, is called double-loop learning. In this process, the theory of action itself is questioned. This entails a shift in the way in which strategies and consequences are framed. In double loop learning, assumptions underlying current views are questioned and the hypotheses about behaviour are tested through interaction.

Argyris (1976) proposes the **double-loop learning** theory which pertains to learning to change underlying values and assumptions. The focus of the theory is on solving problems that are complex and ill structured and which change as problem-solving advances. Double-loop theory is based upon a "theory of action" perspective outlined by (Argyris & Schon 1974). This perspective examines reality from the point of view of human beings as actors. Changes in values, behaviour, leadership, and assistance to others, are all part of, and informed by, the actors' theory of action. An important aspect of the theory is the distinction between an individual's espoused theory and the "theory-in-use". Bringing these two into

congruence is a primary concern of double-loop learning. Typically, interaction with others is necessary to identify the conflict. The end result of double-loop learning should be increased effectiveness in decision-making and better acceptance of failures and mistakes. Double loop learning requires learning situations in which participants can examine and experiment with their theories of action.

4.12.4 Deutero-Learning

A third form of learning, Deutero-learning, enhances 'learning to learn'. The members of an organisation must discover and modify the learning system in place. Evaluating the learning system may lead to information, which can be used to develop, use and evaluate new learning strategies.

4.12.5 Transformation from Single-Loop to Double-Loop Learning

This is an important aspect for SMEEs, especially since they are often under staffed. Argyris and Schön (1974) state that invention, production and generalisation are necessary to transform a cycle of discovery. This means that the starting point of transformation is to understand the learning system already in place. Members of the organisation need to know their existing behavioural patterns in order to develop new learning behaviours. Therefore, new learning behaviour takes place when the double-loop and Deutero learning system is practised. In this process, intervention is often required to unfreeze the existing learning system and theory of action. This is done before training the organisation's members' double-loop learning principles. This intervention, often carried out by a consultant, is required to break the 'resistance to change' of the members of the organisation. This intervention consists of six phases (Argyris and Schön 1974) namely:

- Phase 1: **Mapping the problem:** to describe and define the learning system in place.
- Phase 2: **Internalisation:** the consultant helps the organisational members to learn about and accept this learning system.
- Phase 3: **Testing the model:** by working with the learning system; let members look at practices and history to see if predictions stand up. A reflection is thus being made of the learning system and its constraints surface.
- Phase 4: **Invention:** invent solutions of the constraints found in phase three.
- Phase 5: **Production:** developing the new learning system
- Phase 6: **Generalisation:** correction of errors as well as generating knowledge for the future will eventually lead to a usable learning system.

For this process to succeed, maximise the participation of clients, minimise the risks of candid participation, start where people want to begin (often with instrumental problems) and design methods so that everybody values rationality and honesty.

For NPD companies, gaining knowledge about the customer requirements is essential. Embedded in the theory of action of the members of an NPD organisation is that innovation is essential to fulfil customer's expectations. All other aspects of the theory of action are placed in this light. Within this theory of action it is accepted that existing rules, norms, strategy and policy are continuously subject to change, which implies **double-loop learning**. This theory of action does not develop overnight. In this process, intervention through training, meetings and information sessions are very important. Within NPD there are concepts that are strongly related with higher forms of organisational learning (double-loop). The organisational structure of an NPD organisation can stimulate the learning process because it emphasises cross-functional interaction and does not have much attention for vertical hierarchies that can hamper the interaction required for **double-loop learning**.

As soon as innovation is structurally embedded within the organisational processes and becomes a second nature of the employee, the possibility of Deutero learning arises. (Van Leeuwen and Waszink, 1990) Employees get to understand through training and experience, their learning behaviour so that in time, the continuous improvement process can be improved.

4.13 QUALITY

Quality is a concept that many authors have endeavoured to define. Every one has their own concept of quality but the concept changes from person to person. Often, quality is used when something is 'good'. For example a person may say that a stereo is of very good quality. This often means the sound; functions and shape of the stereo are appreciated. (Garvin 1991) tried to grasp these quality descriptions into five major categories:

- **Transcendent:** Quality is understood only after exposure to it, e.g. the quality of an artist becomes only apparent when one sees the work or show. Quality cannot be defined; and you recognise it only when you see it.
- **Product-based:** Quality is based on the absence or presence of particular attributes. Higher quality means more of the desirable attributes are present in the product. Quality is precise and can be measured, according to the amount of attributes of the product.
- **Manufacturing-based:** Quality is defined as a product or service's conformance to a set of predetermined requirements or specifications. This approach assumes that a specification is a valid guide and description of a customer's requirements and, if met, will satisfy the customer. Here, quality is preliminary focussed internally at 'doing it right the first time'.
- **User-based:** The criteria of quality lies in the ability to satisfy customer requirements, expectations and needs. Quality depends on the customer and is therefore relative and subjective.

- **Value-based:** This implies that a product or service is offered at a fair and reasonable price. Quality is defined in terms of price and costs.

Quality must be a fundamental long-term goal of the organization. It should be viewed as strategy to increase sales, reduce costs and help secure jobs for employees. Quality management is the improvement achieved by the change in focus from merely inspecting and removing defective products from the end of a production run, to preventing defective products from being produced in the first instance. One of the aims of this study is to develop a tool that assists individual SMEEs to improve their competitive advantage by increasing their employee involvement with the improvement of processes. It will introduce SMEE management to these techniques as well as changing their focus and the focus of the enterprise concerned towards this vital aspect of production in a competitive global economy.

This means that the different perceptions of quality and that the term quality, when used, must be defined in order to establish its actual meaning in context. Burrill (1999), defined quality in an organization as being based on the quality improvement effort of the organization. Some key concepts of this are as follows:

- Quality is directed at customer satisfaction.
- Quality means “meets requirements”.
- Quality is simply delivering what was promised.
- Quality requires change in an organization’s culture and must become part of the organization’s culture and a principle in all operations.
- Quality requires top management leadership. If top management is not solidly behind a quality initiative, it will not happen. Quality improvement requires top management’s time and effort, it cannot be delegated. As quality improvement means reshaping the corporate culture, everyone in the organization needs constant

reassurance that management is a hundred percent behind the effort.

- Quality is everybody's job. To satisfy customers, it is necessary to produce quality products in all operations, namely: requirements, design, advertising, marketing, manufacturing, servicing, personnel, and finance to mention a few. Each individual is responsible for the quality of the work he/she produces.

4.13.1 Total Quality Management

The American term TQM was initially developed by the Naval Air Systems Command in 1985 to describe its Japanese-style management approach to quality improvement (Summers, 1997). Since the introduction of TQM by the Navy, the term has been widely used by other, mostly western, companies. At this point, various meanings and definitions of TQM evolved.

In the USA, the quality-emphasis remained on reducing the costs of manufacturing operations and complying with company designed specifications (e.g. fewer product defects), which resembles Garvin's manufacturing-based quality. For example, General Motors lost considerable market share in the 1980s because the goal of achieving low manufacturing operating costs overruled analysing customer requirements. As globalisation hit the economy and Japanese products actually entered the US markets, the difference became clear. Confronted with this enormous Japanese success and fierce competition in the 70s and 80s the US' focussed it's attention on quality. (Deming and Juran, 2003), (Goldratt 2003), (Crosby and Feigenbaum 2005) have made great contributions to the elevation of quality processes in the US.

In reality both quality and innovation go hand in hand. Adopting a TQM approach ensures that a company can more easily assimilate innovations due to the willingness of the employees to accept new ideas. This is as a

result of the continuous improvement ethos. A highly skilled, involved crew is always better to implement innovation, because such workers are usually capable of understanding and accepting new systems of operating.

4.14 INQUIRING CULTURE

Organisational culture is defined in various ways. One of the most common definitions may be found in the saying “the way we do things around here” (Lundy & Cowling, 1996). The components of routine behaviour, norms, values, philosophy, rules of the game, as well as feelings all form part of organisational culture (Hellriegel *et al.*, 1998; Smit & Cronje, 1992). This organisational culture plays an essential role in an organisation. A strong culture provides shared values and ensures that everyone in the organisation is on the same track (Robbins, 1996). The role that organisational culture plays in an organisation can be divided into the functions of organisational culture and the influence that organisational culture has on the different processes in the organization (Martins & Terblanche, 2003).

As groups evolve over time, they face two basic challenges namely, integrating individuals into an effective whole and adapting effectively to the external environment in order to survive. As groups find solutions to these problems over time, they engage in a kind of collective learning that creates the set of shared assumptions and beliefs we call "culture". Because culture is so deeply rooted in an organization's history and collective experience, working to change it requires a major investment of time and resources. Help from a change agent outside the system is often advisable. Without such help, it is difficult for insiders to view their "reality" as something that they have constructed, and to see meaning in things they normally take for granted. In general, culture is often considered important by both large and small business.

This research hopes to indicate that organisational cultures which value inquiry, creativity and technical ability, and which involve their people, are more successful at adopting innovations.

4.14.1 Creativity and Inquiry

Being innovative and creative is the responsibility of the whole workforce and allows SMEEs to adapt to changes in the state of the market, technology and competition efficiently.

Adults learn best from each other by reflecting on how they are addressing problems, questioning assumptions and receiving feedback from their team and from their results. To create a shared vision large numbers of people within an organization must draft it themselves, empowering them to create a single image of the future. All members of the organization must understand, share and contribute to the vision for it to become a reality. The mental model of people is the way they react and think about different issues, situations and behaviour. Some people say that individuals will act to the true mental model that they subconsciously hold, not according to the theories which they claim to believe. The team members can challenge each other's ideas constructively in order to get another point of view on the case. They are, in fact, gradually creating a shared mental model for the team without being aware of it.

4.15 CONTINUOUS PROCESS IMPROVEMENT (CPI)

Originally, the concept of continuous improvement was brought to Japan from the US after World War II to assist in the reconstruction of Japanese industry (Schroeder & Robinson, 1991). Continuous improvement refers to programs and initiatives that emphasize incremental improvement in work processes and outputs over an open-ended period of time (Davenport & Beers, 1995). Enthusiasm and empowerment are the vital tools required to take the organization to the next level of CPI implementation.

The Japanese word Ky'zen, introduced by Masaaki Imai (1990), literally means improvement. It is a collection of quality concepts that have been used for decades by Japanese companies. Imai defines Kaizen as improvement. Moreover, Kaizen means continuing improvement in personal life, home life, social life and working life. When applied to the workplace, Kaizen means continuing improvement involving everyone, managers and workers alike, in a gradual and orderly fashion.



Figure 4.3: Ky'zen

Another, shorter version of this definition is given by Van Leeuwen, Waszink (1993): 'Kaizen is continuous improvement in which every employee is involved'. In these definitions the 'P' of process is not explicitly mentioned, and will be explained later at the 'Kaizen concepts'.

Kaizen is both a philosophy and a strategy. In Japan, improvement is seen as an overall accepted necessity to survive in an international world economy. It is not just a tool used in the working life but has a much deeper philosophical meaning. (Imai 1990) states, "in Japan change is part of everyday life. According to the Kaizen philosophy, our way of living deserves to be continuously improved". Kaizen is based on the belief that everyone desires quality and inner value. Everybody deserves to, and should be willing to improve themselves continually for the better.

Besides being a philosophy, Kaizen is also a strategy, because it contains aspects that affect a company's long-term goals and performance. It is a strategy of sustained continuous improvement focusing on eliminating

waste throughout the whole organization. One single management tool cannot do this alone. Kaizen therefore consists of many practices of which examples are shown below:

- Total Quality Management (TQM) activities
- Product Development, e.g. Quality Function Deployment (QFD)
- Business Process Improvement (BPI)
- Just-In-Time (JIT)
- Iihikawa's Quality Control Circles (QCC-circle)
- Quality Control
- Total Productive Maintenance (TPM)
- Policy Deployment
- 5S
- Kanban
- Shingo's Poka Yoke (or mistake proofing)
- SMED (or quick change)
- Suggestion Systems
- Team Deployment
- Automation

These practices, ironically, contain many concepts developed by Americans like Deming and Juran (2003). To fully describe all these practices is beyond the scope of this study, but it becomes clear that Kaizen is not a 'one-size-fits-all' clearly defined problem approach. The practises used for continuous improvement differ from company to company.

Imai (1993) prefers to use the term 'improvement' to 'quality'. Imai claims that improvement in a company is always useful and will automatically lead to improvements in the field of quality and productivity. In the broadest sense quality involves 'something that can be improved'. This means quality is not only related to products or services but also to the way people work, how machines are handled and the way in which a company deals with procedures and systems. Therefore quality, which

means improvement in all fields, contains all aspects of human behaviour. Kaizen sets improvement not profits, as the company's primary goal.

4.16 GENERATING COLLABORATIVE KNOWLEDGE

According to Tidd et al (2001), companies collaborate for a number of reasons, namely to:

- reduce the cost of technological development or market entry
- reduce the risk of development or market entry
- achieve scale of economies in production
- reduce the time taken to develop and commercialise new products.

For ease of analysis the rationale for collaboration is categorised into technological, market and organisational motives. Technological reasons include the cost, time and complexity of development. There is increasing recognition that one company's peripheral technologies are usually another's core activities and hence it is logical to source such technologies outside, rather than incurring the risks, costs and timescale associated with in-house development. Many products incorporate an increasing range of technologies as they evolve, for example, automobiles now include much computing hardware and software to monitor and control the engine, transmission, brakes and, in some cases, suspension. Therefore most R & D and product managers now recognise that no company, however large, can continue to survive as a technological island. Two factors need to be taken into account when faced with the decision of whether to 'make or buy' technology; they are the transaction costs and strategic implications.

4.17 THEORETICAL FRAMEWORK

If NPD becomes a company's strategy and it implements continuous improvement, it can lead to the transformation of a firm to double-loop learning (Van Leeuwen and Waszink, 1990). There are some conditions to make this transformation successful. If employees are supported by an

organisation culture that values learning, they are capable of constructing a new, shared meaning that will transform a company. For this learning culture to be developed, a firm must not only have a relatively flat organisational structure with enough employee responsibility, it must also have a supportive management style and open communication. Tools such as structured interaction and collaborative knowledge generation, strategy, information systems and networks are also necessary for this transformation to take place.

Innovation is the process of creating product and service solutions that deliver customers new and additional value. Organisational managers must be able to devise solutions that better satisfy the criteria customers use to measure value in order to perfect the innovation process. According to Ulwick (2003), customers measure value of the product or service based on the following criteria:

- Its ability to help them perform one or more jobs
- The degree to which their desired outcomes are met when using the product to perform those jobs
- The degree to which their constraints are overcome to perform those jobs in required circumstances

4.18 CONCLUSION

This chapter, together with Chapters Two and Three attempted to cover the theory required to develop or design a NPDP model for SMEEs. The theory and knowledge gained in this chapter will be used in Chapter Six when the model is presented. Chapters 2, 3 and 4 have provided the platform to develop a NPDP model for SMEEs.

Innovation, obviously the key to NPDP, is always a difficult issue to address because it includes new ways of making processes and designs more efficient and effective and must also meet customer requirements. This often entails doing things differently and is often unknown to the

company or the individuals. All companies are constantly busy looking at ways to do things better. Some have students or outside consultants who help them on issues like Quality Processes, Management Approaches, Inventory Control or acquiring new machines. SMEEs find it particularly difficult because they have to deal with staff shortage and a lack of skilled workers and are therefore not able to share information, create open communication channels and empower their workers. This normally results in workers lacking enthusiasm and low morale.

There are some conditions that make this transformation successful. If employees are supported by a firm's culture that values learning, they are capable of constructing a new shared meaning that will transform a company. For this learning culture to be developed a firm must not only have a relatively flat organisational structure with enough employee responsibility, it must also have a supportive management style with open communication. Tools such as structured interaction and information systems are also necessary for this transformation to take place.

Poor quality, low productivity and high human and economic costs are all factors contributing to the challenges SMEEs now face. The purpose of the study is to determine if, and to what extent, the implementation of a NPDP model can positively impact SMEEs. It is hoped that the findings of the study will provide new insights into how SMEEs activities can be effectively managed by utilizing the principles of CPI to create an innovative working environment that results in fewer SMEEs failing.

The theoretical model is meant as a tool for SMEEs to create an environment where they can be innovative and improve their sustainability potential. Questions based on the theoretical model will be drawn up to take to SMEEs in order to answer the research questions.

CHAPTER 5

RESEARCH METHODOLOGY

5.1 INTRODUCTION

This chapter outlines the research methodology used to answer the following critical research questions for this study:

- Why is an inquiring culture, knowledge generation, and continuous process improvement needed for SMEEs to remain sustainable
- Which are the NPDP that are required for SMEEs to remain sustainable?
- How can SMEEs measure their “sustainability potential”?

This is a multiple case study that aims *to develop and validate a diagnostic New Product Development Practices (NPDP) Model for the sustainability of Small Medium Engineering Enterprises (SMEEs)*. The research topic was informed by the reality that there are many SMEEs with potential for sustainability which are not fulfilling their mandate. This reality became apparent to the researcher while placing engineering students for their in-service training at engineering companies. The owners of these companies would often seek assistance for designs, factory layouts and skilled personnel. After the topic of NPDP was identified and an initial literature review had been undertaken, a pilot study was initiated to establish lines of enquiry for the study. The pilot study investigated six SMEEs to establish whether NPDP was necessary for SMEEs to remain sustainable and grow. These SMEEs were found in the Department of Trade and Industry’s SMME database, as discussed in section 5.2.5

All the research questions were developed around real problems and crucial issues within the SMEE sector and were coupled to theory.

This chapter is divided into four main sections:

- Justification for the Paradigm and Methodology
- Data Acquisition Plan
- Data Analysis
- Ethical Considerations and Validity

5.2 JUSTIFICATION FOR THE PARADIGM AND METHODOLOGY

This study is located paradigmatically within a pragmatic framework that is not committed to any one system or philosophy. Early pragmatists “rejected the scientific notion that social inquiry was able to access the ‘truth’ about the real world solely by virtue of a single scientific method” (Mertens, 2005). The pragmatist paradigm or mixed method research places “the research problem” as central and applies all approaches to understanding the problem (Creswell, 2003). In this study the research question is ‘central’, with data collection and methods of analysis chosen as those most likely to provide insights into the question with no philosophical loyalty to any alternate paradigm. Such is the case in this study, as some of the outcomes of the research are located paradigmatically within the interpretive framework, which sees reality as subjective and constructed. Studies within this paradigm seek to understand the world and hence, in this study, the world of SMEE practices. Other outcomes of this research are located paradigmatically within the positivist framework, namely the categorising of the companies and the validation of a diagnostic model.

The pragmatic paradigm allowed the researcher to combine qualitative and quantitative methods. This is commonly referred to as the “mixed methods” approach (Greene, 1989). While pragmatism is seen as the paradigm that provides the underlying philosophical framework for mixed-methods researchers (Tashakkori & Teddlie, 2003; Somekh & Lewin, 2005) some mixed-method research aligns philosophically with the transformative paradigm. Transformative researchers “believe that inquiry

needs to be intertwined with politics and a political agenda” (Creswell, 2003) and contain an action agenda for reform “that may change the lives of the participants, the institutions in which individuals work or live, and the researchers life” (Creswell, 2003). This study, as mentioned before, is situated in the pragmatic paradigm which enabled the researcher to use methods that suit the study, in order to achieve the results. While there are many debates about the use of qualitative versus quantitative methods (Trochim, 2006), both methods were chosen here as they complement each other. Qualitative methods like interviews, observation and document analysis were used in the data gathering process, while a mixture of quantitative and qualitative methods were used to analyse the data, as described in section 5.4.

5.2.1 Case Study Approach

This work investigated eighteen SMEEs. The advantage of building an understanding from multiple case studies includes the possibility of generating new in-depth insights through data of various kinds and from various sources. The case studies were used to gain a multi-layered impression of the SMEE sector. Yin (1984) defines case study research methodology as an empirical inquiry that investigates a contemporary phenomenon within its real-life context, when the boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence are used. In this work the phenomenon is NPDP and the real-life context is that of SMEEs. The practices in these companies are real life ones and it is for this reason that the case study approach was chosen.

Case studies are complex because they involve multiple sources of data, which may include multiple cases within a study and produce large amounts of data for analysis. Case studies are used to build upon theory, to produce new theory, to explore situations, or to describe an object or phenomenon. This work conforms to this methodology since it aims to

describe NPDP leading to the sustainability potential of SMEEs. The advantages of case study methodology are its applicability to real-life, contemporary, human situations and public accessibility through written reports. Case study results relate directly to the reader's everyday experience and facilitate an understanding of complex real-life situations. It is true of this study that companies vary in terms of their NPDP, human capital, infrastructure requirements, production systems and types of products, to name a few. This work caters for a wide range of complex real-life situations and therefore the case study methodology is applicable.

After analysing various methodologies such as phenomenology, ethnography and grounded theory, the multiple case study methodology was chosen because it offered an option to evaluate the SMEEs and to gain a better understanding of the complexities of this work. The choice of case study methodology was thus strongly tied to the research questions, its aims and the fact that it lends itself to the discussion of themes, issues and implications.

5.2.2 Interpretive Paradigm

Interpretive views originate from different disciplines such as sociology and anthropology. The paradigm is known for its critique of positivism in the social sciences. Angen (2000) offers some criteria for undertaking research from an interpretivist perspective:

- Careful consideration and articulation of the research question
- Carrying out inquiry in a respectful manner
- Validity located in the “discourse of the research community”
- Ethical validity, i.e. recognition that the choices we make through the research process have political and ethical consequences
- Substantive validity, i.e. evaluating the substance or content of an interpretive work

The purpose of interpretive research is to understand and interpret reasons for social action and to discover the meaning systems used to make sense of the world. The assumption is that reality is not objective but subjective. The strengths of this perspective are that it uses flexible procedures to collect descriptive data and present respondent's views and experiences in their own words (Sarantakos, 1988). The reason for using features from this paradigm is because the study requires flexible data collection procedures to ensure that the researcher is able to understand the responses, and make sure that the respondent understands the questions. This meant that the researcher could explore and get the respondent's descriptive data in his/her own words.

5.2.3 Positivist Paradigm

The positivist paradigm of exploring social reality is based on the philosophical ideas of French philosopher August Comte, who emphasised observation and reason as a means of understanding human behaviour. According to him, true knowledge is based on the experience of the senses and can be obtained by observation and experiment. Positivistic thinkers adopt his scientific method as a means of knowledge generation. Hence it has to be understood within the framework of the principles and assumptions of science. These assumptions, as Conen *et al* (2000) noted, are determinism, empiricism, parsimony and generality. Some of the assumptions in this paradigm are:

- Problems can be defined in advance.
- The complexity of social situations can be reduced to a number of variables which are clearly operationalised.
- There is a reliance on controlled experimentation.
- Events can be explained in terms of cause and effect.
- There is one 'right' interpretation.

The researcher used features of the positivist paradigm to evaluate the companies' responses with that of the model so that they could be put in

various categories. The validation of the model also forms part of this paradigm since the researcher made use of a cause and effect scenario.

5.2.4 Mixed Method Approach

Mixed method research employs quantitative and qualitative methods or techniques in the same study. It adds an attractive alternative to qualitative or quantitative research because both approaches have strengths that could be combined. It is an effective way of creating alternatives to traditional or more monolithic ways of conceiving research. It is a strategy of integrating different components of the research paradigms in a cohesive way. Rather than a “cookbook” from which you choose the best recipe, it is a way of structuring a study in order to address a defined set of research questions (Trochim and Land, 1982). Studies using the mixed-method approach have shown that integration of these traditions within the same study can be seen as complementary to each other (Greene and Caracelli, 1979; Caracelli and Greene, 1997).

The mixed-method research has its critics. Howe (1988) asserts that qualitative and quantitative research approaches, including their associated methods, cannot and should not be mixed. Guba, a leading qualitative purist clearly represents the purist position when he contends that “accommodation between paradigms is impossible, we are led to vastly, disparate and totally antithetical ends” (Guba, 1990). Other theorists, such as Greene et al (1989) have a different view and highlight five major purposes for using a mixed method design. These are:

1. **Triangulation** tests the consistency of findings obtained through different instruments. In the present study the three instruments used were interviews, observation and document analysis.
2. **Complementarity** clarifies and illustrates results from one method with the results of another method. In the present study, qualitative responses from the interview method were coded as per the

questions and the themes. These responses were then scored and quantitatively analysed in order to categorise the SMEEs.

3. **Development** results from one method shaping subsequent methods or steps in the research process. In the present study, the qualitatively sourced data was coded and then used to score and categorise the companies quantitatively.
4. **Initiation** stimulates new research questions or challenges results obtained through one method. The data and results from the pilot study (the initial six interviewed companies) initiated the actual study by establishing the lines of enquiry.
5. **Expansion** provides richness and detail to the study exploring specific features of each method. In the present study, using the mixed method approach assisted the categorising of the companies into a typology, and therefore allowing the researcher to make clear comparisons regarding the processes and practices in a company and its sustainability potential.

5.2.5 Pilot Study

After an initial literature survey, the researcher planned an investigation to establish the relevance and importance of innovation and NPDP, as well as the problems encountered at SMEEs regarding their NPDP. This investigation was done at six SMEEs in the Western Cape.

Questions (Appendix 1) were formulated to examine what NPD actually is, why it is important, through what means ideas can be obtained, how collaboration can play a part in NPD and what factors and problems are of importance when being involved with NPDP. These questions were derived from theory, the conceptual framework of the study and the researcher's experience. Meetings were arranged with the SMEEs and the data from the interview questions, as well as subsequent discussions, established the importance these companies attach to producing their own products.

The data revealed an awareness of the importance of innovative activities among SMEE owners. Most of them distinguished between production process and product innovation. Their main reason for innovation was company growth so that there would be an increase in job creation opportunities, enhancement of worker skills and an increase in their customer database. Other reasons offered were reliable or regular reasonable profits to ensure the company's continuity, spreading risk over more products or product lines, and innovation for future technologies.

The general outcome of the pilot study was that innovation and NPDP affecting NPD were vital factors for SMEEs, not only to remain sustainable but also to grow their profits. The information collected from the companies, together with the more specific information on NPDP in the literature, were a springboard for this work. A full description of the pilot study has been detailed in chapter 3.

5.2.6 The NPDP Model Development

The NPDP model, fully explicated in chapter 6, was developed based on the literature review and the data arising from the Pilot Study described in chapter 3. The model was used as a methodological tool in this work. All the questions for the first phase interviews were developed from the model (Appendix 2). The analysis of the responses from the eighteen companies enabled the author to categorise them in terms of the degree of their conformance to the NPDP model.

5.2.7 Research Design

The unit of analysis in this work was NPDP which lead to an innovative space for NPD for the 18 SMEEs participating in this study. The focus of this work was on the role that the NPDP model could play in predicting the

sustainability of SMEEs. The author was an outsider to all the SMEEs that participated in this work, with no formal links to any of the companies. The author's first contact with the companies was to negotiate with the owners, or managing directors their participation for research purposes.

All the companies were contacted telephonically and invited to participate in the research process. The researcher explained the purpose of the study, queried what sources of data they had available and established their key contact information. Since the data to be collected and examined included organisational documents, the researcher stated his intent to request copies of these documents, and plans for storage, classification and retrieval of these items, as well as the interview data.

The 18 SMEEs were one of two types of company, both good candidates for this research. They were companies which produced their own products and companies which produced products on behalf of other organisations. The companies represented a strongly regional perspective, but a national and international perspective was also sought.

Fourteen of the companies were based in the Western Cape region, two in KwaZulu Natal, one in the Eastern Cape and one in the US. Twelve of the companies had their own product lines and the others were at various stages in their new product development programs. The six companies used for the pilot investigation formed part of the fourteen from the Western Cape.

At the outset of this study, thirty-six companies listed in the trade and industry SMEE database conformed to the types required for the study, namely companies which produced their own products and companies who produced products on behalf of other organisations. All of these companies were approached as potential participants in the study. Twenty companies were not interested in participating in the study, while sixteen companies (fourteen from the Western Cape and two from KwaZulu Natal) agreed to participate. A further company in the US was approached

through a collaborative project at Cape Peninsula University of Technology. This was to provide an international perspective. The final organisation, from the Eastern Cape, was approached through the technology stations network. This company, together with the two from KwaZulu Natal, afforded the study a national perspective.

Three sources of data were considered for this work, namely company documents, researcher observations and the data collected from in-depth interviews with key personnel at each organization. The study included interviewees from different departments and hierarchical levels in order to provide a useful foundation for identifying shared beliefs, as well as inconsistencies; this is what Anderson (Anderson et al. 1994) calls democratic validity.

Qualitative research, which is used in this study, is seldom concerned with issues of generalisation as a way of externally validating a study. What is of greater concern in externally validating qualitative studies is the notion of 'transferability'. According to Lincoln and Guba (1995), a researcher achieves transferability through 'thick description' where the researcher provides rich, contextual detail. In this study rich contextual detail was provided for each of the SMEEs in the data set.

In an effort to achieve theoretical validity, sampling was not applied in the data acquisition, which requires the researcher to compare a large quantity of data from many different participants. This also builds the credibility of the data, what Lincoln and Guba (1985) refer to as 'referential adequacy' or a well-developed data corpus. Towards these ends, all SMEEs in the Western Cape involved in product development and listed on the Department of Trade and Industry's SMEE database were invited to contribute to the research study. Eligible SMEEs in the Western Cape (thirty-six) were invited but only fourteen agreed to participate. The fourteen participants together with the four participants from outside the Western Cape gave their informed consent to the study after the researcher completed and signed a confidentiality clause (Appendix 2).

The clause assures them of confidentiality and protection of their anonymity. Both confidentiality and anonymity were important ethical considerations in this study as the participants are private companies and the data could pose a threat to trade secrets.

The same 18 SMEEs were used for the two phases of data acquisition. The first phase of data acquisition was to establish the SMEEs conformance to the model and the second phase of data acquisition was to establish the growth factors and hence the sustainability potential of these SMEEs so that the model could be validated. The growth factor of the companies was determined by responses relating to turnover, infrastructure growth, employee growth and new product development. This will be discussed fully in section 5.4.3 on data analysis.

Reliability is a measure of the extent to which data can be considered consistent and stable and, as such, it is also an indicator of whether or not the repetition of a study will produce the same results (Remenyi et al., 1998). This view of reliability is not appropriate for this study which relied primarily on interview data from human beings who socially construct their own values, norms, and aspirations. This affected the way they interpreted and answered the questions. Some issues in this study, such as the company's growth factors, were regarded as sensitive. One way of increasing reliability was to create an interview setting in which the interviewee felt comfortable to speak freely. This was dealt with by giving a guarantee of anonymity and the fact that the interviewees had an opportunity to read all the material before it was presented publicly.

Another critical issue was the fact that the researcher's interpretation of the respondents' answers may induce bias. To reduce this, interpretations and results were presented and discussed with the respondents before they approved the responses. This is referred to in the literature as "member checks" (Lincoln and Guba, 1985). This interactive approach can be regarded as a process of sense-making in which the researcher and

respondents participate, in order to arrive at an increased understanding of the phenomena being investigated.

Finally, the triangulation of the three methods, interviewing, observation and the survey of documentation formed a key part of the validation process (Section 5.5)

5.3 DATA ACQUISITION PLAN

Three data collection methods were employed in this study, namely observation by the researcher, document analysis and in-depth, semi-structured, open-ended interviews conducted with key members of each organization. These were considered the best instruments to establish detailed responses from the respondents as they allowed the researcher to probe more deeply, thus eliminating any ambiguity. This ensured triangulation of methods and sources which increased the validity of the data.

In response to the research questions of this study, a NPDP model (figure 6.4 in Chapter 6) for successful SMEEs was derived from the key aspects arising from a comprehensive literature review and information from the pilot study (Chapter 3).

This model, fully explained in chapter 6, was used to shape the data collection instruments and later as a tool for data analysis, since the model represents the ideal status of a SMEE. In order to categorise the companies, it was necessary to establish their conformance in terms of the NPDP model.

The interview questions (Appendix 2), although open-ended, were semi-structured around the research questions and the NPDP of the model in phase one and around sustainability potential in phase two as defined at the start of the study. This was done in order to find answers to the

research questions as well as to map each of the companies against an ideal status as depicted in the model.

5.3.1 Interviews

The interview method was the primary source of generating data for this study. The reason the researcher chose to use semi-structured interviews was to ensure that the same areas of information were collected in order to categorise the companies in terms of conformance with the NPDP model. It provides more focus than the narrative interview method yet allows one the freedom and adaptability in getting the information from the interviewee. The value of open-ended interviews is that they allow for detailed responses from the respondents and for the researcher to probe more deeply thus permitting one to build up a “thick description” of the case. The author used follow-up telephonic interviews when it was necessary to verify information after the initial interview.

Although interviews are time consuming, the process is particularly useful for getting the story behind a participant’s experiences. The interviewer can pursue in-depth information around a topic (McNamara, 1999). It allows the interviewer to probe responses in a way that a questionnaire or survey cannot. The interview seeks to describe the meaning of central themes in the life world of the subjects and in this case the subjects are the companies (Kvale, 1996). It is easy for the interviewer to seek reasons for answers as well as follow up on issues that may be raised during the interview. The method also yields a better response rate than questionnaires. With regard to this study, one of the key factors why the author chose this method was because of the ease with which one can adapt to differing situations, as was the case here, because the companies in the study are managed differently and they have varied NPDP.

The disadvantages of the interview method must also be recognised. It can be a very costly exercise if there is a lot of travel involved. Often one needs to visit a site more than once. This happens when companies do not cancel or postpone appointments ahead of time. Another disadvantage is the amount of time it takes to prepare for, conduct the interviews and to analyse the responses. One needs to be very careful when preparing the interviews because poorly constructed questions make it difficult for the researcher to analyse the data. A further disadvantage is one of subjectivity. It is very important to ensure that procedures are put in place to avoid researcher subjectivity. This was addressed in that the researcher asked the same questions, even though open ended, to all respondents. Another factor that addressed the issue of subjectivity was the fact that the researcher had declared up front that the model was a tool to analyse the data.

The interviews were guided by a schedule to ensure that there was uniformity and consistency. The interview schedule was informed by the pilot study. In addition, observations were recorded when the researcher was taken on a tour of the facilities at the companies and company documents were also surveyed. This will be fully discussed in the following two sections of this chapter.

The researcher arranged to visit the companies to interview the owners, senior persons in the company and employees selected by the owner. In some cases the owners brought in people they saw fit to answer some of the questions. In most cases there was more than one interviewee. This was an important part of the process because it ensured that the data were valid and reliable. One important criterion of validity, in using a method that includes participation, is that the process takes place in a community of inquiry, which is capable of effective communication and self-reflection (Reason, 1993). Permission to audio record the process was also requested and granted in all cases. After the interview the researcher asked the group to contact him if there was any further information that had not been discussed at the meeting.

During the interviews the researcher took written notes, and made an audio recording of all interviews which provided an important back-up for the written notes. All audio-tapes were transcribed verbatim and the transcriptions, together with the written notes, provided the text for analysis. This will be more fully discussed in section 5.4 of this chapter.

The first phase interview questions were developed from the NPDP model which was informed by the literature review and the pilot study. This phase addressed the first two research questions in 5.1. The second phase interview questions were developed from growth and sustainability factors found in the literature review which addressed the third research question in 5.1.

In the first phase all the participants were interviewed over a period of three months. The interviews over this period of time were an important part of the iterative data production process. Although this was a very labour intensive task for the researcher, the timeframe allowed for ideas and emerging constructs from each interview to be coded systematically and consistently. In the first phase each of the 18 interviews lasted between two to four hours. The interviews in the second phase lasted about an hour for each of the 18 companies, with each interview having a similar structure. During the first part of the interview the researcher verified the telephonic arrangement. In all cases a tour of the facility showing the infrastructure growth was planned.

In the first phase, the researcher rescheduled follow-up interviews with the companies where there were unclear comments. The international company was contacted telephonically and by email and the researcher spent one week at the company. The researcher coded and entered the entire data set into a database. This will be discussed more fully in the data analysis section of this chapter.

The second round of interviews was arranged (in the same manner as the first set of interviews) in order to establish the “health” of the company in

terms of turnover, employee growth, increased product development and infrastructure expansion. These data were analysed and companies were categorised according to their “growth factor”. A company in category A has a high conformance to the model and is therefore deemed to have a high potential of sustainability. It is expected that a company in category A would show a healthy “growth factor”. Companies were very reluctant to divulge written financial documents and were prepared to offer only verbal figures, in most cases these were percentage increases or decreases of their turnover and product development costs. The companies did not have a problem giving details of their infrastructure growth, employee growth and the number of new products since the last interview. It was easy to verify this information when the researcher again toured the facilities.

5.3.2 Observation

Observations were recorded as field notes after the interviews had been conducted. This took place during a tour through the premises and, where possible, a tour to the various departments, the workshop and the dispatch area. Where it was not possible to visit the departments the researcher requested a tour of the manufacturing facility. Certain companies allowed the researcher to verify the responses to the interview by putting the same questions to other workers in various departments. The researcher made field notes and recorded observations and impressions as well as lines of enquiry that assisted in the interpretation of the data from the interview. The author also made field notes on the practices observed while touring the SMEEs. This information provided a secondary set of data against which the author was able to verify many of the responses from the interviews. These data were also coded and entered into a database.

5.3.3 Documentation Analysis

When the arrangements for the study were confirmed the researcher asked for copies of the company's brochures and written material describing its goals and, where possible, a list of products. All available documentation was surveyed and analysed. The purpose of the survey and analysis of the company documentation was threefold:

- To have a sense of the company's strategic goals
- To have an idea of the company's product range
- To have an idea of the company's structure

The analysis of the documentation enabled an understanding of what the company was about and where it was heading, and contributed significantly in the acquisition of the deep, rich data required to address the research questions of this work.

5.4 DATA ANALYSIS

The choice of data analysis acquisition is as crucial to the quality of a research study as the data production techniques. A range of options is available to the researcher. Freeman (1996) presents us with a continuum of categories ranging from a priori analysis, through guided analysis and negotiated analysis to grounded analysis. A priori analysis refers to categories of data analysis that are determined before the process of data acquisition commences. Guided analysis refers to categories of data analysis that are determined in advance and which guide the analysis, but are modified through interaction with the data as the process of analysis unfolds. In a negotiated analysis the process is developed by the researcher in conjunction with input from the research participants. In grounded analysis, it emerges from the data with a priori expectation on the part of the researcher at a minimum. It can be argued that the grounded analysis end of the continuum is never completely grounded, as

the researcher is never innocent in the data acquisition process, having designed the research process in a particular way.

Although the author would argue that the first round of data analysis in this study was closer to the a priori-analysis-end of the continuum, it has to be acknowledged that certain choices in the data acquisition phase, such as how the model was developed could sway it slightly to the guided analysis. The model was developed from the literature review and the pilot study and was therefore not an existing model. One could also argue that the model was influenced by the pilot study that included participants of the final study and this gives it a guided flavour. The fact that the questions were developed from the model and the pilot study before the data collection puts it into the a priori category. This is one of the advantages of the pragmatic paradigm in that one does not have to choose either, as a combination is acceptable.

The second round of data analysis in this study was a priori in that the “growth factors” were pre-determined and therefore the questions were pre-determined. The second round of data analysis sought to validate the model by examining each company’s performance or “growth factor” to its potential for sustainability. For example, a company with an A classification would be expected to show a healthy “growth factor”.

5.4.1 Analytical Framework

Within-case analysis is the technique used with each of the SMEEs in the study. The researcher studied each organization’s documentation, the field notes and interview’s response data as a separate case to identify unique patterns within each company. Detailed responses from the interview were written for each organization in order to determine within-group similarities and differences (Appendix 4). “Due to the voluminous nature of the raw data contained within Appendix 3, 4 and 5, the data which are

formally documented, will under separate cover be kept for inspection at the Faculty of Engineering and the Built Environment, UCT.

5.4.2 Analysis of Company's Classification

This section presents the results of the analysis of responses to the interview across companies. The aim was to establish the status of the company relative to the ideal status presented in the model. The responses of all the companies per question are found in appendix 3, and the individual responses in appendix 4. The responses were all treated equally with a positive response counting 1 and zero for a negative response. These responses were put into a spreadsheet (table 7.1) for interpretation. The spreadsheet indicates each company's negative responses to the questions in the various categories. The number of positive responses to the questions as well as the number of positive responses to category 8 indicates the status of the company. Category 8 establishes the development of an innovative space at the companies. The innovative space is the outcome of the processes and practices in the model. This innovative space creates a conducive environment for NPD and is fully discussed in chapter 6. The number of positive responses relates to conformance with practices expected by the model.

The responses place the 18 companies into one of 5 categories namely A, B, C, D or E. The criteria for these categories are defined in 7.3. The results of the analysis of every company's responses to the interview questions were used to compare the companies relative to the ideal company's status represented in the model. Companies were then categorised depending on the score achieved relative to the model.

5.4.3 Growth Analysis

A second round of interviews was arranged to establish the sustainable growth factor of the companies in order to validate their predicted

sustainability potential in terms of the model. In this phase, pertinent questions were posed, aimed at establishing the status of the company in the market place in terms of growth and hence sustainability. The growth factor of the companies was determined by the responses from questions relating to Turnover, Infrastructure Growth, Product Development and Employee Growth. The responses to the questions were categorised as positive, no change or negative. The responses were weighted as follows, positive 2 points, no change 1 point and negative 0 points.

The responses from each company's questions in terms of their growth factors are found in appendix 5. The responses were categorised and put into a spreadsheet (Table 8.2) for interpretation. The spreadsheet indicates each company's responses to the questions from the interview and the field notes gained from observations taken during the tour.

The validity and credibility of the data analysis were further ensured through a process described as 'member checks' by Lincoln and Guba (1985). This was achieved by sharing the first round of data analysis with the data sources for validation, during the second round of interviews.

5.4.4 Comparative Analysis

The purpose of the comparative analysis was to compare the results of the individual company's score, obtained through the analysis of the "growth factor questionnaire", as to what is expected from its potential for sustainability that occurred at the time of the initial data collection phase (interviews, company documents and observations). The disparity if any is explained in terms of the path that the company may have taken subsequent to its original classification.

5.5 ETHICAL CONSIDERATIONS AND VALIDITY

Ethical consideration was dealt with at the start of the interview process. The ethical agreement is found at the start of the interview questions (Appendix 2) and the researcher signed the agreement before commencing with the data acquisition process. It must be noted that ethical considerations and validity are discussed only briefly in this section because they are discussed throughout the chapter and in the various research procedures. In an effort to build internal validity and ensure the credibility of the findings, the data gathering plan triangulated the data in three ways: method, source and form. This triangulation is summarised in the table below:

Table 5.1: Ethical Considerations and Validity Data Set

METHOD	SOURCE	FORM
In-depth interviews using semi-structured open ended questions	Researcher, all consenting companies.	Audio tapes, verbatim transcripts
Company observation usually a tour of the facility after the interview	Researcher, all consenting companies	Observation notes, photographs, responses from workers.
Survey of documentation to create an understanding of the company	Researcher, all consenting companies	Planning documents, brochures , list of products

The verification of unclear information in follow-up interviews established external validity. External validity is defined as the establishment of domains in which findings are true (Yin, 1994).

5.6 CONCLUSION

Critics of the case study methodology believe that the study of a small number of cases fairly often offers no grounds for establishing reliability or generalisation of findings. Generalisation means that the results can be used for others instances. Others feel that the intense exposure to study of the case biases the findings. Some dismiss case study research as being useful only as an exploratory tool. Yet researchers continue to use the case study research methodology with success in carefully planned and crafted studies of real-life situations, issues and problems.

This chapter has discussed the pragmatic and other forms of paradigm, case study methodology and the development of the interview questions relative to the SMEE's new product development practices model. The identification of the research context, the selection of the case studies and the data collection and analysis procedure were described. The validity and reliability of the data were also addressed.

The data produced in this study provide information to validate a model that can be used to inform SMEEs of their probable sustainability.

The following chapter describes the key aspects of the NPDP model used in this study.

CHAPTER 6

THE DEVELOPMENT OF THE MODEL

6.1 INTRODUCTION

This Chapter presents the research process of the thesis. A model for benchmarking the success of small and medium enterprises was developed, based on information of the sector circumstances in Chapter 2, the responses to the empirical study of the six SMEEs in Chapter 3 and initial and follow-up literature reviews found in Chapters 3 and 4 (Fig. 4). The benchmarking model which will be called the “New Product Development Practices” (NPDP) is a practice made up of different processes within the various elements as well as the connections of the elements. One such connection is managing the Innovative Space found in section 6.4.2.

New Product Development Practices Model (NPDP)

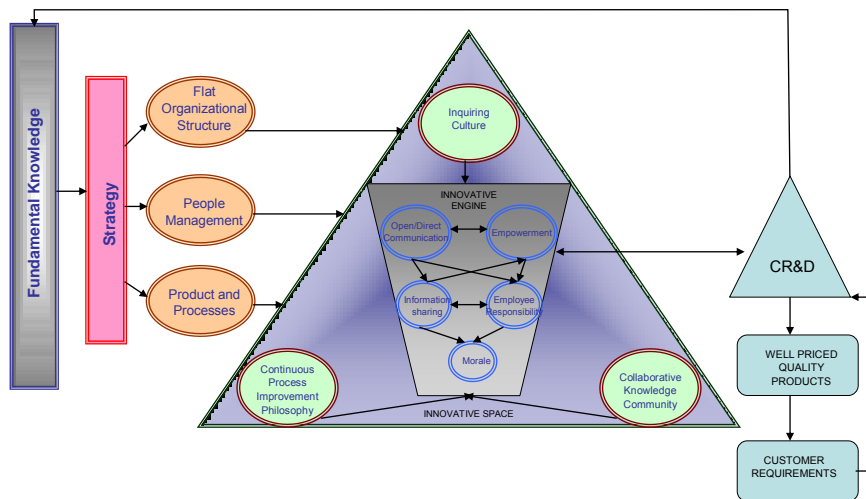


Figure 6.1: New Product Development Practices Model

The model comprises a pillar, namely Fundamental Knowledge (FK), a hub called the Innovative Engine (IE), an environment called the

Innovative Space (IS) and eight components namely, Strategy, Flat Organisational Structure (FOS), Customer Requirements (CR), Collaborative Research and Development (CR&D), People's Management PM, Products and Processes (PP) and Well Priced Quality Products (WPQP). The implementation of the model in SMEEs generates the practices required for product development. These practices may vary in each of the elements or connections of the model but it is the collective that enables SMEEs to manufacture products and remain sustainable. All these areas will be discussed in this chapter.

The pillar consists of **fundamental knowledge** on which the business strategy is developed thus shaping the company's structure, personnel management, products and processes. This is followed by the hub (IE) which operates in an environment (IS) created by a culture of inquiry and a philosophy of continuous process improvement, both enhanced and assisted by a collaborative knowledge community. In essence the hub deals with intra employee relations regarding their empowerment and morale by devolving responsibility to shop level through open and direct communication and the sharing of information. Employees should be a factor at the core of the strategy for achieving the company's goals.

The mechanics of the NPDP model are as follows: There are three articulation routes that enter the IS from FK. All three articulation routes starting from FK, are connected to the company's strategy and then through to the three drivers of the IS, namely, a FOS, PM and PP. The innovative engine drives the Collaborative Research and Development (CR&D) and this produces reasonably priced quality products meeting customer requirements. It is only when this is complete that there is an opportunity for sustainable product development. The NPDP model's FK pillar and the components with their elements are well defined in the literature and are therefore not unique. What is unique in the NPDP model is what happens within the model, the links, as well as the creation of the **Innovative Engine** or hub which resides in the **Innovative Space**. The

section deals with how the IS forms an environment that is conducive for product development possibilities in SMEEs.

It is proposed here that when IC, a CPIP and the CKC are integrated they, in fact, create the IS which is the fundamental component in the framework required for best practices in small and medium engineering enterprises.

6.2 INNOVATIVE ENGINE (IE)

The IE is the area where everyone in the organization is involved. This is a term defined by the author in the context of this research. There are no distinct definitions of an IE in the literature. Angel (2006) describes an innovative culture as the action of “sharing of ideas in a team”, “holding annual innovation boot camps,” “using measurement to change behaviour” and “making front-line supervisors better coaches of their teams.” This is helpful but does not meet the full description required. In this model the hub is situated in an IS. The IE may not be dysfunctional and cannot operate outside of this space.

The IE, being the hub of the proposed NPDP model, is comprised of five inter linked elements namely, open and direct communication, employee responsibility, information sharing, empowerment and morale. The order and sequence of the links between the various elements differ depending on the situation, product and the process. A typical link is the link between open/direct communication and information sharing. Regular and direct communications enhance the exchange and access to information among employees and other stakeholders inside and outside the organisation. The outcome of the various links is high morale.

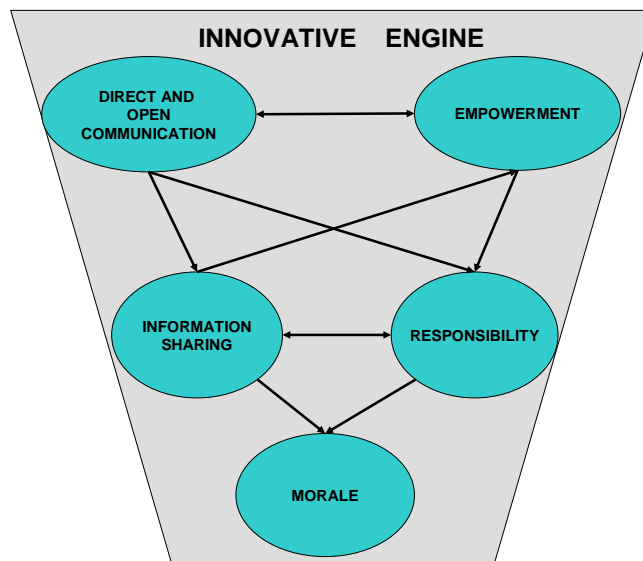


Figure 6.2: Innovative Engine

The author proposes that the innovative engine is the area in which an organization clearly identifies the product to be manufactured and sets the long-term objectives. It is the vehicle that should involve everybody in the organisation within the innovation process. The idea of an IE was largely influenced from the responses in Chapter 3. “Most entrepreneurs try to stimulate workers by giving them more responsibility so that the company and the workers benefit mutually. “A lot of time, effort and money are put into developing employees because they are regarded as valuable assets” (Chapter 3).

6.2.1 Direct and Open Communication and Information Sharing

Regular **Direct Communications** lead to enhanced employee engagement and feeling of corporate connection. Communication is the key to successful strategic management (David, 2005). Ribbens (2000) defines interpersonal communication as “communication between two or more people involving the transfer of **information** between them”. Such a

process leads to the enhanced exchange and access to **information** among employees and other stakeholders inside and outside the organisation, hence increased **Information Sharing**.

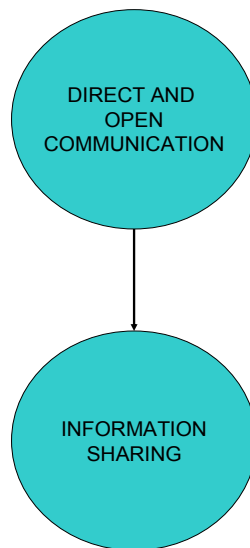


Figure 6.3: Direct and Open Communication and Information Sharing

6.2.2 Information Sharing and Employee Responsibility

Information Sharing is a process or practice of creating, sharing and using knowledge, wherever it resides, to enhance learning and performance in organizations. **Information** sharing is the process by which an organisation **shares** its knowledge among **employees** in order to promote learning and produce new knowledge or understanding (Burrill & Ledolter, 1999). When individuals take **responsibility** for their decisions, they often make a significant contribution in improving and facilitating information **sharing** among **employees** and supervisors.

Internal, technical, competitive and industry **information** should be openly available to those with a need to know. **Information** is thus made accessible and is **shared**.

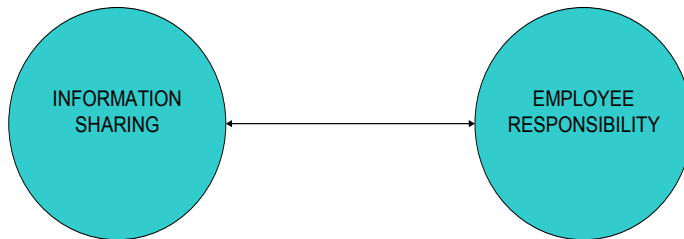


Figure 6.4: Information Sharing and Employee Responsibility

6.2.3 Employee Empowerment linked to Direct Communication and Employee Responsibility

Empowerment means to give legal or moral power or authority to people therefore unleashing the human potential and enhancing human ability to nurture societal growth. Lashley (1999) suggests that **employee empowerment** has been hailed as a management technique which can be applied universally across all organizations as a means of dealing with the needs of modern global business. **Employee empowerment** allows managers more time to engage in broad-based thinking, visioning and the nurturing of ideas. This intelligent and productive division of duties, focusing on emerging opportunities by understanding the customers' requirements, and **empowering the employees**, provides for a well-managed enterprise with strong growth potential (Tidd et al, 2005). Employee involvement entails **empowering employees** by creating good **communication** systems. When the **employees** are **empowered**, they take ownership and become **responsible** for their actions. For individuals to be **empowered** through an organization, management must reach new

levels of performance by means of participative work practices and the delegation of authority and **responsibility**.

Empowerment allows employees to redirect their attitude in the way things are done and to start to think about teamwork instead of being individualistic (Claydon and Doyle 1996).

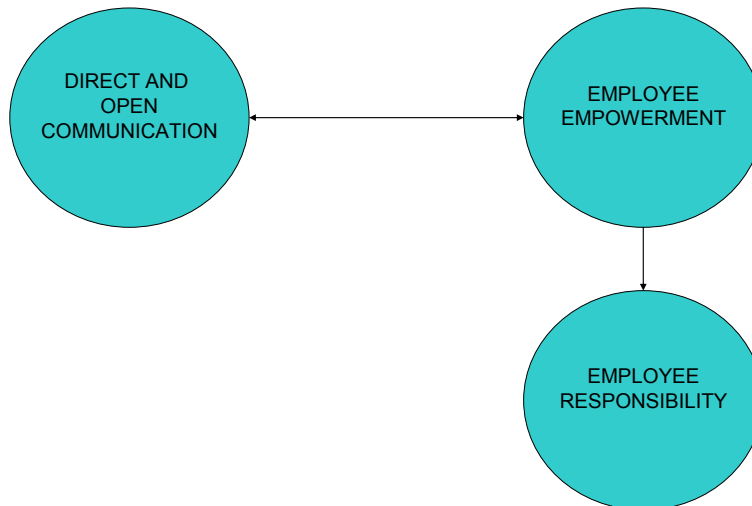


Figure 6.5: Employee Empowerment linked to Direct Communication and Employee Responsibility

6.2.4 Employee Responsibility linked to Communication, Employee Empowerment and Information Sharing

The responsibility of the employee can be defined as his ability to make decisions that affect the outcomes of his job. When employees become more responsible, there are a number of benefits that accrue to the company:

- improved productivity
- improved product quality
- greater product flexibility
- faster response to technological change
- fewer job classifications
- improved work attitudes.

Employee lack of responsibility is one of the major causes of a company's decline and is reflected by low productivity and product quality. It results in high costs per unit, hence higher prices, resulting in the commodities not being competitive enough on the market (Patterson *et al.*, 1999). Employee responsibility creates a culture of freedom to communicate, share information and knowledge and facilitates learning in an organisation of the self-managed.

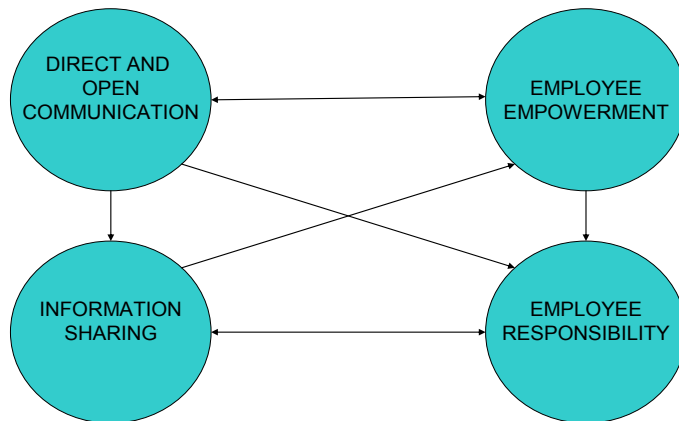


Figure 6.6: Employee Responsibility linked to Communication, Employee Empowerment and Information Sharing

6.2.5 Morale

Morale is the force that energizes behaviour, gives direction to behaviour and underlies the tendency to persist, even in the face of one or more obstacles. Job satisfaction, resulting from high morale and responsibility, is often considered to be a strong determinant of turnover, new ideas and creativity. It must be remembered that the morale of employees is gained when there is support from management. Morale is closely related to teamwork and confidence in the leadership. It can be concluded that morale is the result of empowerment and open communication. It manifests itself in employee enthusiasm and commitment.

Morale is the special feeling shared with others of trust, usefulness, purpose, team loyalty and support, pride in your achievements and those of the group, and includes faith in the organization's leadership and in the organization's ultimate success. High morale inspires people to be self-sacrificing and courageous, to go beyond what is normally expected, to take extraordinary responsibility for their own work and be totally dedicated to the work of the team.

6.2.5.1 Empowerment and Morale

The most important element of employee empowerment is striving for a win-win approach towards a problem. It also strives for moral rightness between employees and management. The empowerment process empowers employees in ways that enhance their resourcefulness when dealing with the daily needs of the organisation. It prepares employees and employers so that they are able to deal with their differences for the benefit of the organisation. It must be remembered that employees' morale is generated when there is support from management.

According to Williamson (1975), empowerment creates an environment where sufficient levels of trust have been generated in order to permit individuals and groups to act in ways that are productive of mutual gains in ongoing relationships rather than engaging in opportunistic behaviour to maximize their own immediate gains at the expense of others. Empowerment also emphasizes personal accountability that is referred to as ownership. Ownership is accomplished when people decide to take responsibility for their actions, and not only consider something that will benefit them individually. Progress against set objectives, customer reports, policing by fellow members of autonomous work teams and other forms of surveillance are deployed as the disciplinary technology of empowerment. Empowerment is also linked to organizational restructuring, job cuts and moves towards increasingly fragmented, unstable and

contingent employment relationships (Ripley, 1992). An empowered workforce becomes committed to what they do, how they do it and it is then that they become responsible.

6.2.5.2 Commitment and Morale

Commitment normally becomes visible when employees are enthusiastic and motivated to work hard. It normally happens when employees are committed to what they are doing. This drive is caused by inner peace that has to do with morale. In other words no morale no commitment. According to Mowday, Porter and Steers (1982), organizations view commitment as a designed attribute, which means every organisation has a way of determining commitment by the way their employees behave. Commitment at all times depends on the employees' well-being at a given time. When employees are disappointed about something in the workplace it affects their output. That is why Werner, (1994) suggests that employee commitment is manifested by their behaviour on the job. Meyer, Paunanen, Gellatly, Goffin and Jackson (1989) support this by saying that commitment is more visible when performance and participation are considered. Mowday et al. (1982) also added that absenteeism is inversely proportional to commitment. Commitment can not be singled out from communication, trust and teamwork. Commitment depends more on a state of mind that has to do with the environment reinforced by the morale of the employee. Commitment is directly proportional to the personality of the management. Teamwork in this case is seen as the foundation of all activities.

6.2.5.3 Enthusiasm and Morale

Enthusiasm is defined as the energy, the fuel, the blazing fire that brings about a successful result. A famous writer once said that nothing great ever happened without enthusiasm (Slechta R, 2009). He continued by

saying that if you want to accomplish great things, if you want to realize great goals, if you want to live a great life, you absolutely must possess enthusiasm for everything you do. Two people with virtually the same amount of skill and talent can differ vastly in the amount of success they achieve, because of their level of enthusiasm. This simply means that the more enthusiastic one is the greater the results. This definition by its nature is directly connected to morale. Enthusiasm and morale bring about confidence and morale does the same. It is an individual decision that one must make and of course will naturally impact on other people in the group. Teamwork will never work if one member is not enthusiastic or if one's morale is down (Slechta R, 2009).

Webster (2006) views enthusiasm as people who support each other by respecting what each person brings to the team as they harness each other. Enthusiasm is characterized by the following: communicating effectively with clear concise communication that will guarantee forward movement both individually and collectively; collaborating on how people plan to work together to ensure cohesiveness; having fun and celebrating milestones also encourages and enhances enthusiasm in the workplace.

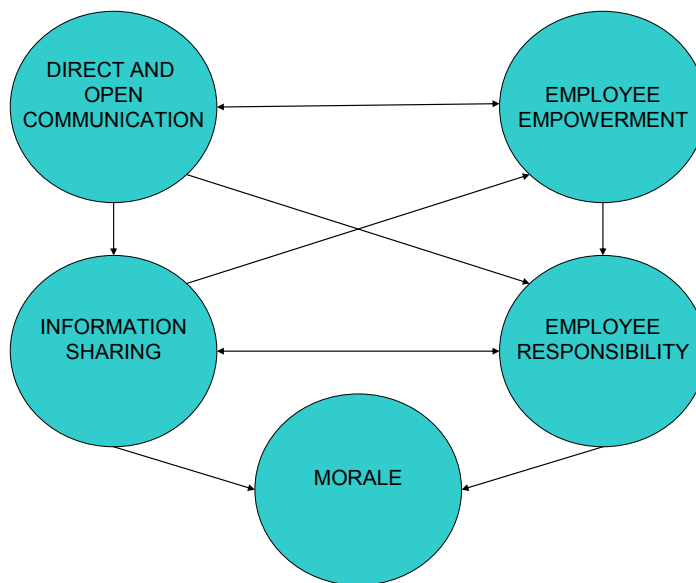


Figure 6.7: Morale as a Result of “Employee Relationships”

6.3 INNOVATIVE SPACE (IS)

An IS can be defined as “an innovative space is the environment where the inquiring minds generate knowledge through collaboration whilst continuously improving the products”. The origin of an IS is FK in the company and an IE that drives it. The author in the context of this work is advancing the definition of an IS as the environment required for SMEE’s to be able to engage in innovation. The IS is the integration of fundamentals namely, IC, CPIP and CKC as shown in figure 11.

In this work it is proposed that when IC, CPIP, and CKC are integrated they form an IS which is a fundamental requirement for new product development in small and medium engineering enterprises. A CPIP in the IS needs workers with inquiring minds who work collaboratively.

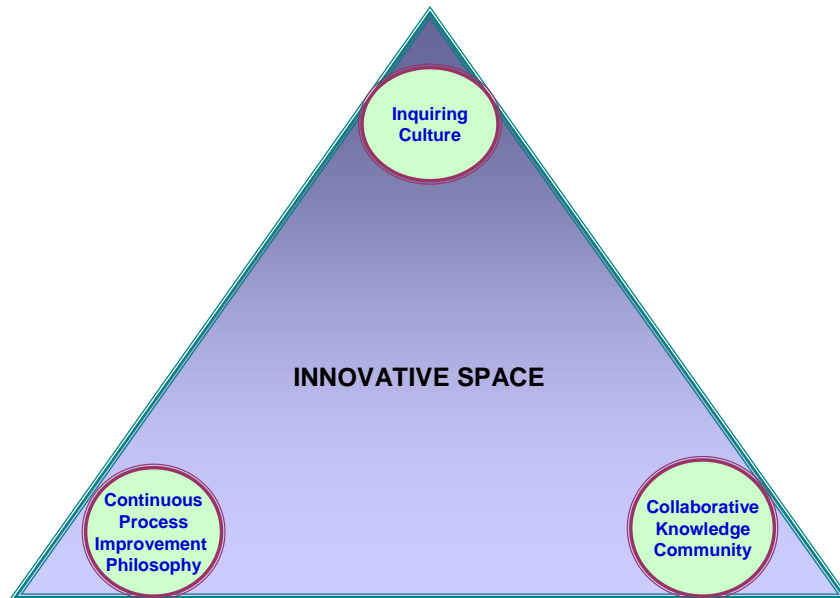


Figure 6.8: Innovative Space

Xie, Song and Stringfellow (1998) stated that the success of NPD relies on the integrated cross-functional input and effective co-ordination and co-operation among different functional areas, and that the interdependence and differences among working parties could lead to conflict in this goal. In other words, the IS ensures that all organizational factors such as organizational structure, roles and responsibilities, people and technology are integrated to achieve organizational goals and objectives.

6.4 INTEGRATING THE INNOVATIVE ENGINE INTO THE INNOVATIVE SPACE (IS)

The IS is the mechanism that enables the IE (hence people) to be enthusiastic workers who are responsible and empowered. They are workers who are not satisfied with the minimum and would therefore embrace innovation and its challenges.

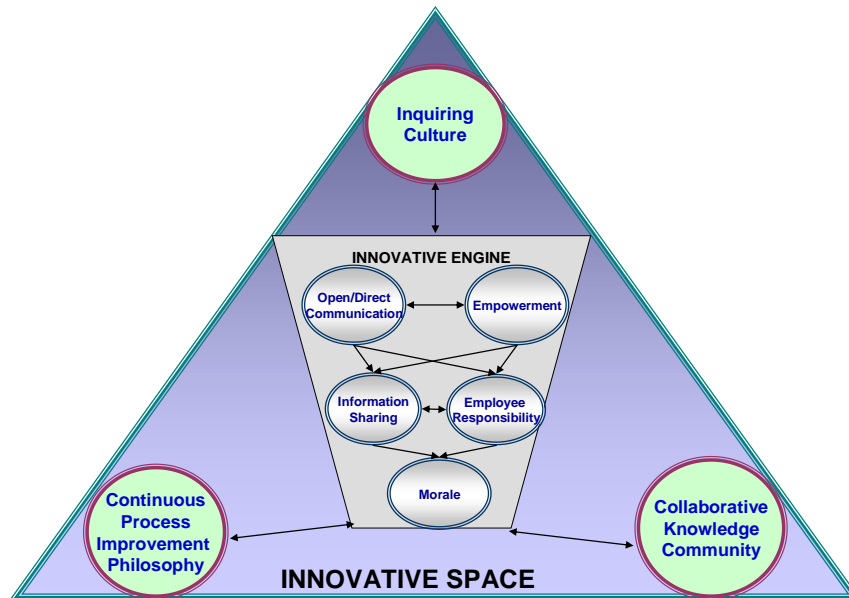


Figure 6.9: Integrating the Innovative Engine into the Innovative Space

6.4.1 Inquiring Culture linked to Innovative Engine

Fundamentally the organisation must establish a proper culture. In the content of this discourse such a culture must be an inquiring one. The culture shapes the organisational structure, the access and flow of information and other resources, the patterns of behaviour, the reward system, in fact all aspects that make it possible to serve the customer. According to Burrill and Ledolter (1999), the following are a resemblance of an “excellent culture”:

- **Attitude:** This relates to how an organisation perceives itself. Issues such as patterns of behaviour and dress code will reinforce their belief that they are different and special.
- **Structure:** The organisation has a relatively flat structure with easy access up, down, and around the hierarchy.
- **Information:** Internal, technical, competitive, and industrial information should be openly available to those with a need to know. Thus information is made accessible and is shared.

- **Empowerment:** People are empowered to take the initiative and explore new paths without fear of failure by the provision of necessary resources. People are encouraged to collaborate and build problem-solving coalitions.
- **Career development:** Training, seminars, tuition reimbursement programs, and other devices are used to encourage career development.
- **Recognition:** Employees need to be recognised for special achievements in the form of awards, praise and plaques just to mention a few.
- **Family bond:** The relationship between the organisation and its workers goes beyond business perimeters.

In order to realise these characteristics an organisation needs to integrate all the elements and components of the NPDP model. It should also be noted that all the characteristics reside in the innovative engine. The discussion below is an attempt to summarise these aspects.

Amabile (1998) and Blum (2000) perceived the need for organisations to have **cultures** that “reward and respect the free flow of ideas and enquiries”, where the “social environment can influence both the level and the frequency of creative behaviour”. An **IE** thrives in a climate where there is a free flow of **information** with little or no distortion. It encourages an atmosphere which “questions all assumptions” (Deazin *et al.*, 1999). Internal, technical, competitive, and industrial **information** should be openly available to those with a need for it. **Information** is thus made accessible and is **shared**.

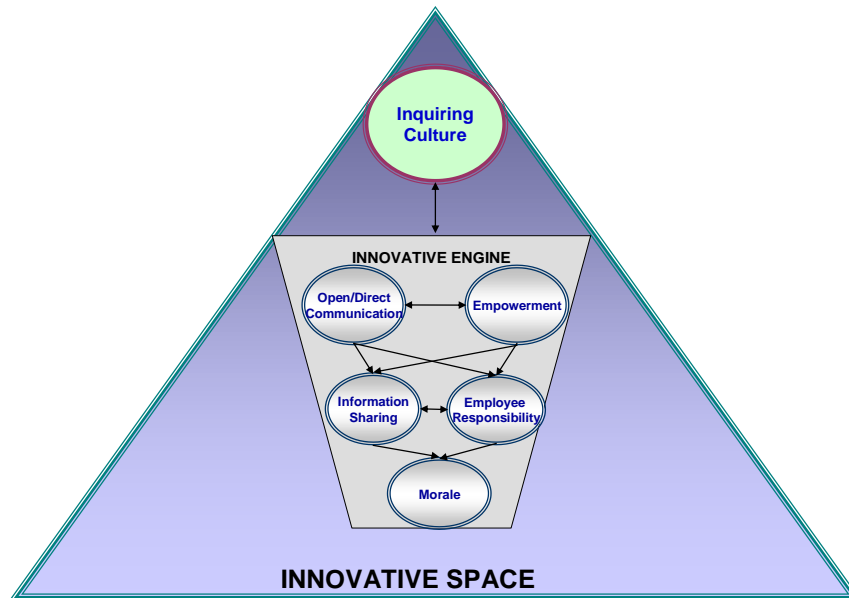


Figure 6.10: Inquiring Culture linked to Innovative Engine

6.4.2 Continuous Process Improvement Philosophy linked to Innovative Engine

The implementation of quality depends entirely on people. To achieve quality, an organization must first provide the necessary “standards” and convince its people to make a commitment to quality and benchmark the work outputs against the standards. Companies A, B and C in Chapter 3 have acquired ISO 9002 certificates and are benefiting from it. The other three companies realise the importance of quality and plan to apply for certification in the near future. Doing things correctly is a matter of having proper systems, procedures, instructions, raw materials, equipment and training. But it is also a matter of attitude. Most people want to achieve and to be members of a winning team. It takes a constant focus on people and their requirements to elicit this behaviour in order to build a sense of achievement through the CPIP.

Motivated employees of an organisation are generally responsible. When workers are responsible, the work that they do is of high quality. Quality

work is more than doing work in the normal way. It takes commitment and thought in execution. Frequently overloading employees with work discourages quality work. Employee involvement also entails empowering employees and creating good communication systems. Teamwork is a critical part of Total Quality Management (TQM) and reliance of TQM on the interdependence of different parts of the organisations and its teams are of major importance in effecting such interdependence. Teams can be steering committees, problem solving teams, quality circles and cross-functional teams.

The culture of the organisation can be defined as all the interactions that take place between people and their relationships with each other. Quality culture is therefore driven by the attitudes and perceptions of the employees towards quality. A quality culture can be established by installing a quality consciousness in all employees who have clearly defined goals and expectations. Adrienne Curry (2002) argues that the concept of TQM will be effective only when all employees are involved, thus emphasising the need for horizontal integration, communication and co-operation using techniques such as quality circles, self directed teams and steering committees.

In the NPDP model there has to be FK and a strategy based on FOS, PM and PP in an environment where quality is practiced in order for an SMEE to develop a CPIP.

Continuous Process Improvement refers to programs and initiatives that emphasize incremental improvement in work processes and outputs over an open-ended period of time (Davenport & Beers, 1995). A CPI philosophy in the IS needs workers with inquiring minds who work in collaboration. **Continuous Process Improvement** can only succeed when employees take **responsibility** for their actions, are **motivated** and take pride in what they are doing.

Proper implementation of a quality process requires, above all, employee involvement and if successful, creates as a benefit the sense of **responsibility** and accomplishment among the employees.

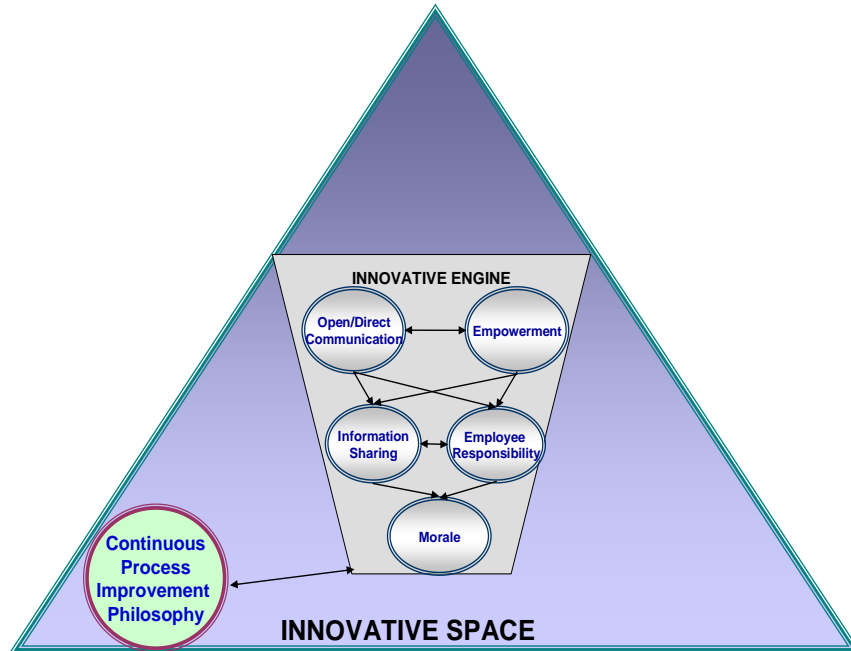


Figure 6.11: Continuous Process Improvement Philosophy linked to Innovative Engine

Quality promises sustainability for companies, and CPI is the philosophy that fuels the need to improve quality and thus the company's sustainability potential. CPI is based on a strategic approach to develop a culture of improvement for reliability, process cycle times, costs in terms of less total resource consumption and productivity which are key factors influencing product development and innovation.

6.4.3 Collaborative Knowledge Community linked to Innovative Engine

In order for companies to survive in volatile environments, they need to develop a CKC. To collaborate is to unite individuals in a formal or non-formal group, or to develop a partnership in a project in order to **share**

ideas for the greater purpose of a common goal. This **collaboration** can be both internal and external. Much of what people learn, and therefore what the organisation comes to know, results from interaction among and between team members. A CKC recognises that knowledge created and gathered from both inside and outside an organisation is important for successful product development.

In a **CKC**, employees are encouraged to be creative and to generate innovative ideas for new commercial products. Innovation encompasses the generation of new ideas and their application for commercial use. A CKC in the IS has values, attitudes and beliefs that steer the actions and behaviour of the individuals making up the organization. It transfers knowledge within an organization in order to improve its effectiveness and quality. Therefore, in order for an SMEE to develop a CKC there has to be FK to inform the strategy so that customer requirements can be met through the IE and CR&D.

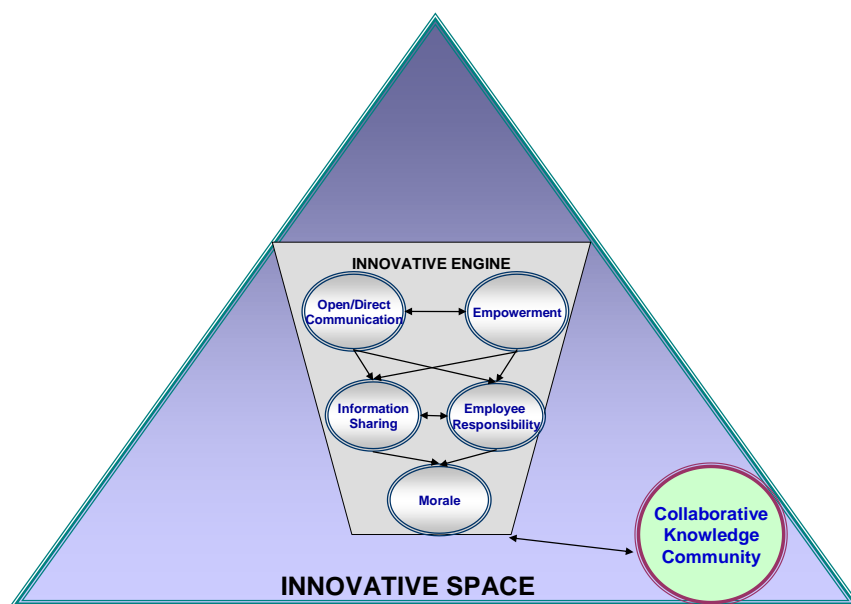


Figure 6.12: Collaborative Knowledge Community linked to Innovative Engine

6.4.4 Fundamental Knowledge Shaping Strategy

Fundamental Knowledge Shaping Strategy is the starting point of the three articulation routes in the model. FK resides in the people at the company. This was one of the challenges identified by all six companies discussed in Chapter 3. There are very few graduates so most of the “workers’ skills are transferred via on-the-job training”. In some of the companies “motivated workers with potential are given an opportunity to become apprentices and some of them are even sent to complete their education, some to tertiary level” (Chapter 3). The success of the business depends on people and their abilities, skills, knowledge, and commitment (Baumard, 1999). Knowledge assets, like money or equipment, exist and are worth cultivating only in the context of the strategy used to apply them (Blacker, 1995).

A company creates its NPDP vision and sets its objectives based on the FK available in the company. Company knowledge therefore provides a fundamental base in assisting and guiding management to design its strategy. Knowledge is a fundamental base and a powerful facilitator of an organization. It is a set of facts used by people to make decisions or take actions that are important to the company. An organization must have FK when creating and deciding on a new product range. It is preferable that this FK resides inside the company.

A well-formulated strategy based on sound fundamental knowledge helps the company to manage and allocate its resources into a unique and viable manner based upon its relative internal core competencies and shortcomings, anticipated changes in the environment, and continental moves by intelligent opponents. Therefore, if becoming more innovative is part of an organisation’s goals, managers will have to develop plans of action to achieve this.

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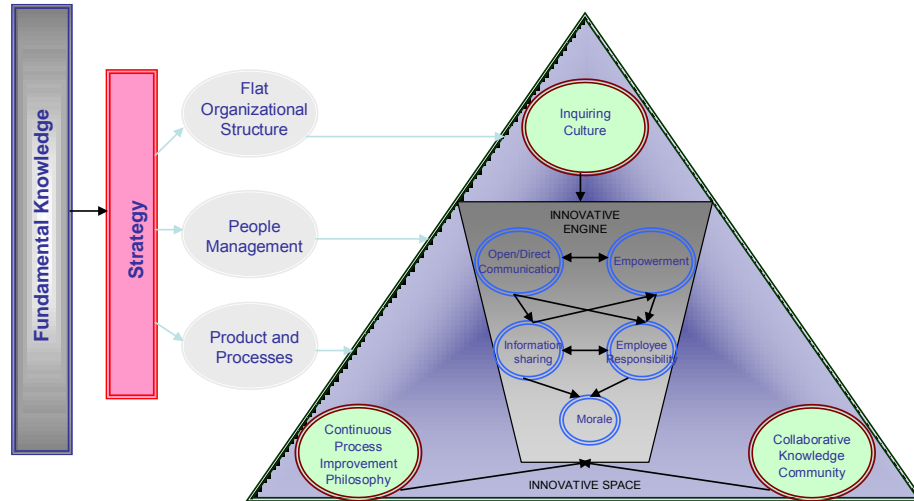


Figure 6.13: Fundamental Knowledge Shaping Strategy

6.4.5 Articulation Route 1 to the Innovative Space

This section discusses the first articulation route that a SMEE must establish, in order to support the infrastructure of an IS. The model indicates that there has to be fundamental knowledge linked to strategy, and through a flat organisational structure, empower the people in the innovative engine operating in the innovative space.

New Product Development Practices Model

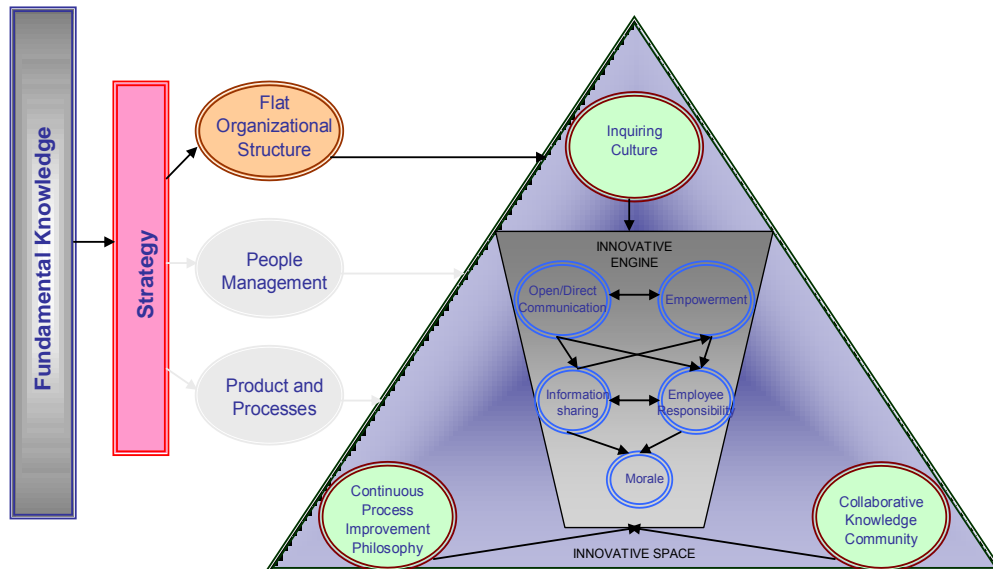


Figure 6.14: Articulation Route 1 to the Innovative Space

6.4.6 Strategy for a Flat Organisational Structure

The creation of an organisational structure is a strategic matter. A strategy is defined as an action plan designed to move an organisation toward achievement of its vision (Ireland R.D, *et al.* 2006). Management should understand that strategy is only effective for a finite amount of time; if it worked well yesterday it is not guaranteed that it will work again tomorrow. Schuman and Prestwood (1994) say that the environment shifts, customers' needs change, competition gets smart, technologies improve and the organization itself evolves. It is therefore important for management to review their strategies from time to time.

The flat organisational structure is the most suitable of the existing structures in the context of SMEs with regards to promoting innovative

activities. The structure will offer the benefit of an open/direct communication channel between management and workers, less bureaucracy and easier decision-making, better team spirit, and fewer levels of management. A FOS encourages diagonal communication between workers in different sections of a company and where the workers involved are on different levels in the company. In the case of SMEEs, an 'ordinary worker' can communicate directly with the director of a company, which does not often happen in large organisations. The FOS therefore creates an opportunity for everyone in the company to get involved with customer requirement discussions and debates. Thus communication between customers and developers/suppliers or between employees and managers is enabled for the success of the business.

A SMEE wanting to develop products should choose a FOS because it allows workers to have an intimate self-knowledge of the organisation's capabilities. In turn management will have a better understanding of the capabilities and commitment of all the workers of the company. The company's strategy and action plans for achieving its objectives are easily communicated and known to all, so that the company is competitive. The FOS enhances the communication of the FK and increases information sharing and the utilization of process documentation. This information sharing promotes organizational integrity and allows people to communicate effectively in the organization.

New Product Development Practices Model

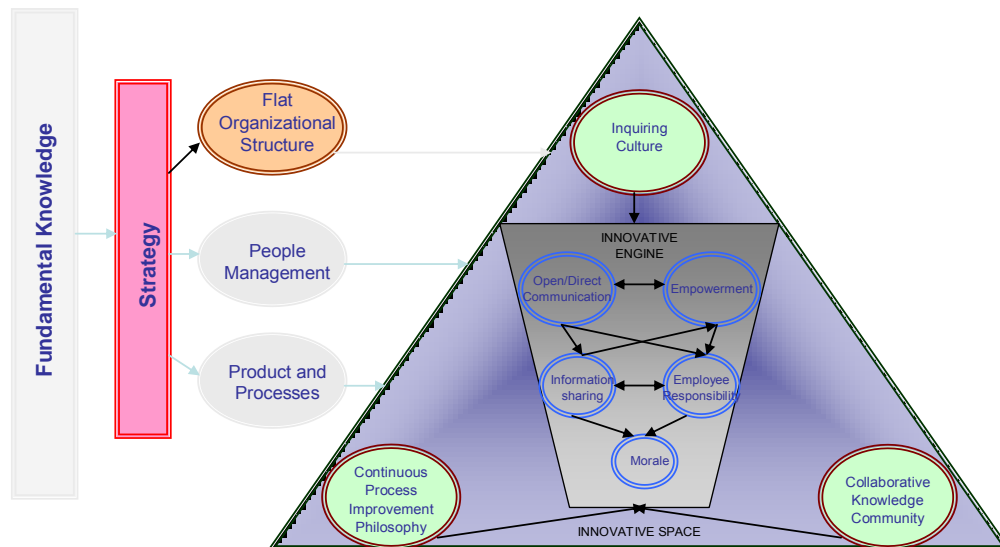


Figure 6.15: Strategy for a Flat Organisational Structure

6.4.7 Flat Organisational Structure linked to the Innovative Space

Managers learn to share information across the company and promote a culture of openness and trust (Hankinson & Hankinson, 1999). Bell and Smith (1999) have found that small companies perform better when they involve employees in the business through direct communication and consultation. This can be adopted by SMEEs in their practices in terms of the development of products and processes. The direct communication method is both the least bureaucratic and hierarchical in an organization. Fewer chains of command mean that there is less information distortion. In other words the information being shared is unambiguous, and tasks will be executed in the correct manner. Eventually there will be no rework, safe guarding against unnecessary losses to the organisation.

The FOS is a move away from bureaucratic, hierarchal forms of management toward more flexible, flatter, leaner structures built on networks in which authority and decision-making are decentralized and distributed.

An enterprise that does not exhibit an IS will find it difficult to survive in a world of ever-changing technology and markets. One of the key elements for the development of an IS in a company is communication made easy through a flat structured organisation where people are the most important asset, and should be treated as such. Hence the FK that people have must be properly managed in order for an organisation to be successful at NPDP.

New Product Development Practices Model

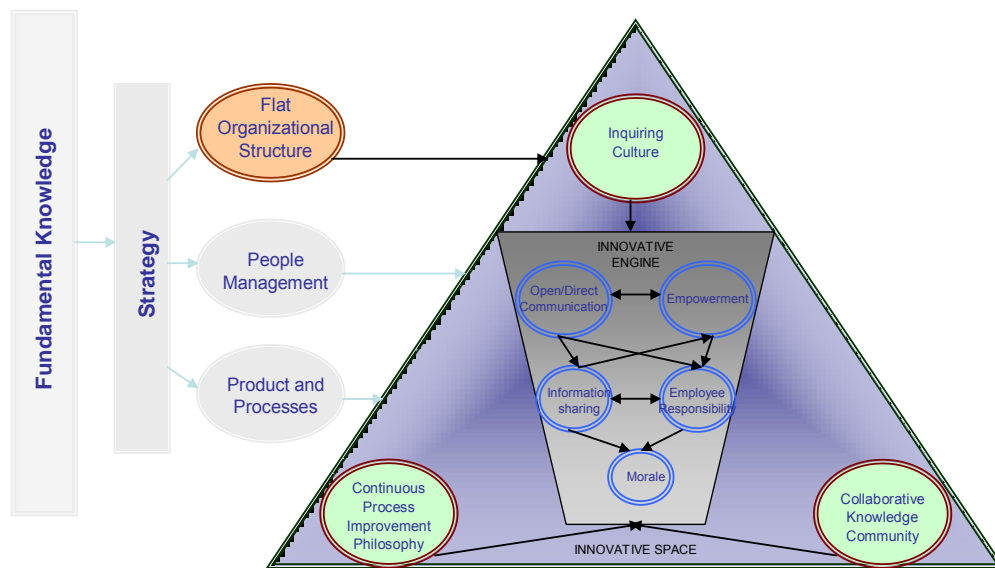


Figure 6.16: Flat Organisational Structure linked to Innovative Space

6.4.8 Articulation Route 2 to the Innovative Space

This section discusses the second articulation route, linking the pillar to the IS. The model indicates that there has to be fundamental knowledge

which, through strategy and people management, will influence the innovative space. This will ensure that the company clearly defines its behaviour and measures its performance.

New Product Development Practices Model

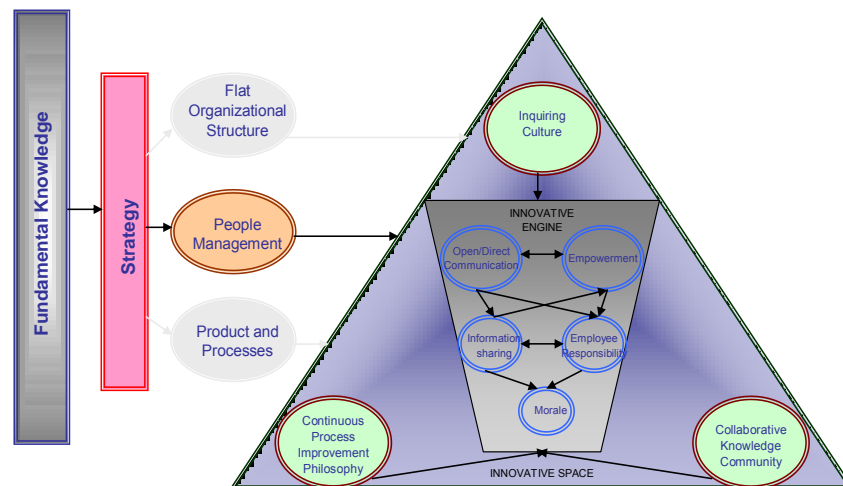


Figure 6.17: Articulation Route 2 to the Innovative Space

6.4.9 The Management of People

A manager's most important and most difficult task is to manage people. They must lead, motivate, inspire and encourage people. At times, they have to hire, fire, and discipline or evaluate employees. Managing people resources also means having the right people, with the right skills and the proper tools, in the right numbers at the right time. It also means ensuring that they know **what** needs to be done, **when**, and **how**. It also means motivating them to take ownership in the project. Without effective people, it is simply impossible for a firm to achieve its objectives. Although plant, equipment, and financial assets are resources required by companies, the people are of paramount importance. It is the people who have to ignite the creativity in a firm.

All these things do not just happen. Companies need effective people management to achieve this. Milkovich, T (1994) says that people management is a series of integrated decisions about the employment relationship that influences the effectiveness of employees and companies.

New Product Development Practices Model

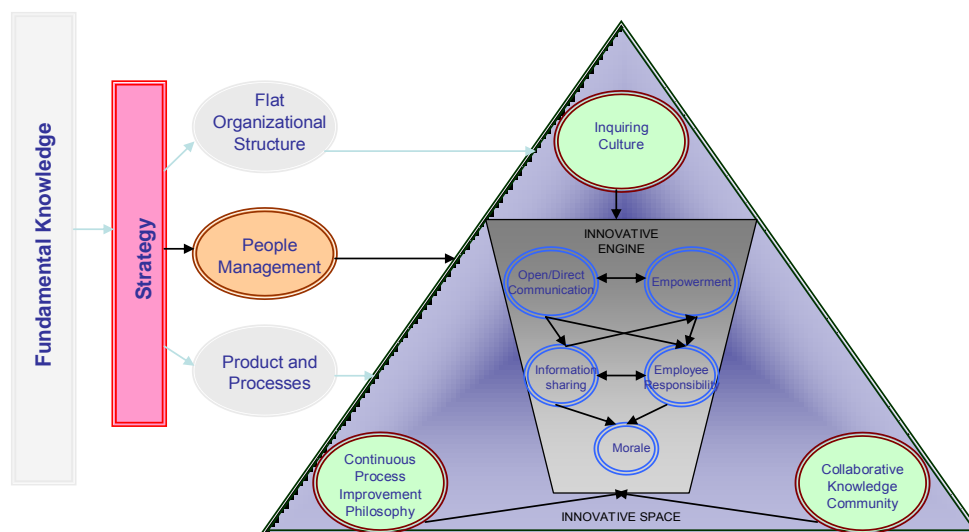


Figure 6.18: The Management of People

6.4.10 People Management linked to the Innovative Space

The role of management in this perspective is to create a culture of participation by providing a compelling mission; a structure that emphasizes flexibility and autonomy, rewards participation as well as ongoing involvement programmes and does not punish risk taking (McGuire, 2003). Craig and Hart (1992) mention that innovation requires managers that have both technical and management skills in order to manage effectively. such skills enable a manager to plan properly bearing in mind the availability of the resources and the capabilities of his organisation.

Barczak and Wilemon (1989) state that management must be a climate setter, which means that management must prepare the way for the employees. Employees are not motivated to work hard in an environment that does not encourage creativity. Employees with potential are often not encouraged to exercise their creativity; instead they are discouraged, because most managers think that if they give their employees room to express their views they will end up taking their positions.

New Product Development Practices Model

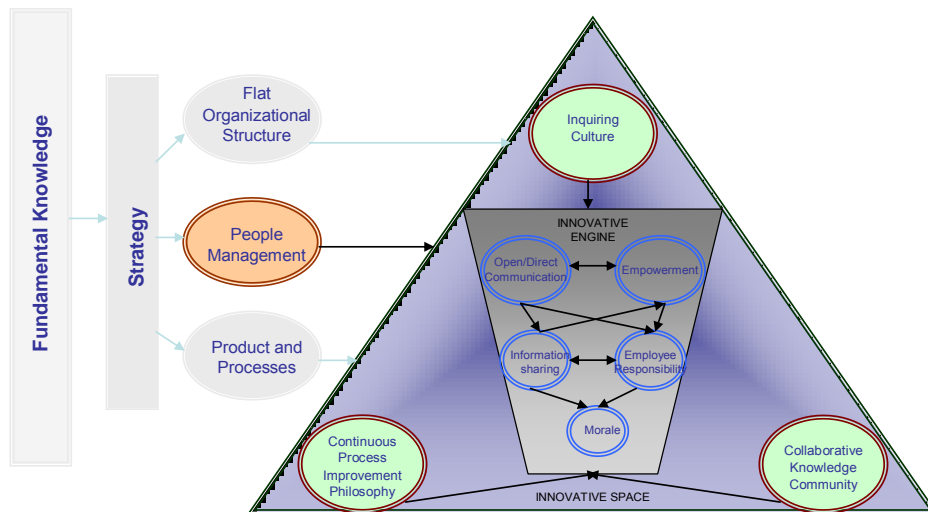


Figure 6.19: People Management linked to the Innovative Space

6.4.11 Articulation Route 3 to the Innovative Space

This section discusses the third articulation route from the pillar to the IS. The model indicates that in order for an SME to sustain an IS there has to be fundamental knowledge to inform the strategy, so that products can be defined through distinct processes. This route is endorsed by the entrepreneurs in Chapter 3, “even though most of the work is produced to order, the companies take full responsibility for the effectiveness of the production process”.

New Product Development Practices Model

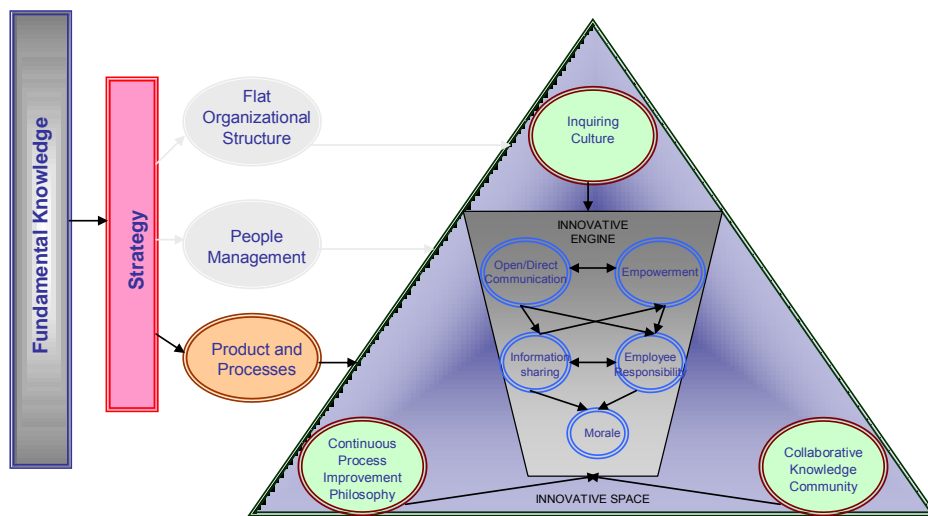


Figure 6.20: Articulation Route 3 to the Innovative Space

6.4.12 Products and Processes

Hansen *et al.* (1999) notes that the strategy chosen depends on how the company serves its clients, the economics of the business and the people it hires. In other words, good ideas and concepts will yield nothing if there are not enough resources in terms of people, time, budgets and equipment to develop them, hence resource allocation and prioritisation is of paramount importance.

This is one of the areas that all six entrepreneurs agreed upon as very important for their companies (Chapter 3 pg. 24). They all have plans for the “innovation of new products and or product processes”. This is further emphasised by the following facts, “Entrepreneurs A, D and E have completed samples of new product innovations. Entrepreneur F has already successfully marketed a new product and is busy with a second one and is busy with the development of a new ladder-making machine. Entrepreneurs B and C have completed designs of their new products.

Technological innovation leading to a product involves the adoption of an idea that directly influences the basic processes. Administrative innovations include changes that affect the policies, allocation of resources and other factors associated with the social structure of the firm (Cooper, 1998). The two most important aspects of these links are strategy and executive power. From the company's overall strategy, other functional or process strategies encompassing innovation can be developed (Cooper, 1998).

New Product Development Practices Model

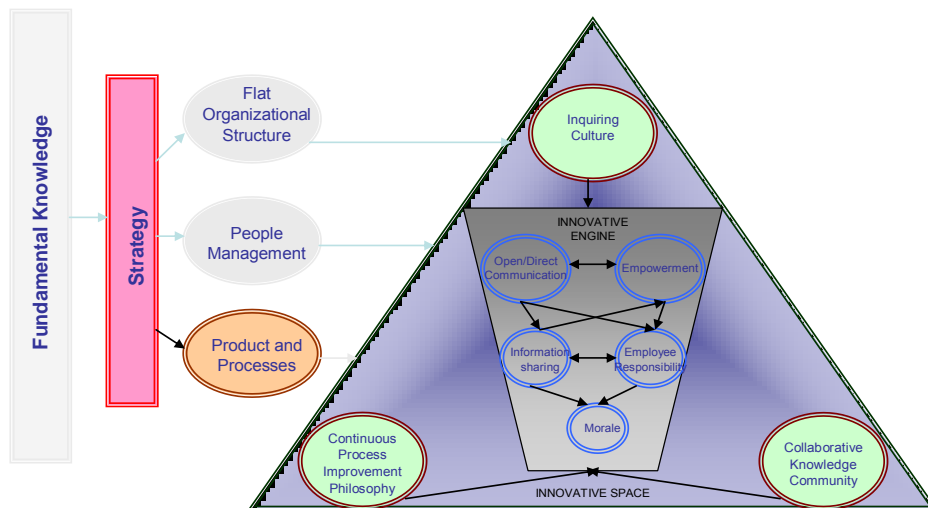


Figure 6.21: Products and Processes

6.4.13 Product and Processes Influencing the Innovative Space

Product and process development plays an increasingly important role in determining the success or failure of new innovations. In addition, increased competitive rivalry is driving companies to commercialize their new products more quickly. Innovation, and more importantly an environment where innovation can take place, is the key to new product development (NPD). Tidd and Pavit (1998) define innovation as ‘the

process of taking new ideas effectively and profitably through to satisfied customers.'

Processes are assets of an organization, much like people, facilities, equipment and information. Quality is achieved through process improvement and therefore well managed and well understood processes will pay off in terms of performance in an organization.

New Product Development Practices Model

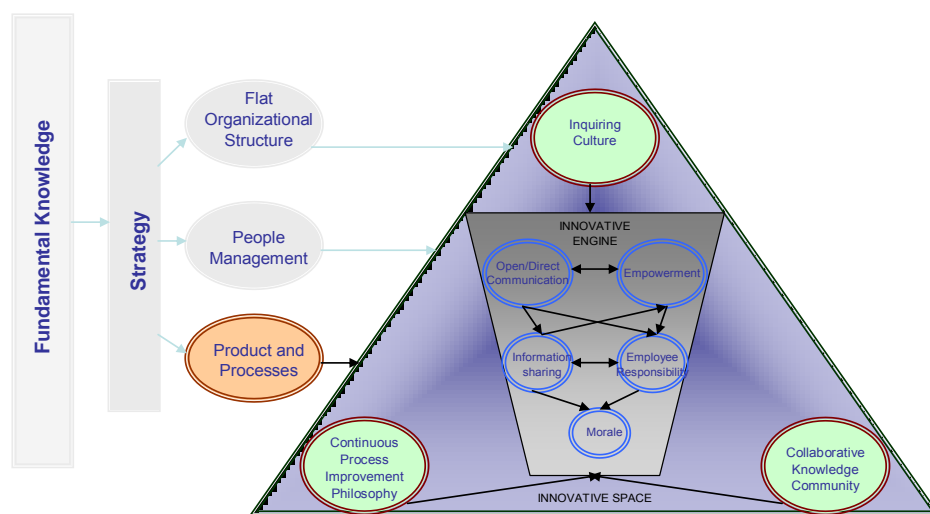


Figure 6.22: Product and Processes Influencing the Innovative Space

6.5 OUTPUTS FROM THE INNOVATIVE ENGINE

Information sharing depends on personal networks and the willingness of individuals to share. Individuals share willingly when the information is available. A great deal of what people learn and therefore what the organisation comes to know results from interaction among team members. Organisations leverage individual talents into collective achievements through information sharing and open communication of people who collaborate.

The IE enables employees to look at the ideas generated from the CR&D section and give their input. The **information** and ideas generated from

the CR&D section are **communicated** through the IE to the rest of the company. One could find that workers in finance or human resources could provide valuable input to a technical problem. The IE makes this possible because it encourages employees to break away from the old solutions or ways of thinking and helps to open their creative powers of to include all dimensions of a problem or solution in the company.

New Product Development Practices Model

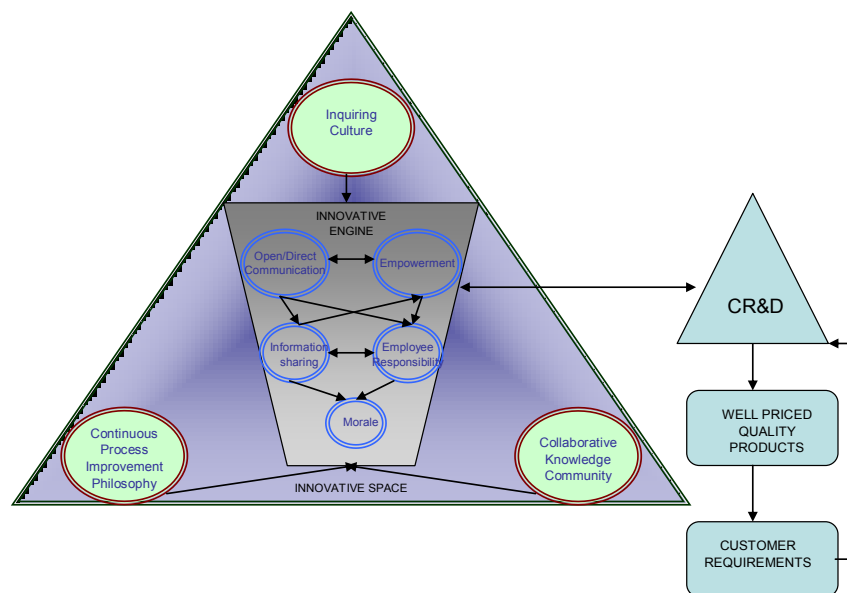


Figure 6.23: Outputs from the Innovative Engine

6.5.1 Collaborative Research and Development (CR&D)

The Collaborative Research and Development component in the NPDP model contains three elements; awareness of external environment, idea generation and information channels and networks. As shown in figure 27, the three elements interact with each other and no one element is more important than the other. The level of interaction and sequence of interaction depend on the projects and options the company has. A typical link is the one between idea generation and information channels and

networks. When ideas are collected through information channels and networks they often create relationships and this improves the way individuals think collectively thus moving from knowledge sharing to collective knowing. This also creates a relationship of improved collective thinking and collective knowledge. This component was influenced by the study of the six companies listed in Chapter 3. Except company F, most customers are involved with the design of the components that have to be manufactured. They submit design drawings or actual samples that have to be machined. Therefore “with the exception of company F, the companies have a shared responsibility in the design process” with their customers.

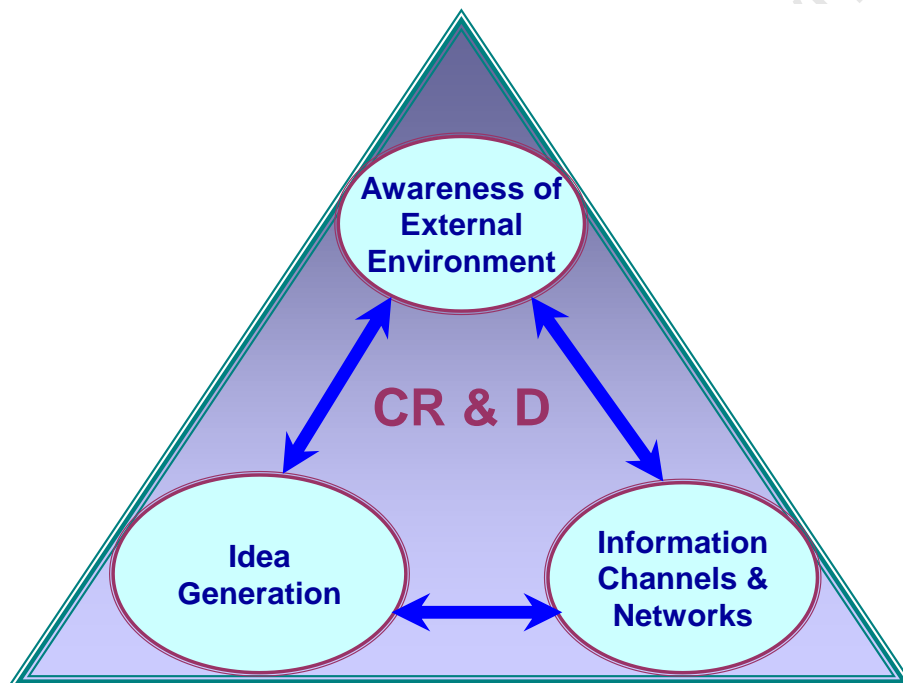


Figure 6.24: Collaborative Research and Development

6.5.2 Innovative Engine Contributing to CR&D

According to Tidd et al (2001) creativity can be defined as problem identification and **idea generation** whilst innovation can be defined as idea selection, development and commercialisation. Namely an idea has

to be developed and put to commercial use for innovation to have taken place; this is supported in a CKC. People in the IE are in fact the essential part simply because the organisation questions the ways, procedures, policies, and production methods and types of products and modifies them. An IS means that workers do not settle on the first and obvious solution to a problem but continue to seek for alternative ways that could lead to a better decision or a more effective action.

It is important to note that the link is a two way one. The reason for this is that CR&D must be able to get immediate feedback from the IE. The CR&D section will generate or find the ideas to meet customer requirements. When the ideas are brought to the rest of the company via the innovative engine, they can be challenged and improved by using internal and external information channels and networks. Internal networks include the interaction between a company's departments and person to person communication during the execution of daily duties. The CR&D section therefore involves the whole company to participate in generating ideas.

Continuous monitoring of customers' requirements enables a company to determine the customers' perception of the quality of the products they require. It is here that the examination and evaluation of consumer needs, desires and wants occur. It involves administering customer surveys, analysing consumer information and determining optimal market segmentation strategies. When there is an awareness of the external environment, ideas can be generated using various information channels and networks.

New Product Development Practices Model

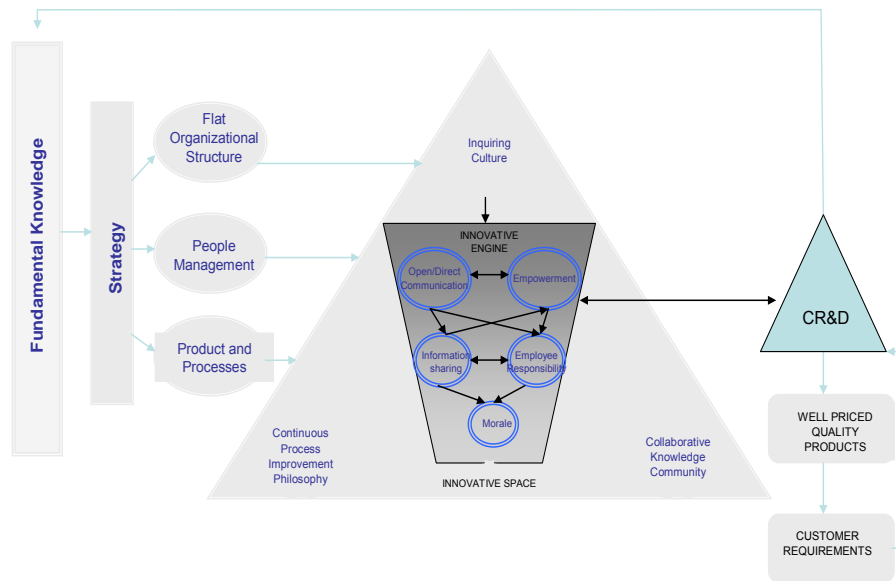


Figure 6.25: Innovative Engine Contributing to a CR&D

A well-developed and articulated strategy unites CR&D and marketing and focuses their combined innovation efforts towards a portfolio of high value opportunities (Streumer & Calon, 1997).

6.5.3 Collaborative Research and Development Resulting in Well-Priced Quality Products

When employees are empowered by participating in decision making and are allowed to make mistakes without fear of being reprimanded, they become creative. A CKC is about sourcing information from different parties and generating exciting ideas that are useful for new product development. This will lead to the production of quality and unique products because the knowledge used to generate ideas exceeds customer satisfaction.

Knowledge is important for competitive initiatives such as improving customer satisfaction, developing new products and markets and providing a faster response. This is an important section of this thesis because it

looks at how SMEEs can find ways of getting information and why they need to innovate.

New Product Development Practices Model

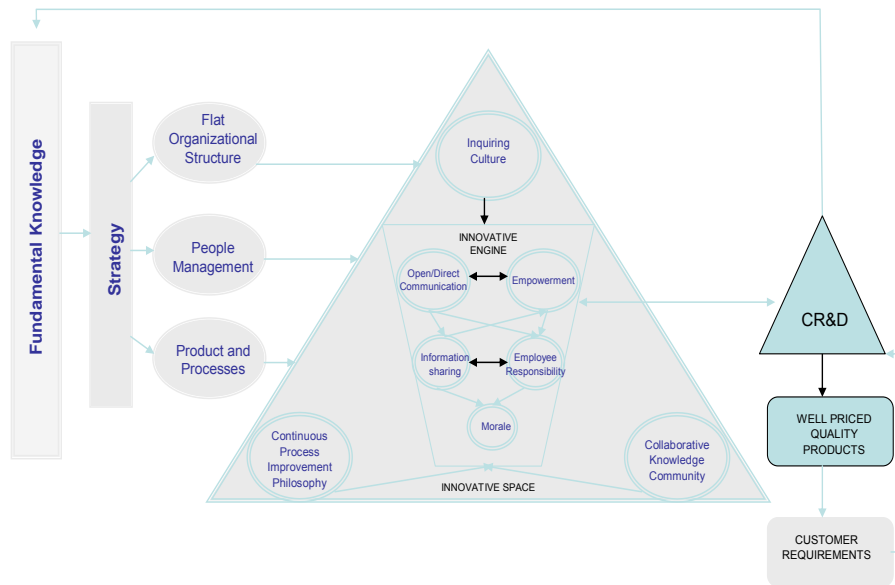


Figure 6.26: Collaborative Research and Development Resulting in Well-priced Quality Products

6.5.4 Well-priced Quality Products Reflecting Customer Requirements

“Costs, quality and delivery times are the most important competitive advantages and remain the particular company’s responsibility” (Chapter 3). Customer needs and expectations tend to change, therefore SMEEs are driven to continually improve their products and processes. They must ensure that managing customer requirements is a continuous process. A Continuous Process Improvement Philosophy always places the voice of customers first by striving to satisfy their needs at all times. The norms, values and standard operating procedures must be properly communicated to all the stakeholders who must work together towards the

common goal of an enterprise. An improvement in process entails a revamp of all the instruments that are linked to it.

New Product Development Practices Model

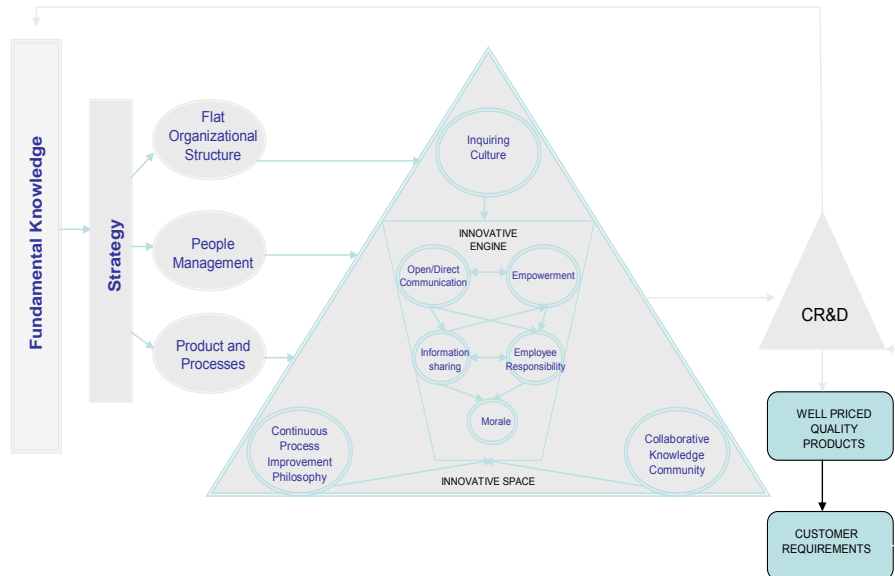


Figure 6.27: Well-priced Quality Products Reflecting Customer Requirements

The quality management system approach encourages organisations to analyse customer requirements, define the processes that contribute to the provision of a product that meets the specified requirements, and to keep these processes under control. The IS component allows the company to continually re-assess their quality standards and implement improvements.

6.5.5 Customer Requirements Affecting Collaborative Research and Development

New products are, by their very nature, innovations. These innovations are as a result of creative insights and freethinking. Companies that do not utilise and manage knowledge will hold back innovation thereby jeopardizing new product development efforts. Managers should make every effort to expose their employees to new working methods and techniques that would challenge their existing knowledge base. As

pointed out by Eisenhardt (2000), change is a crucial driver of innovation. Employees must be asked to continuously challenge the way things are done, find out how other people do the job and look for improvements in order to meet customer requirements.

6.5.6 The Influence of Collaborative Research and Development on Fundamental Knowledge

The basics of new product development are the creation, utilization, exploitation and management of knowledge and this is embedded in the IS. Thus, developing organizational mechanisms and management processes that enhance knowledge creation, knowledge transfer and knowledge exploitation are critical for sustaining business and human development. Companies need to acquire greater flexibility and introduce new technologies and new production concepts in response to the pressures of competition and the quality of products. All this is dependent on the FK in the company. The gaps will be identified in the CR&D. If the FK does not reside within the firm, external sources need to be identified.

6.6 THE EFFECT OF THE MODEL

The model intends to illustrate how an environment for learning and sharing takes place in SMEEs. The learning process starts with the creation of knowledge by individuals and it ends when the organisation understands, interprets and assimilates the knowledge required for a new idea. The output of the idea generation phase is the concept of a new product expressed in terms of functional characteristics and requirements. For this to happen, the management of SMEEs must ensure that the IS fundamentals become useful and that the organisation is able to develop and produce a new product. This requires that the company clearly defines its behaviour, measures its performance and creates a continuous process of the product development.

Many researchers have explored the underlying organizational variables influencing NPD performance. These variables have been grouped under development time, productivity, commercial success of new products, and quality (Clark & Fujimoto, 1991; Pisano, 1996; Ulrich & Eppinger, 2003; Henderson & Cockburn, 1996). All these variables are embedded in the practices in the model. Since the model covers all the important aspects relating to NPDP, implementing them into a SMEE will improve the chance for successful products.

6.7 FRAMING THE MODEL

The model was developed using the literature review and field data (six companies) in Chapters 2, 3 and 4. It is framed within a well managed quality oriented IE with responsible skilled workers feeding into a CR&D facility with networks that collaborate internally and externally. This model will be tested in industry.

This model is framed by extracts from the following theorists:

- **Lawton Smith et al. (1991)** where they define collaborative new product development as the cooperative relationship between companies aimed at innovation and the development of new products.
- **Parker (2000)** says that collaboration on innovation has been an increasing trend over the last decade. This is because of the increasing complexity and the faster rate of product obsolescence as well as the need to gain faster access to markets.
- **In Allen's (1982)** view, although company boundaries are normally clearly defined in terms of the internal and external environment, there is a trend towards the social embeddedness of companies. To partly overcome resource barriers to innovation, there has been an increasing trend in strategic collaboration. This goes beyond transactions or project-based co-operation but includes things like, joint ventures, strategic alliances and also joint R&D activities. Besides Allen's informal and formal links, companies can also make

use of networks with external organisations that do have appropriate resources and knowledge.

- **A network** perspective often gives a fuller picture of a firm's innovation activities and how the strategies and activities of others in the network affect that it's innovation strategy. Furthermore, it could be argued that network relationships that are intentionally developed and managed by the firm will have a more noticeable effect on innovation performance than less intentionally and more informal network relationships.' (Dickson & Hadjimanolis, 1998)
- **Tidd and Pavit** (1998) defines innovation as 'the process of taking new ideas effectively and profitably through to satisfied customers.' They also state that there is a fundamental difference between radical and incremental innovation. Besides radical and incremental, there is also fundamental innovation.

6.8 CONCLUSION

This study suggests that an Inquiring Culture, a Continuous Process Improvement Philosophy and a Collaborative Knowledge Community show evidence of innovation in SMEEs. Innovation activities consist of developing new ways of working and incremental product innovations. This is possible if SMEEs ensure that the fundamentals of the IS are integrated.

A critical feature of this model is that workers must form successful teams and must be empowered to make decisions. Employee empowerment allows managers more time to engage in broad-based thinking, visioning and nurturing. This intelligent and productive division of duties, focusing on emerging opportunities by understanding the customers' requirements and empowering the employees, provide for a well-managed enterprise with strong growth potential (Tidd et al, 2005).

The formation of a conducive NPDP environment is not dependant on the effectiveness and efficiency of each single phase of the model but also on

the degree of integration among them. This means that the NPDP performance is related to how departments within and outside the firm manage the quality and quantity of knowledge generation, knowledge transfer and the different phases of the development of products and processes (Carbonara & Schiuma, 2004).

One can conclude that innovation depends on the foundation of the enterprise. According to this model, Fundamental Knowledge and Strategy are basic tools that should be implemented. In this case knowledge on how to be more innovative is required. The knowledge acquired should be used to set up a vision, goals and objectives. A strategy with the correct organisational structure must be implemented. The organizational structure must reflect the strategy, how the work should flow and how the objectives can be achieved. The IS, an outcome of the articulation routes, indicates a favourable environment in SMEEs for successful product development.

This model attempts to meet the needs as identified by the six companies in Chapter 3 as well as the information found in the literature. From Chapter 3, "The general outcome was that the companies firmly believed that innovation and NPD were vital factors for SMEEs not only to remain sustainable but also to grow their profits".

CHAPTER 7

DATA ANALYSIS (COMPLIANCE WITH THE MODEL)

7.1 INTRODUCTION

This Chapter presents the results of the analysis of the data gathered as responses from the companies during the data collection process in Phase One. This consisted of interviews, the field notes on the tours of the facilities and the information gained from company documents that were available. The researcher studied each company's data separately to identify unique patterns within each company.

7.2 COMPANY ANALYSIS (LEVEL OF COMPLIANCE WITH THE MODEL)

This section presents the results of the analysis of company responses in their respective interviews. The aim was to establish the status of the company relative to the ideal status presented in the New Product Development Practices (NPDP) model fully explained in Chapter 6. These responses were collated after the first round of interviews. The responses of all the companies to each question are found in Appendix 3 and the individual responses in Appendix 4. The responses were all treated equally with a positive response counting 1, and a negative response zero. These responses were put on a spreadsheet (Table 7.3) for interpretation. In the spreadsheet each company's negative responses to the questions in the various categories are indicated. The number of positive responses to the questions as well as the number of positive responses to section 8 indicates the status of the company. The number of positive responses relates to conformance with practices expected by the model.

The reason for treating Section 8 differently to the rest is because it clarifies aspects related to the innovative space of the model discussed in

Chapter 6. The innovative space is the environment that SMEEs should create in order for innovation to take place and therefore crucial to the analysis of the sustainability potential of the companies. In Chapter 6 the innovative space was defined as follows: an innovative space creates an environment where enquiry generates knowledge through collaboration in order to continuously improve products. The origin of an innovative space is the fundamental knowledge in the company and an innovative engine that drives it". It is therefore an environment required for SMEE's to be able to engage in products and processes. The author made the distinction between Section 8 and the other sections in terms of importance and **it being critical to the sustainability potential of the companies**. The author decided that only those companies which had positive responses to all the questions in Section 8 could be considered as category A companies. The other criteria are discussed in section 7.3.

All the questions for the first phase interviews were developed from the model as discussed in Chapters 3 and 6. The numbers in brackets in the model signifies the number of questions that were generated from each component in the model.

New Product Development Practices Model

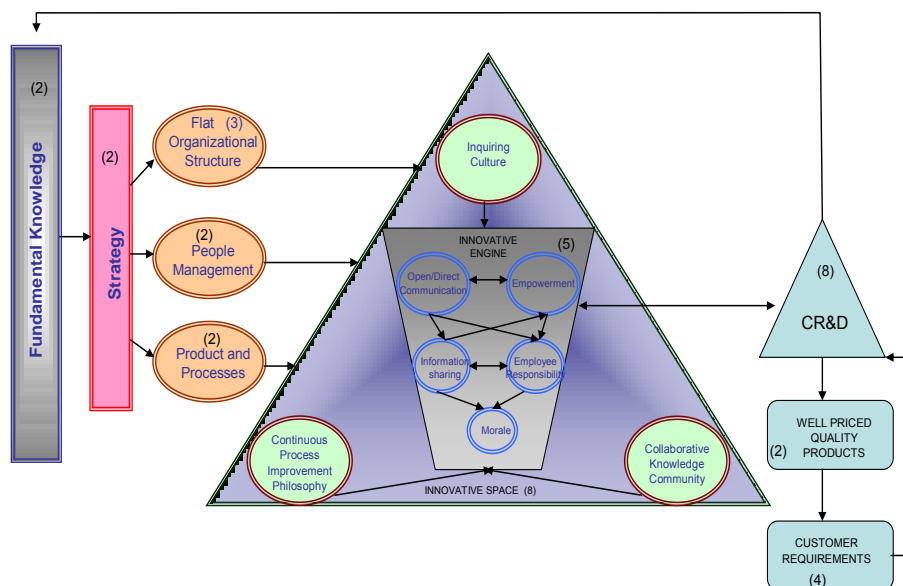


Figure 7.1: NPDP Model (Indicating the Number of Questions)

The components of the model as reflected in table 7.3 are:

FK	-	Fundamental Knowledge
S	-	Strategy
OS	-	Organisational Structure
CR	-	Customer Requirements
CR&D	-	Collaborative Research and Development
IE	-	Innovative Engine
Q	-	Quality
IS	-	Innovative Space
PP	-	Product and Processes
PM	-	People Management

7.3 DEFINITION OF CATEGORIES

The model is utilised to rank the 18 companies into one of 5 categories namely A, B, C, D or E. The criteria for these categories are defined as follows:

Category A

Companies which responded positively to 35 or more of the 38 questions (92% minimum) in the interview as well as responding positively to all the questions relating to the innovative space (8 questions) in section 8.

Category B

Companies which responded positively to 35 or more of the 38 questions (92% minimum) in the interview as well as responding positively to 7 of the 8 questions relating to the innovative space (8 questions) in section 8.

Category C

Companies which responded positively to 31 - 34 of the 38 questions (81% minimum) in the interview as well as responding positively to 6 of the 8 questions relating to the innovative space (8 questions) in section 8.

Category D

Companies which responded positively to more than 27 of the 38 questions (71% minimum) in the interview as well as responding positively to at least 5 of the 8 questions relating to the innovative space (8 questions) in section 8.

Category E

Companies which responded positively to fewer than 27 of the 38 questions (71% minimum) in the interview as well as responding positively to fewer than 5 of the 8 questions relating to the innovative space (8 questions) in section 8.

University of Cape Town

Table 7.1 Company Responses

Components	FK		S		OS			CR				CR&D								IE					Q		IS								PP		PM		Total	
	1	2	1	2	1	2	3	1	2	3	4	1	2	3	4	5	6	7	8	1	2	3	4	5	1	2	1	2	3	4	5	6	7	8	1	2	1	2	Positive Responses	Categories
Company 1																		0																				37	A	
Company 2									0					0												0			0						0	0		32	C	
Company 3			0																																			37	A	
Company 4											0										0											0						35	B	
Company 5			0			0	0					0	0												0	0				0									30	D
Company 6																															0		0			36	B			
Company 7	0												0																						0			35	A	
Company 8													0																									37	A	
Company 9																											0					0						36	C	
Company 10							0					0	0	0						0									0			0			0			29	D	
Company 11									0					0											0													35	A	
Company 12			0	0			0																		0				0									33	C	
Company 13																															0		0			36	B			
Company 14							0													0						0	0	0	0			0						30	E	
Company 15																				0																		37	A	
Company 16													0	0													0	0										34	C	
Company 17			0	0		0	0	0		0	0	0	0	0			0		0	0							0	0	0	0							19	E		
Company 18							0			0															0	0						0					31	C		

7.4 RESULTS

There are eighteen companies that responded to the thirty-eight questions detailed in Appendix 2. None of the companies responded positively to all the questions that were based on the model. From Table 7.1 it is seen that there are 6 companies in category A, 3 in category B, 5 in category C, 2 in category D and 2 in category E. In terms of what is expected by the model, the companies listed should be sustainable or require improvement in certain aspects.

7.4.1 The characteristics of a typical Category A company as expected by the Model

Companies must have a very good strategy and understand the type of workers required to be successful.

“Our strategy is to create wealth for shareholders and partners, have a good time, develop and train staff – especially Previously Disadvantaged Individuals, establish market share for our principles products” (Appendix 3, answer 2.1, Company 2)

They must understand the requirements required to create an innovative space and culture. They have to know how to treat their staff and what is required from their staff in an innovative space.

“The team must be comprised of communicative, flexible, competent, participative, contributive, aware, lateral/free thinking experienced members who are not lone wolves or lose cannons and must not be afraid to make mistakes, change direction, ask advice form outsiders and, above all, be totally committed to the project and the culture of the organization’s systems, code of ethics, code of business conduct and be team-players who have faith & trust in the product and the team”. (Appendix 3, answer 3.2, company 1).

The company also needs to understand the importance of in-house collaboration. Part of their success story is the communication strategy as well as good team dynamics.

“In-house Collaboration, departments, business units, staff and colleagues need to be a team and it is essential that like thinking people work together to achieve the goal. It is extremely important that the in house team is selected from the best lateral thinkers who communicate well before getting involved with outsiders. The culture of in- house collaboration is paramount, as the united in- house team must share ideas, work as a team in problem solving. There is no place for “lone wolves” or lose cannons”. (Appendix 3, answer 5.2, company 12).

Companies must make innovation part of their company culture by allowing workers to contribute towards innovation in a non-threatening environment and rewards should be given for success.

“Develop a culture within an organization that rewards suggestions, allows employees the freedom to experiment and be creative. Acknowledge successes; be supportive of failures or near misses. Teamwork is essential” (Appendix 3, answer 8.1, Company 1).

7.5 COMPANY ANALYSIS

The weakness or non compliance with the model for each individual company is highlighted and discussed briefly. Predictive recommendations for improving the status of the company are presented.

Note: **Text in italics** signifies typical responses from the company in question and the **yellow coloured elements and components** signify where the company’s non-conformances with the model exist.

7.5.1 Company 1 (Category A)

This company’s non-conformance is that they are not clear on the characteristics required for collaborating partners and therefore they were not collaborating as they should. They do however collaborate with their customers and within the company but with nobody else. This is a perceived weakness as they could achieve more by adding to their fundamental

knowledge if they are open to collaboration with others in the sector and with their suppliers.

“No partners, they are not ethical we go it alone. First enter into confidentiality agreements so that you don’t transfer the knowledge to your competitors in order to increase their revenue”.

New Product Development Practices Model

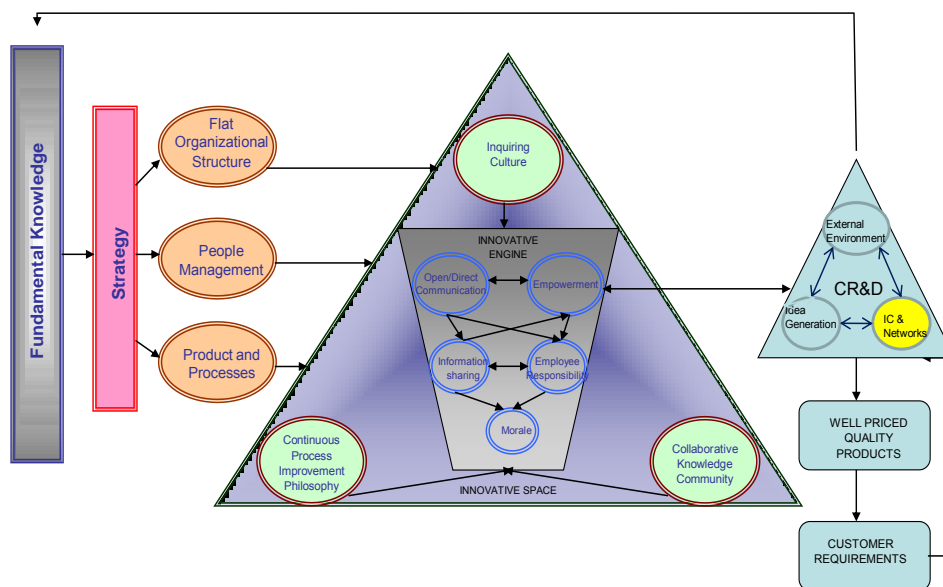


Figure 7.2: Company’s (1) Non Conformance with the NPDP MODEL

The company should change their stance concerning collaboration with other partners. They should identify partners with common interests and sign memoranda of agreement or similar non-disclosure documents.

7.5.2 Company 2 (Category C)

In this company a non-conformance is their failure to recognise the importance that quality has on customer requirements. The company has not fully embraced the notion of open communication. They practise a form of open communication but it is used only so that they can learn from one another not because of the opportunity it gives for innovation or the opportunity it gives for everybody to participate.

The company appears to have no idea of how to create an innovative space and the role that workers play in the development of one. Part of the problem is the proper understanding of an innovative space because they are clear on what kind of people they need, but not the role that people should play in innovation.

“I think that they should play an extremely important part but I am not sure how”

Product development challenges are not something to which they have given much thought. Their only response is that finance is required and that the company should experiment. From the observations it is clear that they do not spend enough time on NPD.

“One should re-invest profits into R&D and experiment”.

New Product Development Practices Model

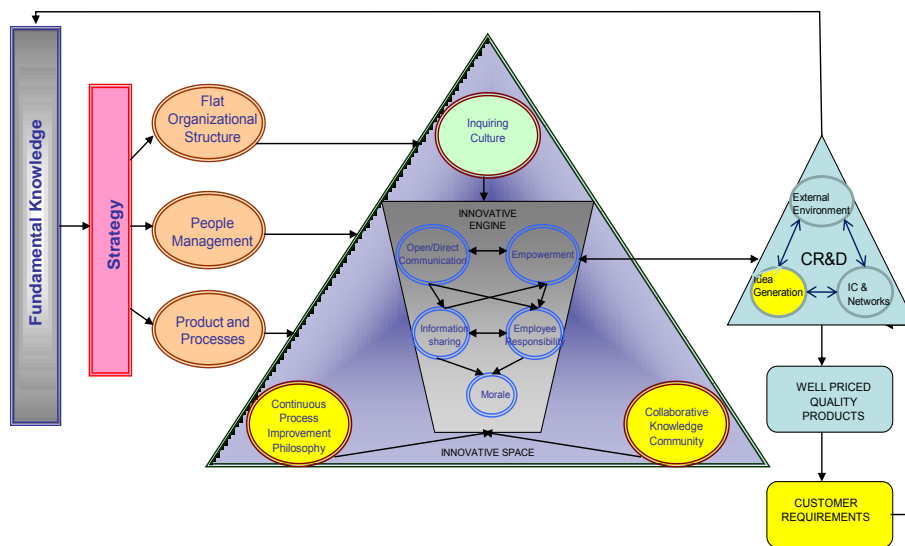


Figure 7.3: Company’s (2) Non Conformance with the NPDP MODEL

This company should be able to improve its performance by organising its R&D and by improving its communication regarding the sharing of innovative ideas. It should consider short dedicated innovation meetings once a week. This will allow workers to expand and test their ideas with others, therefore creating an environment for an innovative space. The company should also understand that although finances are important for product development,

giving people time to be creative is as important. They should allow workers, who have the potential, or display an interest, to get involved with innovation, and should allow dedicated time off to look at new designs and product development.

7.5.3 Company 3 (Category A)

The major non-conformance in company 3 is the fact that their strategy is not aligned to innovation. They know all the components of a strategy but have not formulated their strategy around their innovations. The company feels that innovation strategies are “high-level stuff” and they do not need to formulate one. When asked for the strategic plan their answer was merely. “Plan and action, monitor, measure, review and improve”.

New Product Development Practices Model

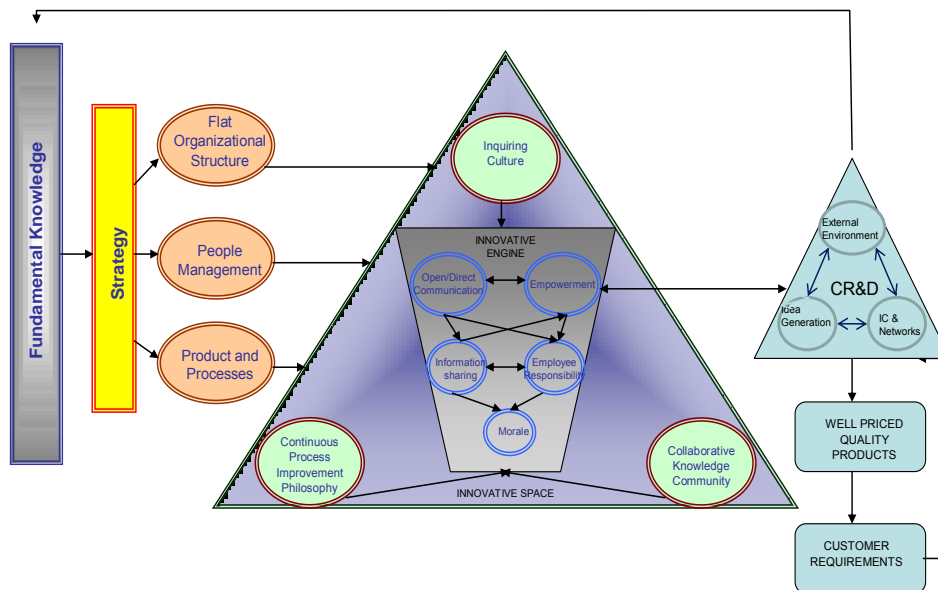


Figure 7.4: Company’s (3) Non Conformance with the NPDP MODEL

This company should call in a consultant in strategy issues in order to formulate a strategy around what they are doing. There is innovation taking place in the company at present but it is not documented as being the core of their strategy.

7.5.4 Company 4 (Category B)

Part of non-conformance to the model by this company is due to not structuring their R&D activities properly.

“I think it leads to a quality expectation based on available facts”

The company has not been able to involve all their workers in the innovation process and have no idea how quality affects an innovative space.

“Quality forms part of product detail and has no significance in the innovative space”

New Product Development Practices Model

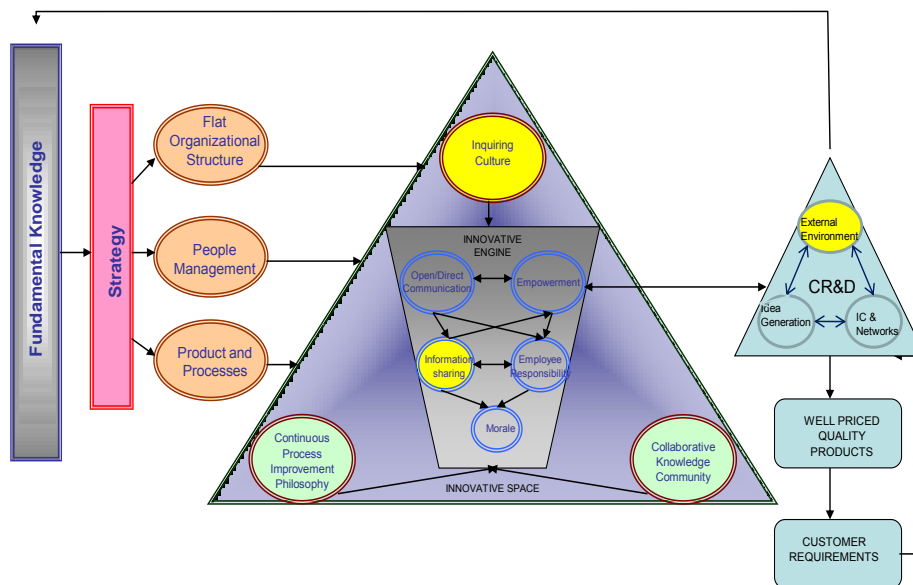


Figure 7.5: Company's (4) Non Conformance with the NPDP MODEL

The company should formulate a structure for their R&D activities in a systematic fashion. It should include the outcomes required from the R&D staff, a list of priority projects which could include return on investment targets. Furthermore the company should implement a continuous improvement philosophy. They will need to hire consultants to take them through the process and in all probability have to give someone in the company the task to oversee the process.

7.5.5 Company 5 (Category D)

The low level of conformance with the NPDP model in this company is largely due to their failure to develop their fundamental knowledge and not creating a culture for employee responsibility. The company has further problems because it does not encourage shared responsibility amongst the workers and this affects the functioning of the innovative engine leaving them with a fragmented organisational structure. They have further problems in that they have not yet realised the importance of collaborating with their customers.

The company does not have a good understanding of R&D, therefore they do not know how R&D could influence a product's quality and how collaborative knowledge could be developed with R&D.

"R&D, it elevates expectations of what must be possible and available" "I think it makes people expect more from a product or service"

The company does not have a formalised quality system. They conduct in-house training as required by the company. They do not have the time and finances to introduce formalised quality systems. This hampers them in that they find it difficult to export their products or to sell to customers who insist on formal quality systems.

New Product Development Practices Model

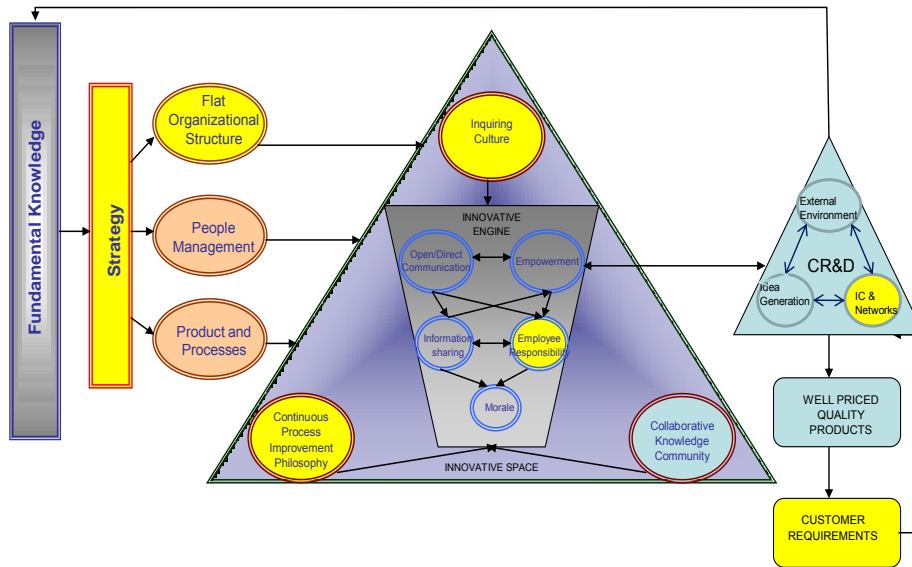


Figure 7.6: Company's (5) Non Conformance with the NPDP MODEL

The company has to put a development programme in place in which their fundamental knowledge will be developed. This programme could include in-house training, seminars, or sending their workers to universities or colleges. Workers on this programme will be obliged to sign contracts so that they are not able to leave the company after their training.

The company must create opportunities for their workers to take responsibility for their work and decisions. These workers should report progress at meetings first thing each morning. These meetings are successful if they are held first thing in the morning and must be short.

The company should appoint a quality controller who will implement a formal quality system at the company. This has to be driven and supported by top management.

7.5.6 Company 6 (Category B)

In this company the only problem areas are that they disagree that quality affects an innovative environment and they do not have any future new products on the drawing board. The reason for this is that most of their products are turnkey products or are designed as part of turnkey products.

“Innovation is not quality conscious, the market is quality conscious” “Our future products are turnkey but we should get a bread and butter line”

New Product Development Practices Model

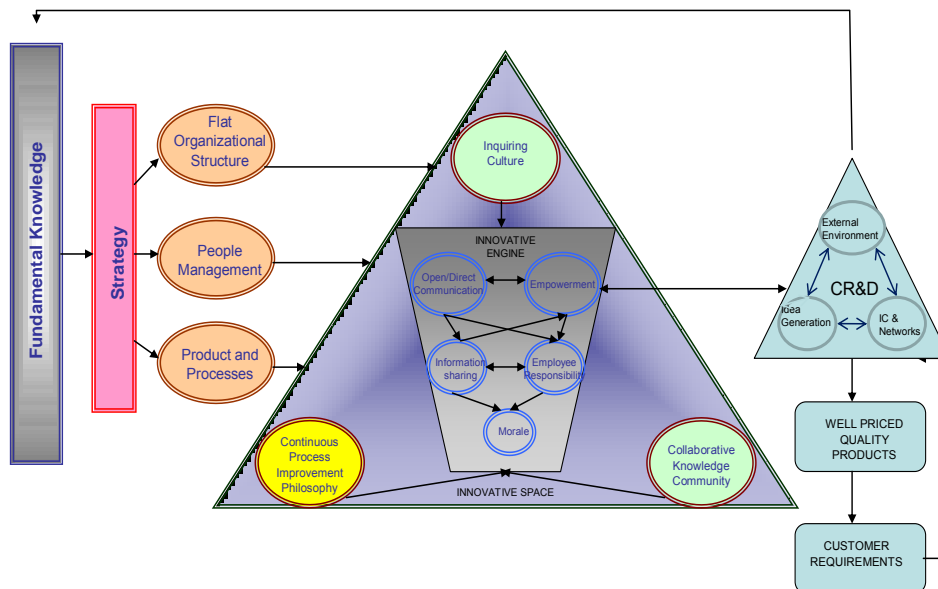


Figure 7.7: Company's (6) Non Conformance with the NPDP MODEL

The company should employ a consultant to assist them to link quality and innovation because they feel that quality issues cloud creativity. The company should also use parallel technology from their existing or previous turnkey products and see how it could be used to develop smaller commercialised products.

7.5.7 Company 7 (Category A)

The two areas of concern are that the company does not actively develop the fundamental knowledge which the company already has and it does not generate collaborative knowledge in their R&D.

“It could be developed through access to the appropriate media” “There is no need to generate collaborative knowledge”

New Product Development Practices Model

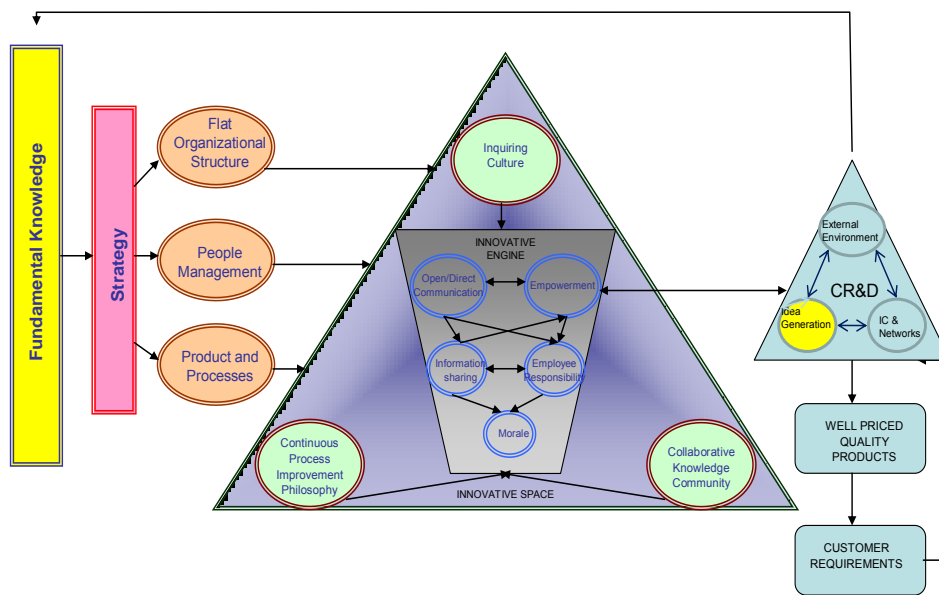


Figure 7.8: Company’s (7) Non Conformance with the NPDP MODEL

The company must involve more people in the knowledge generation process. This could be accomplished by creating incentives for the workers who have ideas that reduce expenditure or decrease the frequency of the maintenance required or improve the aesthetics of a product. The company should include all the workers in dedicated innovation meetings and also involve people from outside the company in these meetings.

7.5.8 Company 8 (Category A)

Like Company 1, the large conformance to the model indicates that this company should be a viable enterprise. The only weakness in the company is its inability to generate collaborative knowledge in its R&D. They work well as a team but have not had the confidence to collaborate with others in their sector.

New Product Development Practices Model

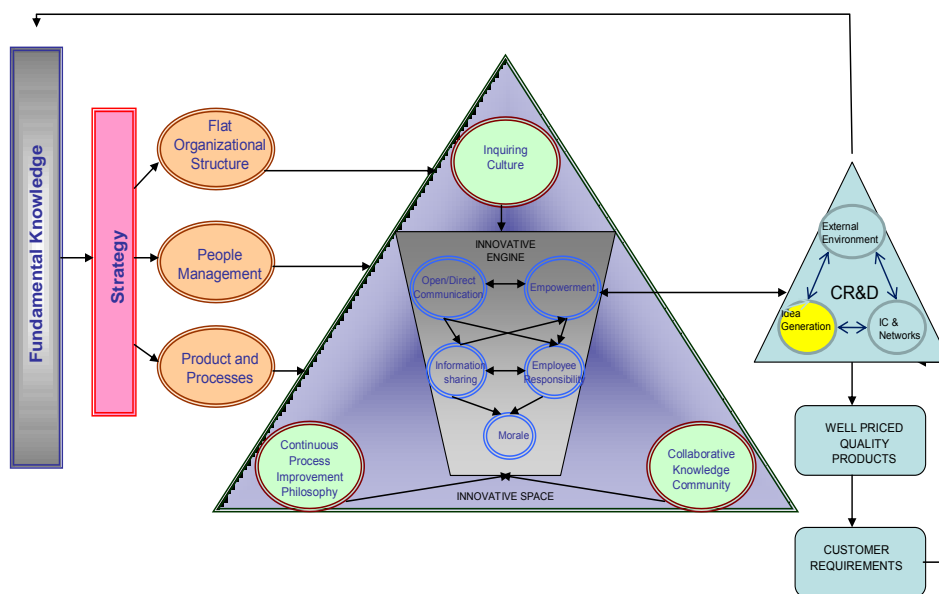


Figure 7.9: Company's (8) Non Conformance with the NPDP MODEL

The company must look at opportunities to collaborate with other players in their sector. The trust factor that concerns them can be overcome by proper non disclosure agreements.

7.5.9 Company 9 (Category C)

This company's problem was that they could not identify the elements required for an innovative space.

"The only element required is implementing something new".

The company is convinced that there is no connection between quality and an innovative space. They believe that quality is about the company's image in industry.

“Our quality has given us a good respectable name in industry”.

New Product Development Practices Model

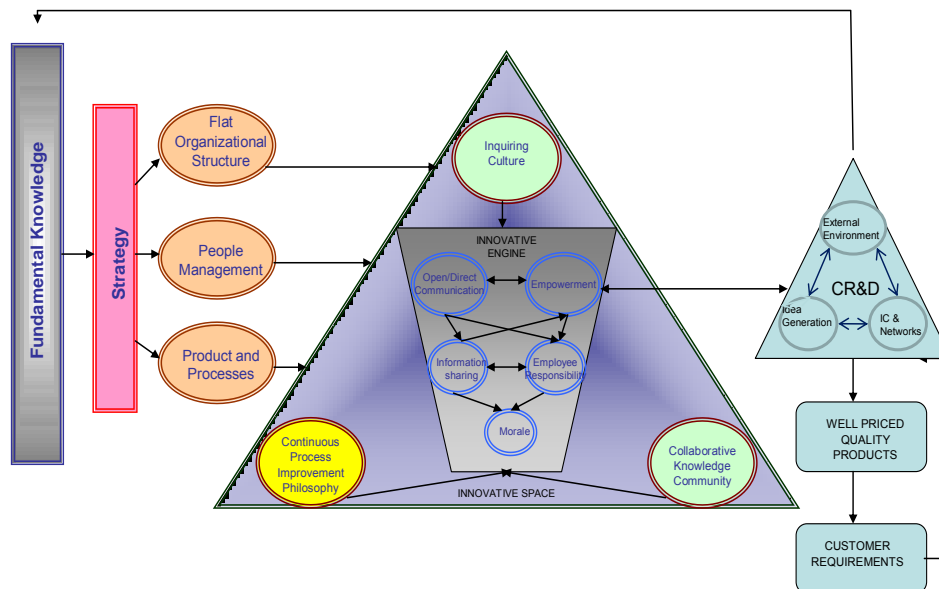


Figure 7.10: Company's (9) Non Conformance with the NPDP MODEL

The company should employ a consultant to assist them with the implementation of a continuous improvement philosophy. This will take time and all workers will need to be motivated to buy into a philosophy that leads to quality. Once this is implemented, all innovation, systems and processes will be quality based.

A similar process should be followed to establish an innovative space. All workers should be taken through a teambuilding process where they are informed of the essential elements required for a successful innovative space. They will need to be taught that the most important element in the innovative space is the workers themselves and that it is their contribution that counts.

7.5.10 Company 10 (Category D)

The non-conformances with the NPDP model in this company consists of not collaborating with its customers and not having workers responsible for their R&D.

“We do not have time for R&D and will not collaborate with our customers”.

The company does not fully agree with the innovative engine concept. They are more comfortable with people concentrating on their own work and minding their own business. Their belief is that employees must only do what they are told to do.

“Collaboration is not part of what we do.”

New Product Development Practices Model

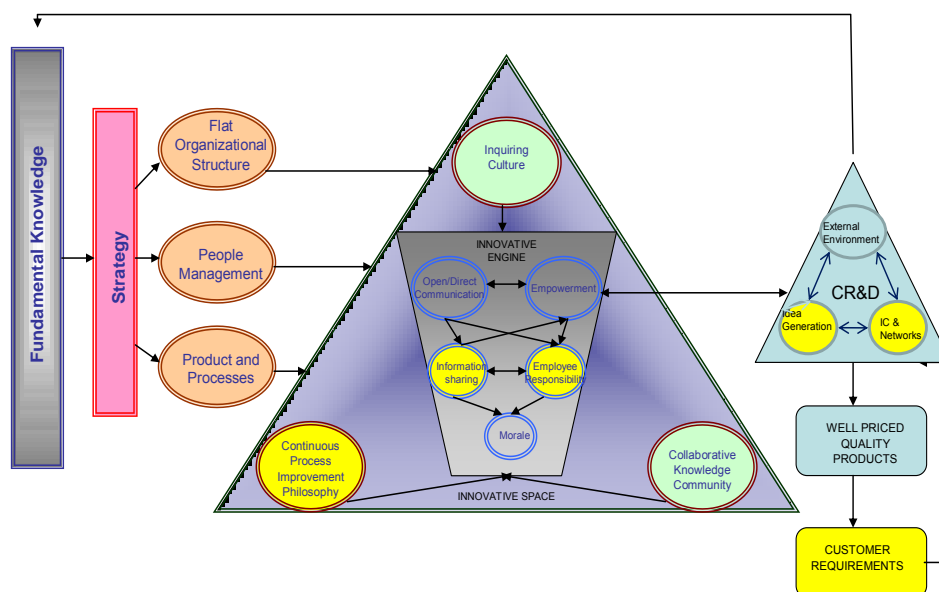


Figure 7.11: Company's (10) Non Conforming with the NPDP MODEL

The company should implement the elements of the innovative engine. This can be done by taking the workers through a process in which they are introduced to the concepts of shared responsibility, information sharing, open communication, the empowerment of people and enthusiasm in the company. Interventions need to be held over a period of time and the company should appoint change agents to oversee the process. It must also

arrange interventions that will create a quality orientated innovative space. It is necessary for the company to ensure that they maintain an acceptable level of performance throughout all their processes and systems. All employees should go through the same intervention to ensure that everyone follows the same system. It is the duty of the owner to initiate such an intervention.

7.5.11 Company 11 (Category A)

Company 11 has a high level of conformance to the model. The company failed to comply with the model in only three of its responses These were:

- how quality affects customer requirements,
- how the company’s R&D influences innovation and
- the characteristics it needs to look for when engaging future R&D partners.

“I would assume the more experienced a company is, the easier it will be to identify the correct characteristics required in R&D partners”.

New Product Development Practices Model

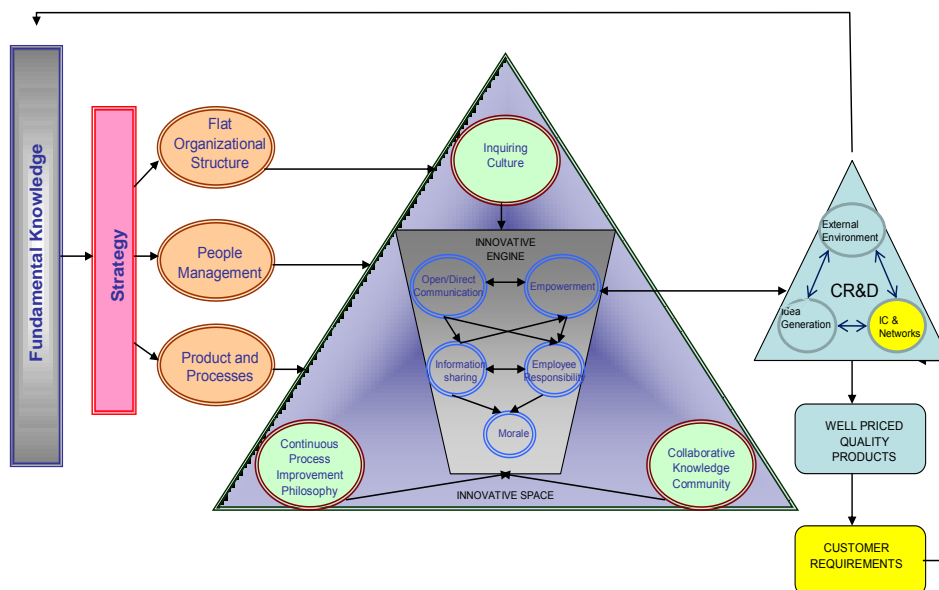


Figure 7.12: Company’s (11) Non Conformance with the NPDP MODEL

The company must conduct a survey with its customers to establish the importance that they attach to quality products. The management of the company needs to organise their R&D activities so that they are able to prioritise their projects and develop a system in which projects and products can be ranked in order of importance and viability. The company should also carefully select their R&D partners in order to ensure that these partners are financially stable, have good infrastructure support, good product knowledge and can be trusted.

7.5.12 Company 12 (Category C)

The company disregards the importance of a good strategy and did not respond to any of the questions in this category during the interview nor the questionnaire. They do not have a company strategy and do not see the need to include innovation. Their responses to the two strategy questions were left blank and, when questioned in the interview, they were adamant that it was not a priority for them at that time. A further obstacle was the inability of the owners to create employee responsibility. Employees had to do what they were told and could not use their own initiative. This caused employees to be de-motivated.

“Although we know that staff play a big role when it comes to innovation because they are the ones actually implementing these products and ideas, and it is up to them to actually prove that the innovation is worth or no. We have the final say and they do not need to know everything”.

New Product Development Practices Model

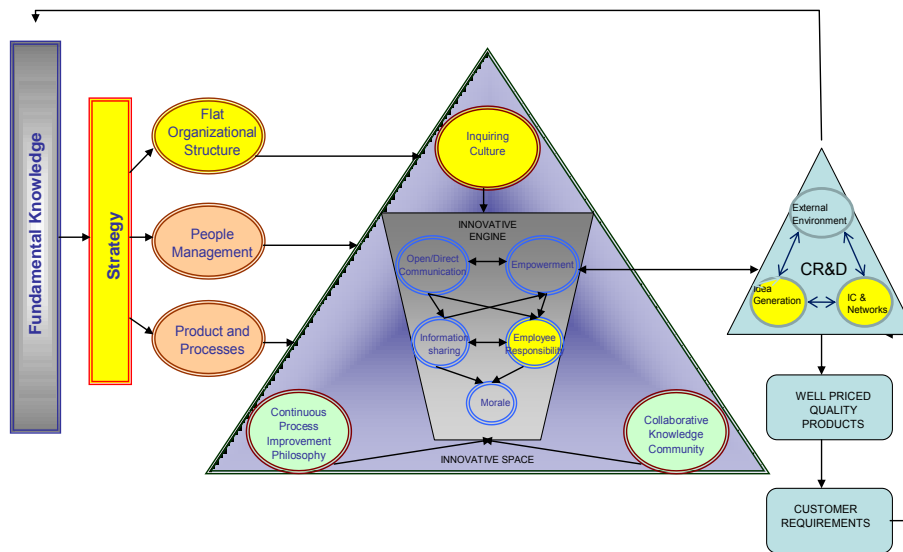


Figure 7.13: Company's (12) Non Conformance with the NPDP MODEL

The owners of the company are only concerned about the profits being made making at the moment and disregard where the company should be heading in the future. This is evident when one looks at the lack of new product ideas. The company must appoint a consultant to develop an innovation strategy for the company. This strategy should include short to medium term objectives covering product development, cash flow and the recruitment of specialist workers in their field. An effective strategy will ensure that the company plan their expenses, purchase strategic equipment, improve their facilities and train their workers.

A consultant should be able to assist them with the implementation of a continuous improvement philosophy. This will take a while and all workers will need to be motivated to buy into the philosophy, thus they will always look at continuously improving the system. Once this is implemented, all innovation will be quality oriented.

Lastly, the owners must learn to share their knowledge with the rest of the staff. They need to empower their workers by giving them responsible tasks, and requiring them to report on a regular basis. A work skills analysis should be done and training be arranged for the identified gaps.

7.5.13 Company 13 (Category B)

The company is in category B which stems from two weaknesses; the absence of quality in their innovation process and the fact that they are very comfortable with their current products and do not have any new ones on the drawing board.

“I think quality and innovation must not be integrated, although it could boost confidence” “We have no idea of our next project or product”

New Product Development Practices Model

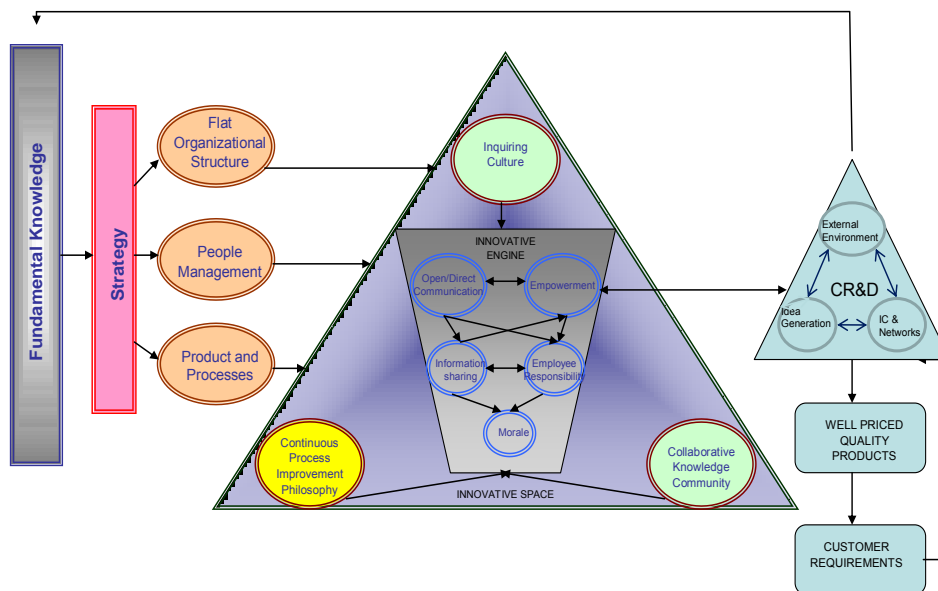


Figure 7.14: Company’s (13) Non Conformance with the NPDP MODEL

The company must find a facilitator to assist them with the implementation of a continuous improvement philosophy. This will take a while and all workers will need to be motivated to buy into the philosophy. They can be motivated by creating incentives for workers who save the company money because of the improvements that they initiate. A person in the company will have to be appointed to oversee the implementation and to make sure that the philosophy is maintained.

They need to look at how they can involve more people in the innovation process. It could be people in the company or from outside the company. This will enhance their products and, by including more people from within the company, they will influence camaraderie. The company also needs to collaborate with their customers. Customers are very good at assisting companies with the quality, price and aesthetics of a product.

7.5.14 Company 14 (Category E)

This organisation differs from a private company because they assist other companies to develop products. They therefore act as consultant R&D specialists for Small and Medium engineering companies. Their weaknesses are in their organisational structure, the interaction of the people in the organisation which is also linked to the organisation not being set up as a business. The workers in this organisation do not collaborate with each other and therefore there is no sense of an innovative space, although they assist many small engineering companies with innovation. The reason for this phenomenon is the fact they have many highly trained specialists working individually and when they require assistance they seek it from external consultants in Germany.

“If you have an R&D facility inside your company, it’s a lot more focused and the possibility of innovation is a lot bigger”.

New Product Development Practices Model

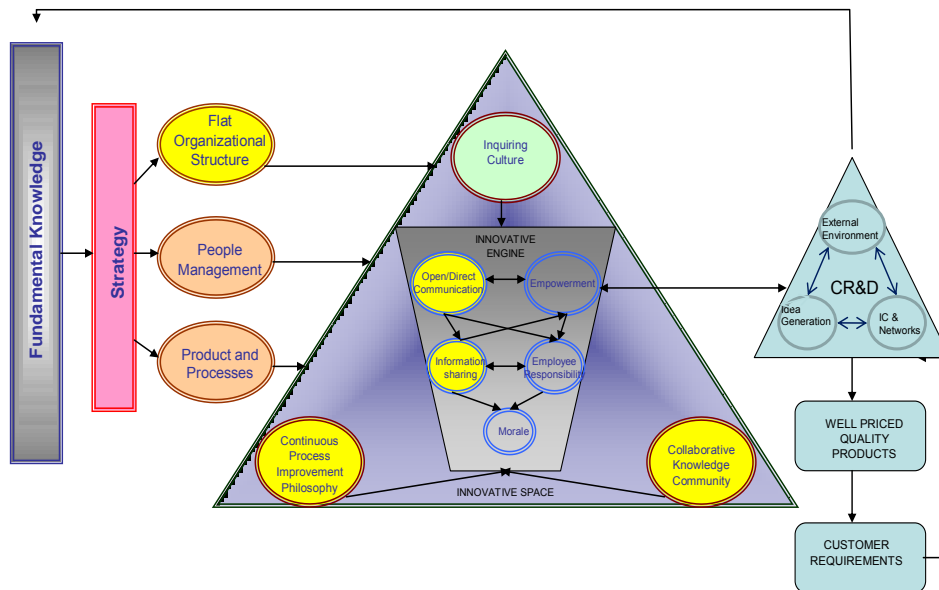


Figure 7.15: Company's (14) Non Conformance with the NPDP MODEL

This organisation can become more effective if it improves its communication and shares information within the company. This will allow them to implement an effective innovative engine. An innovative engine concept can be implemented by taking the organisation through a change of management process. This process should include information sharing in the organisation, the understanding of open and direct communication among colleagues, the implications attached to taking responsibility and the benefits of teamwork.

7.5.15 Company 15 (Category A)

The only weakness this company exhibits is that there are no structured collaboration sessions. The collaboration that takes place in the company happens by accident or on a need to know basis. The workers often do not know what projects are running at the company. They rely on a computer programme to keep them in touch with one another.

“Yes we sort of E-mail each other. You know for continuous improvements we have a system called 8DTops, which maintains the information. It is good but it cannot replace the face-to-face meetings. The major advantage is that

you now have a body of knowledge that you can save away which contains the whole history of that problem from when it first was reported to when it was bedded down. It's a great system".

New Product Development Practices Model

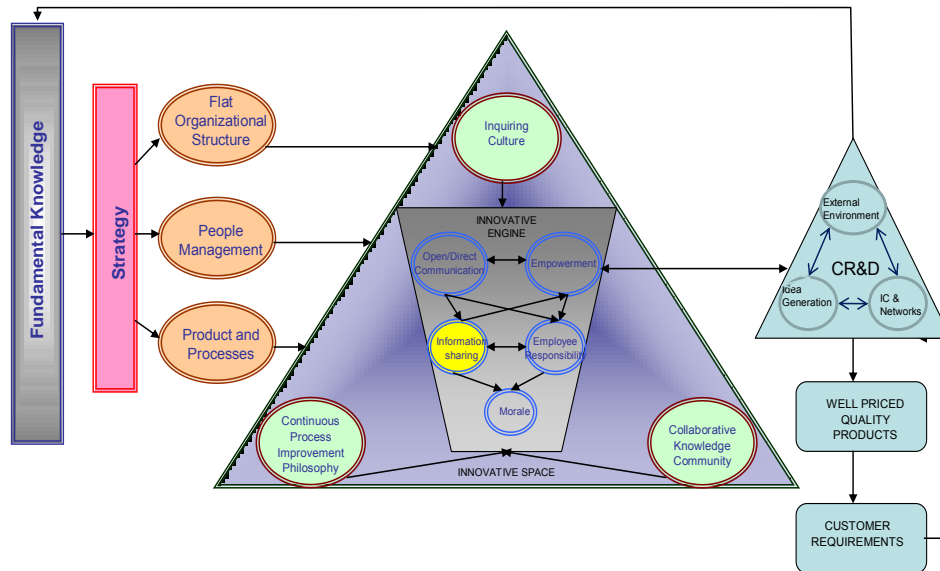


Figure 7.16: Company's (15) Non Conformance with the NPDP MODEL

This weakness is easily overcome by holding dedicated, short innovation meetings each week for all the workers. This can be complemented by introducing a suggestion or innovation box where workers can put their suggestions if they are not confident enough to do so at the meetings. A further enhancement could be to put the company's activities, such as project details, time frames, problem areas and due dates, on a notice board that is visible to all.

7.5.16 Company 16 (Category C)

The company falls short in that they are not collaborating with others in the sector around R&D and therefore are not getting the benefit of other experts in the field. They are reluctant to collaborate with others outside the company because they believe that entrepreneurs must work as individuals. The company has also not prioritised their R&D activities.

“If you’re an entrepreneur and you want to make money, then you’re going to make time for those ideas”.

Most of the innovation in this company is done by the owner and although he is open to ideas he has never used any but his own. The role of the staff in innovation is minimal.

New Product Development Practices Model

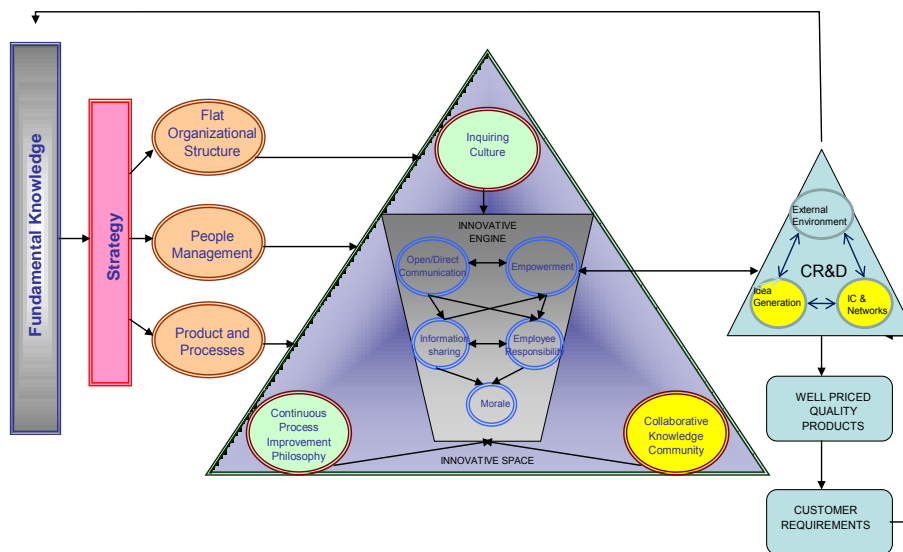


Figure 7.17: Company’s (16) Non Conformance with the NPDP MODEL

The company should invest in a change of management style and implement the innovative engine principles. The principles include information sharing in the organisation, the understanding of open and direct communication, the implications attached to taking on responsibility and the benefits of teamwork. By doing this the organisation will also improve its internal collaboration and sharing of best practices. In the case of this company, it would be advisable to appoint an external facilitator. The owner is not reluctant to collaborate because he does it very successfully with their customers. The problem is that he is not doing the same with the workers in the company.

7.5.17 Company 17 (Category E)

The company is one of two companies' rated in the lowest category. This company should theoretically be struggling to survive and in all probability they need serious intervention. Most of their problems are directly linked to the absence of a strategy for the company. They are solely reliant on external support and are not planning to develop expertise in the company.

“Well, we do not have much other than our entrepreneurial skills. We are going to be trained by the university when we have time”. “Our strategy is to survive, no higher level things now. We have an opportunity to employ unemployed people and so we are only concentrating on our products now and some pay at the end of the month”.

New Product Development Practices Model

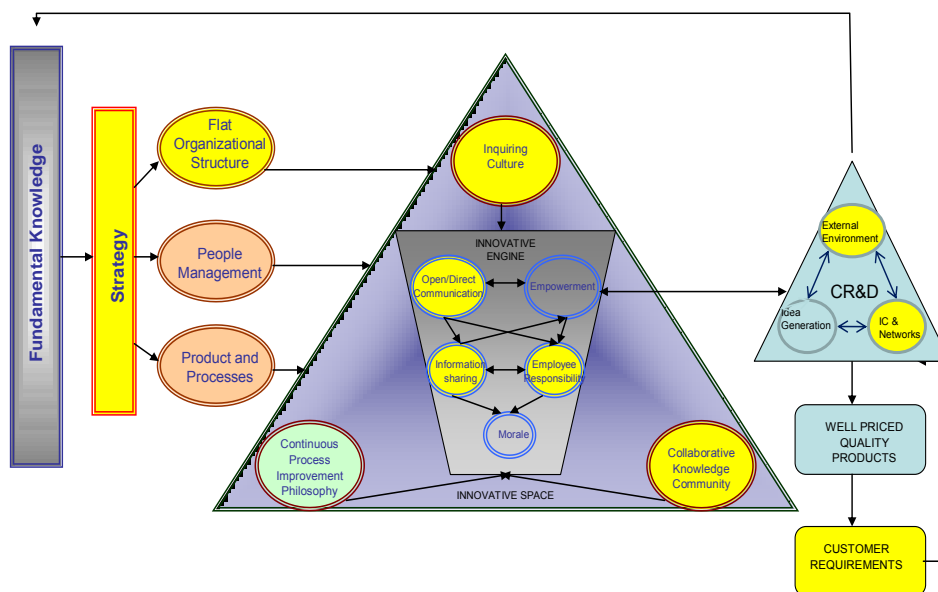


Fig 7.18: Company’s (17) Non Conformance with the NPDP MODEL

This is a company made up of a group of individuals that needs to develop a strategy with some short and medium term objectives. They should seek assistance, possibly from the government, to develop a strategic plan. This plan should include product priorities, cash flow, finding premises, employing a person with administrative and financial expertise, as well as the purchase of strategic equipment. They will have to develop a database of prospective

clients and contact them. The company should apply to become part of State databases so that they can tender for government projects.

They should honour the memorandum of agreement with their funder's regarding the terms and conditions of the seed money given to them, the period of time they will be allowed to use the current premises and an arrangement to use the university as their R&D section.

Most importantly, the company should appoint a leader or manager from their group. Things are not getting done because nobody has taken the leader's role and this has led to much infighting and unpleasantness. Their reliance on cash flow, operational costs, free rental and a small customer base is not healthy.

7.5.18 Company 18 (Category C)

This is a company based in the US where most of their products are developed but not commercialised. They specialise in tendering for government projects and products. All their products belong to the government which in turn liaises with its customers. The company has therefore not invested in marketing and sales personnel to communicate and collaborate with customers.

“No we do not have sufficient capabilities within the company to do that. To come back within a year or two years' time and say, hey we have one or two innovations that are really interesting and that we can take to the next level that really warrants it from a commercial point of view”.

Because of confidentiality clauses in government contracts they have not been able to collaborate with other partners. This takes away their ability to embark on local R&D capability. The company does not have a formalised quality system. They are inspected by the government and have to adhere to its standards.

New Product Development Practices Model

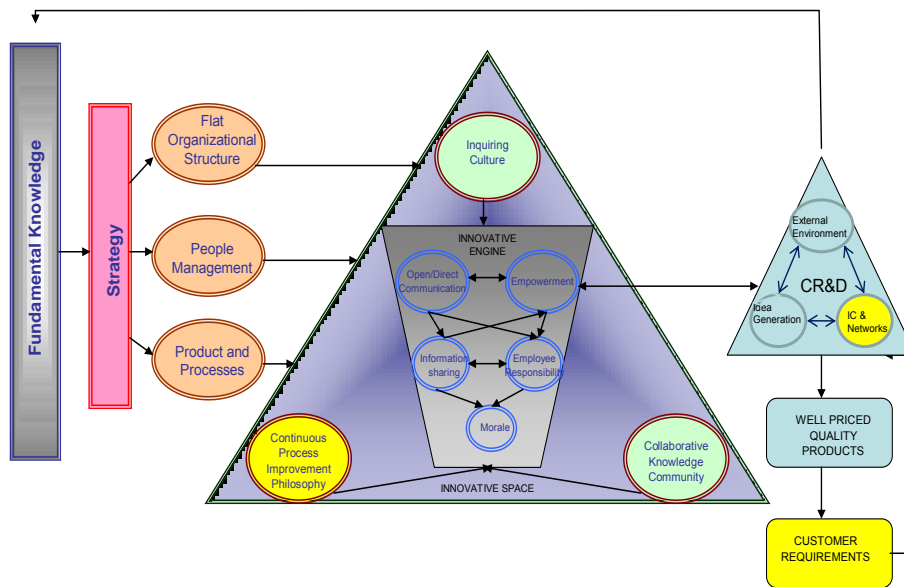


Figure 7.19: Company's (18) Non Conformance with the NPDP MODEL

The company should utilise its existing technologies to develop high end products for other customers other than the government. This can be done by arranging report back sessions after every completed product as well as have weekly dedicated innovation meetings. One or two of the engineers should be tasked to analyse how the technologies could be used to create new or diverse products.

7.6 CONCLUSION

This section has shown results of the analysis of responses to the questions at the first interview aimed at establishing the status of every company relative to the ideal status presented in the model. The responses were all treated equally with a positive response counting **one** and a negative response **zero**. These responses were put into a spreadsheet for interpretation. The number of positive responses to the questions indicates the status of the company. The number of positive responses means conformance with practices expected by the model. Using the model one is able to categorise the 18 companies into one of 5 categories namely A, B, C, D or E depending on their status. The weaknesses or partial non compliance

with the model for each individual company were highlighted and discussed briefly. Predictive recommendations for improving the status of the company were presented, solely for the reader of this document. The companies are unaware of these recommendations.

The following section looks at the growth factors of the companies. This was accomplished through further interviews where pertinent questions were asked, aimed at establishing their status in the market place in terms of growth and sustainability potential.

University of Cape Town

CHAPTER 8

COMPANY ANALYSIS (GROWTH FACTOR)

8.1 INTRODUCTION

The “growth factor” of the companies was determined by their responses to four pertinent questions relating to Turnover, Infrastructure Growth, Product Development and Employee Growth. The responses to the questions were categorised as positive, no change or negative. The responses were weighted as follows, positive 2 points, no change 1 point and negative 0 points. A high points total means conformance to the positives accrued from the answers. A fifth question was posed to establish if there had been any changes in the company since the original interview. In Chapter 9 these responses will be used to follow up on the sustainability potential of the companies with their current health. The questions are found in Table 8.4 and the responses to the questions in Appendix 2.

The answers to the questionnaire were categorised and put into a spreadsheet (Table 8.2) for interpretation. The spreadsheet indicates each company’s responses captured during the second interview that took place following a period of approximately 3 years, and the field notes gained from observations during the second tour. The growth as evidence of predicted sustainability of each company is indicated as a point count in a column on the right hand side of the spreadsheet.

8.1.1 Growth Factor (GF)

The determinants for the “growth factor” of a firm were chosen specifically for Small and Medium Engineering Enterprises who are involved with product and process development. The author chose these determinants because they were judged as being significant indicators re-affirming a firm’s potential for sustainability. All organizations want to grow to maturity and sustain their market status for as long as possible. The issue of growth and sustainability

potential is the reason that organizations continue to spend resources in order to remain in the market and be relevant (Seun, O. 2010).

Organizational growth is the process of moving to maturity giving rise to command of the market. Organizational sustainability is the totality of all activities, ensuring that growth, or an organization's maturity, is retained for as long as possible. In order to achieve this, there is a need for strategies, plans and policies to be put into action, as illustrated below.

Some of the strategies or plans that an organization could use in ensuring growth and sustainability: (Seun, O. 2010)

- **Product development:** Product development could be the end result of thorough research and development exercises on how to make an organization grow. There may be a need to create a new use for an existing product or to add to the product line of the existing product.
- **Market development:** Another means of boosting the growth of an organization is through the development of an existing marketing plan or developing a new one. "Market" here stands for customers, users or buyers of the company's products or services.
- **Best brain approach:** The growth of an organization also depends on its workers or employees, which is the main reason why an organization is ready to pay generously for highly experienced workers and to provide the environment to retain them. An increase in talented, gifted and/or experienced workers could generate ideas that will turn-around the history of an organization. "Any organization with seasoned ideas does enjoy seasoned growth".
- **Partnership:** Partnership could be another way of ensuring growth by way of partnering with a stronger and vibrant organization. It could be forward partnering with wholesalers or distributors of the organisation's products or integration involving the suppliers of raw materials to the organization.

Statistics, Canada's Science, Innovation and Electronic Information Division, undertook a unique assessment of a broad range of growth factors that relate

to Canadian companies. The project was developed out of the need to better understand how and why certain businesses grow.

There have been numerous approaches to studying the determinants that contribute to the growth of companies. Theoretical models as well as empirical research (Niosi, 2000) point at factors such as conducting R&D, engaging in alliances with other businesses, competence in funding, protecting their IP and finding a market niche. These factors all have a bearing on increased turnover, infrastructure growth, growth in employee numbers, product improvement or increased product range. Previous studies have assessed the contribution of various factors to growth without considering the growth stage of the firm (Hanks, 1993), its industry or the important management practices in which they might be engaging. The common theme that emerged from the companies who showed growth in the study was innovation (McMahon 1998):

Almost all the companies were innovative to varying degrees. The companies conducting R&D were clearly doing so to develop technologies that were “new to the world”. A few advised caution that it was better to remain on the “leading edge” as the “bleeding edge” was too risky. Several respondents, in relating their growth stories, mentioned instances in which the future existence of the company was at risk. In one case, a major supplier withdrew the license; in another a major competitor marketed the technology first.

The companies also mentioned some of the barriers to their growth that were the most difficult to overcome (McMahon 1998):

- **Funding:** Obtaining funding was the most commonly cited barrier. Several respondents mentioned difficulties in obtaining venture capital.
- **Increased Turnover for business development:** One former CEO remarked that “The government won’t fund anyone who owns a tie”, implying that funding is available for scientific and technological development not for business. “We need a significant increase in turnover to afford these developments”.
- **Obtaining and increasing appropriate, highly-qualified personnel:** While most businesses had few problems in attracting scientists or

managers, some did cite problems in attracting persons with specific technical skills. There was also a number of companies that indicated they had difficulty locating a marketing person (where marketing was defined as the ability to not only identify and pursue new clients, but also to locate promising companies with whom to partner and integrate their technology). The larger companies interviewed sometimes had concerns over the future availability of sufficient engineering and scientific skills.

- **Market acceptance of new products:** In some cases, products were slow to gain acceptance due to their absolute novelty.

While the generally-accepted growth factors did play an important role in many of the companies that made the transition from small to medium, for many companies, other factors were as important or more important to their transition. The growth factors that have been discussed in this section give an indication why the author chose to use products, employee growth, infrastructure growth and increased turnover as elements of the growth factor in this study.

8.2 GROWTH FACTOR VALUES

The analysis of the questionnaire that reflects the NPDP model has placed the 18 companies into one of 5 categories namely A, B, C, D or E, reflecting their sustainability potential. Evidence or affirmation commensurate of this predicted sustainability may be found in the “growth factor” calculated as follows:

Growth Factor (GF) of 1

Eight is the maximum score because each positive response is weighted 2 points, and would result in a GF of 1.0.

Growth Factor (GF) not less than (0.875)

Companies which have 7 out of 8 points.

Growth Factor (GF) not less than (0.75)

Companies which have 6 out of 8 points.

Growth Factor (GF) not less than (0.625)

Companies which have 5 out of 8 points.

Growth Factor (GF) not less than (0.5)

Companies which have 4 out of 8 points.

Growth Factor (GF) (0.0)

Companies no longer exist

8.3 DATA COLLECTION

The data for the growth factor were collected from questions (Table 8.1) relating to the following four categories :

- Turnover (T)
- Infrastructure Growth (IG)
- Product Development (PD)
- Employee Growth (EG)

The first and the last questions were asked to start the interviewing process as well as to collect information on activities that took place after the previous interview. This was important since it gave the author a sense of any change that may have occurred during this time. It also allowed the author to investigate if there were any deviations from their initial responses. The companies could look at their sustainability potential rating that they earned according to the NPDP model.

Table 8.1 Growth Factor Questions

Growth Areas	Questions	Code
Turnover	Has your turnover increased in the past 3 years?	T
Infrastructure Growth	Has your infrastructure growth increased in the last 3 years	IG
Product Development	Have you developed new or improved products in the last 3 years?	PD
Employee Growth	Have you increased your numbers of employees in the last 3 years?	EG

8.4 RESULTS AND DISCUSSION

The results of the eighteen companies' responses to the questions appear in Table 8.2 below. The answers to the questions in the various categories were classed as positive, no change or negative where the green shading represents "positive", the blue shading represents "no change" and the purple shading represents negative.

Table 8.2: Responses from the 18 Companies

Questions	Growth Areas				Total
	T	IG	PD	EG	GF
Companies					
Company 1					1
Company 2					0.75
Company 3					0.75
Company 4					0.875

Company 5					0
Company 6	0.25	0.25	0.25	0.25	0.75
Company 7	0.125	0.25	0.25	0.25	0.625
Company 8	0.25	0.25	0.25	0.25	0.875
Company 9	0.25	0.25	0.25	0.25	0.625
Company 10	0.25	0.125	0.25	0.25	0.5
Company 11	0.25	0.25	0.25	0.25	0.875
Company 12	0.25	0.25	0.25	0.25	0.625
Company 13	0.25	0.25	0.25	0.25	0.75
Company 14	0.25	0.25	0.25	0.25	0.875
Company 15	0.25	0.25	0.25	0.25	1.0
Company 16	0.25	0.25	0.25	0.25	0.875
Company 17					0
Company 18	0.25	0.25	0.25	0.25	0.75

It is seen in Table 8.2 that there are 7 companies with a GF not less than 0.875, 5 with not less than 0.75, 3 with not less than 0.625, 1 with not less than 0.5, and 2 with 0.0. In terms of what is expected from the growth factor, the companies listed should be sustainable or require improvement in certain aspects.

8.4.1 Company 1

Company 1 scored a GF of 1.0. It showed an increase in all four “growth factor” areas that were assessed. It has extended its premises, purchased the property next to the factory, upgraded its testing equipment to conform to international standards, increased the number of employees both in the factory and in the design office, added two new products to its list and increased its turnover by 23% over the past 3 years.

8.4.2 Company 2

Company 2 scored a GF of not less than 0.75. It has not increased its infrastructure nor employee growth areas. Its turnover has increased and this is mainly due to a new product it developed. The training and upgrading of its staff meant that it was able to get them to multi-task and therefore it was not necessary to employ additional staff.

8.4.3 Company 3

Company 3 scored a GF of not less than 0.75. It has increased its turnover by approximately 4% over the last three years and used some of the funds to purchase machinery and add on a section to its stores area. An increase in employee numbers and an increase or improvement in its product range could improve its GF.

8.4.4 Company 4

Company 4 scored a GF of not less than 0.875. It increased its turnover and spent quite a bit of its extra cash on improved equipment and increasing the infrastructure at the factory. Although it has not increased its overall number of employees significantly, it has recently employed highly qualified employees to fill vacant positions.

8.4.5 Company 5

There was no growth factor in company 5 because the company was liquidated.

8.4.6 Company 6

This company scored a GF of not less than 0.75. Its turnover and infrastructure increased over the last three years. Its turnover grew by 10% in the last three years. This was due to purchasing 2 new CNC milling machines and 1 CNC lathe. The new automated equipment meant that it did not have to employ more people. All workers using the new equipment were sent for specialised training. The company has been able to make significant improvements to the current products because of the new equipment.

8.4.7 Company 7

Company 7 scored a GF of not less than 0.625. Since the original interview it has increased the size of its premises by 150m² and added three products to its range. Turnover dropped by 15% in 2007 and 10% in 2008. This was due to losing a customer who contributed 40% of the turnover.

8.4.8 Company 8

Company 8 scored a GF of not less than 0.875. The company has increased its turnover by 27%, 37.4% and 30.5% in the past 3 years. It has increased the size of its factory and purchased 5 million rand worth of capital equipment. It has added to its product range by using parallel technologies. The new equipment means that it was not necessary to employ more workers.

8.4.9 Company 9

Company 9 scored a GF of not less than 0.625. Since the original interview there has been a 5% increase in turnover. There has been very few product development activities at the company except for minor modifications which occurred only because of products failing and not because of enhancement or own innovative reasons. The company has purchased a small quantity of equipment and tools but has not increased the number of its employees.

8.4.10 Company 10

This company scored a GF of not less than 0.5. It has improved its turnover over the past three years. This was due to the sale of its premises. The value of its infrastructure has therefore decreased since the sale of the premises. The company is now in a rented facility. Its product range has remained the same with few or no modifications. The number of its employees has not increased.

8.4.11 Company 11

The company scored a GF of not less than 0.875. Its turnover has increased by approximately 15% per annum in the past three years. The company has not had major equipment purchases but has re-arranged its factory to improve productivity and therefore had no need to expand the existing facility. Two new products were developed since the original interview. There has been an increase in the number of employees at the company.

8.4.12 Company 12

This company scored a GF of not less than 0.625. Its turnover has increased but its infrastructure, product development and number of employees has remained the same since the original interview. It has made minor

modifications to their existing products but there has been no significant development.

8.4.13 Company 13

This company scored a GF of not less than 0.75. Its infrastructure remained the same and it had an insignificant increase in turnover since the original interview. It increased the number of employees and added two new products to its range.

8.4.14 Company 14

This company scored a GF of not less than 0.875. Its turnover increased significantly and it was able to expand its premises as well as purchase equipment to value of R20m. It has completed 16 new products in the past 3 years without additional employees.

8.4.15 Company 15

This is one of two companies who had a perfect growth factor score. In the past 3 years it has increased its turnover by 15%, purchased new equipment valued at 14 million rand, developed 7 new products and increased its personnel by 8%. It therefore has a category A growth factor rating.

8.4.16 Company 16

This company scored a GF of not less than 0.875. It could not give an accurate breakdown of the increase in turnover over the past 3 years but their current turnover is 23% more than 3 years ago. The company increased its number of employees as well as its product range. Its infrastructure has not increased significantly. It was able to re-arrange its production space and is considering the acquisition of additional space in the near future.

8.4.17 Company 17

Company 17 has a 0% growth factor. It has been liquidated.

8.4.18 Company 18

This company scored a GF of not less than 0.75. The company's turnover has increased by 18% over the past three years. There was no infrastructure growth but it has developed 4 new products since the last interview. There was no employee growth in the past three years.

8.5 CONCLUSION

This chapter showed the results of the analysis of responses to the questions at the second interview aimed at possibly validating the status of every company relative to a "growth factor". The sustainability potential responses were all treated equally with an increase in the activity counting 2, no change in the activity counting 1 and a decrease in activity 0. These responses were put onto a spreadsheet for interpretation. The number of increased activity points indicates the growth factor, therefore validating the sustainability status of the company. The growth or lack thereof for each individual company was highlighted and discussed briefly.

The following chapter will conclude this thesis by presenting the results from the attempt to test the scope of the model. This will be done by comparing the companies' compliance (and therefore sustainability potential) with the model, to their status in the market place in terms of growth.

CHAPTER 9

VALIDATION OF THE MODEL

9.1 INTRODUCTION

This chapter concludes the dissertation by presenting the current “health” of the 18 individual companies obtained through the analysis of the “growth factor questionnaire”. The GF is also used here to affirm, or otherwise, each firm’s “predicted potential of sustainability” that was evaluated at the time of the initial data collection (interviews, questionnaires and observations). The “health” is explained in terms of the path that a company may have taken subsequent to the original classification of its sustainability. For example, did it accidentally or by pure chance of events adopt “corrective” steps for an indicated deficiency or concern, defined in the thesis as “non-conformance” with the model? Has this action resulted in notable growth or not and was it commensurate? Each company had the opportunity to attain a GF of 1.0 during the three years after the first interview and will be discussed in terms of its deficit after the second interview.

Table 9.1: Prediction of Sustainability Potential and Growth Factor

COMPANY	MODEL STATUS	GROWTH FACTOR	DEFICIT OF EXPECTED GROWTH
Company 1	A	(1.0)	0.0%
Company 2	C	(0.75)	25%
Company 3	A	(0.75)	25%
Company 4	B	(0.875)	12.5%
Company 5	D	(0.00)	100%
Company 6	B	(0.75)	25%
Company 7	A	(0.625)	37.5%
Company 8	A	(0.875)	12.5%
Company 9	C	(0.625)	37.5%
Company 10	D	(0.5)	50%
Company 11	A	(0.875)	12.5%

Company 12	C	(0.625)	37.5%
Company 13	B	(0.75)	25%
Company 14	E	(0.875)	12.5%
Company 15	A	(1.0)	0.0%
Company 16	C	(0.875)	12.5%
Company 17	E	(0.00)	100%
Company 18	C	(0.75)	25%

9.2 COMPANY ANALYSIS

9.2.1 Company 1 (Category A)

Company one's 0% deficit is in line with the evidence of its compliance to the model after the first interview. This company indicated a (1.0) GF and this could be due to an increase in its conformance to the NPDP model. The company has increased its conformance with the NPDP model by starting to collaborate with other companies in its sector around R&D and the importing of bulk materials. The company has signed agreements with companies and this has added enormous value to its R&D activities. One of the successes was the opportunity to purchase and import bulk materials together with its partners. It has extended its premises, purchased the property next to the factory, upgraded its testing equipment to conform to international standards, and increased its employee numbers both in the factory and in the design office, added two new products to its list and increased its turnover by 23% over the past 3 years.

9.2.2 Company 2 (Category C)

This company has a deficit of 25% from the minimum possible and should attempt to improve this to 0%. Reasons for the indication of a (0.75) GF could be as a result of the following:

- it developed a new product.
- it implemented a training programme and the upgrading of its staff meant that it was able to get them to multi task and therefore no additional staff required.

9.2.3 Company 3 (Category A)

Company 3 has a 25% deficit. This is surprising since the expectation after the first interview was that the deficit should be 0%. The GF could improve since the company has new management and has changed a lot of the original owner's ideas. It is in the process of creating a new strategy. Although the turnover has increased the owner realises that the company is not functioning to its full capabilities. The owner has requested the author to assist with the implementation of the model at the company.

9.2.4 Company 4 (Category B)

Company 4 has a deficit of 12.5% but in spite of this, a (0.875) GF should have a positive impact on its sustainability status. This company improved its operations by:

- using its increased profits on superior equipment as well as increasing its infrastructure at the factory
- employing highly qualified employees in specialist positions

9.2.5 Company 5 (Category D)

The company has a deficit of 100% because it was liquidated.

9.2.6 Company 6 (Category B)

It is recommended that Company 6 decreases the deficit to 0%. Their deficit (25%) could be as a result of failing to increase the number of employees in

the firm. It's indicated (0.75) GF could be because of increased orders. The company has just implemented a quality system and this is why it has experienced an increase in orders. In the past it lost customers because it could not offer a quality certificate. When this happens it will probably increase its sustainability potential status. The company purchased new automated equipment which meant that it did not have to employ more people in the short term.

9.2.7 Company 7 (Category A)

Company 7's deficit of 37.5% is very high for a company that showed a high compliance to the model after the first interview. One of the reasons for the deficit could be is the loss of a customer who contributed 40% of its turnover. The company's turnover decreased by 10% in 2007 and 15% in 2008. It had become too dependent on existing products and made very little progress with new or modified products. The owner still does not include his workers in an idea or knowledge generation process. After the decline, the company has started the process of developing its workers and was forced to improve its customer relations, as well as use current technology to produce alternate products. They have an impressive new range of products.

9.2.8 Company 8 (Category A)

This company was expected to have a 0% deficit because of the evidence produced at its first interview. The deficit of 12.5% could be as a result of no increase in employee numbers at the firm. The (0.875) GF could be linked to an increase in turnover even though the company has not employed extra staff. The company has also used parallel technologies to increase their product range.

9.2.9 Company 9 (Category C)

Company 9 is not displaying the “health” required from a company and its 37.5% deficit proves this. Its low category C sustainability potential status as per its compliance to the NPDP model, determined at the previous visit, could be the reason for its deficit. This is worrying since a category C company with no growth is vulnerable. It seems as if it is content to struggle.

9.2.10 Company 10 (Category D)

This company is struggling to make ends meet and this is could be the reason for the 50% deficit. Its improved cash flow over the past three years was due to the sale of its premises. The company now rents a facility. Its problems started when the shareholders could not agree on a strategy for the company. The differences and infighting amongst them resulted in a lack of focus and therefore the disagreement about strategy. This situation goes against the practices of the model especially with regard to the innovative engine.

9.2.11 Company 11 (Category A)

Company 11 has a 12.5% deficit. The deficit should be rectified when it expands its infrastructure. The company is consistent and continues to embark on creative enterprises which could be related to its (0.875) GF. It increased productivity by simply re-arranging the factory and therefore did not need to expand their existing facility.

9.2.12 Company 12 (Category C)

Company 12 has a 37.5% deficit and is struggling to make ends meet. Its sustainability potential status, category C, as determined at the first visit had placed it in a vulnerable position and it will have to reconsider the way things

are done. It has not used its increased income to expand the infrastructure or product development activities. It therefore seems the company requires major intervention.

9.2.13 Company 13 (Category B)

Company 13 has a 25% deficit. This deficit should improve once it has invested money in a quality system. Most customers require quality certificates with products.

9.2.14 Company 14 (Category E)

A deficit of 12.5% for company 14 is an indication that it has improved considerably since the first interview. The deficit could be made zero when the company hires more workers. The indication of a (0.875) GF must have improved this company's sustainability status. The GF could be attributed to the fact that a change in strategy yielded 16 new products in the past 3 years without requiring additional employees.

9.2.15 Company 15 (Category A)

This is one of two companies which had a perfect GF score. The performance of the company is consistent with its compliance with the model. Their GF score could be connected to the introduction of a fifteen minute innovation meeting every Friday. This not only created a pool of new ideas it also pulled them together as a team. The success is evident in that over the last 3 years they have increased their turnover by 15%, purchased new equipment valued at 14 million rand, developed 7 new products and increased their personnel by 8%. The company has not abandoned the 8D Tops programme and now communicates the outcomes of their Friday meetings and any other information via 8DTops.

9.2.16 Company 16 (Category C)

Company 16 has a 12.5% deficit which could be eradicated if it improves its infrastructure significantly. This company has done exceptionally well to achieve a (0.875) GF, which, in all probability, has increased their sustainability potential. The main reason for this GF is the fact that it has developed cell groups in which workers are forced to collaborate with one another. These cell groups have also been given the opportunity to interact with the design department. This was lacking in the first interview.

9.2.17 Company 17 (Category E)

The company has a deficit of 100% because it has been liquidated. It is one of the companies that had the least compliance with the model in chapter 7.

9.2.18 Company 18 (Category C)

This company has a 25% deficit. The deficit could be improved if they introduce significant infrastructure improvements and a growth in employee numbers. The indication of a (0.75) GF must have improved this company's sustainability status. This GF could possibly be linked to the quality system they have implemented.

9.3 FINDINGS

Companies 5 and 17 were closed down. The common areas of non-conformance to the model by these two companies were the absence of a strategy, a poor organisational structure, no employee responsibility, the lack of networking, a disregard for customer requirements and the absence of an inquiring culture.

Companies 9, 10, and 12 are in the danger zone. There are no common areas of non-conformance to the model for these three companies. They

varied from the absence of a strategy, a poor organisational structure, no employee responsibility, the lack of networking, a disregard for customer requirements, no quality systems and the absence of an inquiring culture.

Companies 3 and 7's deficit was very high when compared to their status after the first interview. There are different reasons for this. Company 3 has a strategy but it is not linked to innovation. Company 7 depended too much on the entrepreneur and customers for its fundamental knowledge. The entrepreneur also failed to involve the workers in the knowledge generation process.

Companies 8 and 11 had minimal deficits of 12.5% and should be able to eradicate these deficits with very few changes to their organisations. Company 8 needs to increase its number of employees and company 11 needs to improve its infrastructure.

Companies 14 and 16 showed credible GF's of 0.875 even though they were classified as category C and E companies after the first interview. Company 14, a previously classified E company did better than 2 previously classified A companies and performed the same as 2 other previously classified A companies. The primary reason for this GF could be linked to the change in strategy which increased the number of products that they manufacture presently.

The companies that continue to do well are those that were compliant and those that have implemented practices similar to those found in the model.

9.4 SNAP SHOT MECHANISM

The author, in paragraph 7.2, suggested that the innovative space is a key area required for SMEEs to be able to engage in products and processes and made the distinction between section 8 and the other sections in terms of importance and **it being critical to the sustainability potential of the companies.**

Although the NPDP model has proven to be a reliable tool to measure the potential for sustainability, as well as a tool to develop SMEEs, it is a lengthy procedure to follow in assessing a company. The author therefore proposes a “Snap Shot” mechanism which can be used as the initial assessment of an SMEE. The “Snap Shot” mechanism uses the eight questions of section 8 of the questionnaire in Appendix 2. The questions are listed below. The biggest advantage of the “Snap Shot” mechanism is that, with minimum “training”, SMEE owners or senior managers could become competent to use the mechanism, which could very well form part of an annual company evaluation.

Table 9.2: Snap Shot Questions

8. Innovative Climate	
8.1	How does one create an innovative climate?
8.2	What are the elements of an innovative climate?
8.3	How does innovation take place in your company?
8.4	What is the role of your staff in innovation?
8.5	How does strategy influence an innovative climate?
8.6	What kind of people do you need to create an innovative climate?
8.7	Why do you think that innovations are not often optimised?
8.8	How does quality affect an innovative climate?

The following section describes the manner by which the author established the status in terms of sustainability or adherence to the NPDP model for each of the 18 companies using the “Snap Shot” mechanism. The “sustainability potential” of the companies is now determined by their responses to 8 pertinent questions relating to the innovative space. The responses are all treated equally with a positive response counting 1 and a negative response zero. The scoring for this mechanism is found in table 9.3.

Table 9.3: Snap Shot Scoring Mechanism

SCORE	CATEGORY	REMARK
8	A	Very Good
7	B	Good
6	C	Satisfactory
5	D	Improvement Required
Below 5	E	High Risk

The outcome of the “Snap Shot” mechanism on the original 18 companies is shown in Table 9.4.

Table 9.4: Outcome of Snap Shot Mechanism

COMPANY	MODEL STATUS	“SNAP SHOT” STATUS
Company 1	A	A
Company 2	C	C
Company 3	A	A
Company 4	B	B
Company 5	D	B
Company 6	B	B
Company 7	A	A
Company 8	A	A
Company 9	C	C
Company 10	D	C
Company 11	A	A
Company 12	C	B
Company 13	B	B
Company 14	E	E
Company 15	A	A
Company 16	C	C
Company 17	E	D
Company 18	C	B

The “Snap Shot” mechanism showed minor discrepancies with four companies. Two of the companies performed better than the result given by the “Snap Shot” mechanism whilst the other two performed worst. One of the companies had a GF of 0.75. The others had a good correlation with the final outcome of the companies. The author therefore proposes that the “Snap Shot” approach could assist in an initial assessment of SMEs.

9.5 CONCLUSION

In conclusion, it may be stated that the NPDP model has proven to be a fairly accurate tool for predicting a company’s sustainability potential. The model suggested here would be a useful mechanism for institutions that have a need to evaluate SME’s.

The author recommends that banks could use this tool to assess whether a company will be sustainable before they offer to assist them with funds. The model could also be used by government in order to make decisions around seed funding and subsidies.

A further recommendation is that the model can be used as a tool for companies that would like to merge or takeover other companies. Most importantly, the tool can be used by the management of an SME to assess the health of their own company and thus make improvements where necessary.

On the basis of the results obtained from the latest questionnaire, in Chapter 8, involving growth parameters, the validity of the model has been established. The model transforms itself into a working tool analysing and predicting a company’s sustainability potential. Companies may avail themselves the opportunity to implement aspects of the model where they show non-conformance.

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APPENDICES

Appendix I: Initial Questionnaire to Select SMEEs (Pilot Study of 6 SMEEs)

1. Organisational structure

- ✓ Indicate the hierarchy of people and departments in your company
- ✓ What is the number of workforce?
- ✓ Describe the different departments
- ✓ What is the number of employees in each department?

2. Products

- ✓ What kind of product(s) are you in?
- ✓ Can you discern any product lines?
- ✓ How many different types and ranges are in your products?
- ✓ Name the most important products or services you provide

3. External environment

- ✓ Can you give an impression of the market size? (In revenues or volumes)
- ✓ What is your estimated market share?
- ✓ Who are your customers?
- ✓ How many different big customers do you have and where are they geographically located?
- ✓ Who are your main competitors and where are they geographically located?
- ✓ Who dominates the market?
- ✓ Who are your suppliers and where are they geographically located?
- ✓ Is there any government legislation that prevents you from doing things you want?

4. Personnel

- ✓ What are working times?
- ✓ What are the required levels of education for the workforce?
- ✓ What are the required skills for the workforce?
- ✓ Are you doing on-the-job training?

- ✓ Does personnel have anything to say about choice of products or processes
- ✓ Do you have any personnel problems?
- ✓ How often do you have meeting with personnel?

5. Process

- ✓ Give a short description of your production process. (batch, bulk, continuous etc.)
- ✓ What equipment do you use?
- ✓ How many machine types do have of each?
- ✓ What is the influence of your customers and suppliers on the design of products or processes

6. Strategy

- ✓ Describe your grand strategy
- ✓ What are short-term goals (-2 years)
- ✓ What are long-term goals (2-5 years)
- ✓ Describe your mission
- ✓ Describe your vision as an entrepreneur

7. R&D strategy

- ✓ Are you doing any process or product innovations?
- ✓ Do your do research and development in order to get new products or new ways of manufacturing products?
- ✓ Is there an overall plan for development and innovation?
- ✓ How many new products or processes have you launched over the last couple of years?
- ✓ How did the market receive these new products?
- ✓ What is the role of staff in innovation?
- ✓ Is informed about new innovation ideas and actions?
- ✓ What factors are driving new product development in your company?
- ✓ Expanding existing product offerings
- ✓ Costs
- ✓ New product entries by competitors
- ✓ Personal vision

- ✓ New technology and equipment
- ✓ Distribution changes
- ✓ Is new knowledge primarily used for opening up new products or changing existing products?

8. R&D activities

- ✓ Are there individuals concerned with R&D activities?
- ✓ Describe the kind of R&D you do (radical, incremental or fundamental)
- ✓ Why do you think your R&D activities are (not) optimised?
- ✓ High investments/costs
- ✓ Government regulations
- ✓ Lack of external knowledge
- ✓ Fear of change
- ✓ Lack of managerial skills
- ✓ How do you come aware of ideas for new product or process innovations?
- ✓ Literature; books and industry, trade magazines and other publicly accessible written information
- ✓ Trade shows
- ✓ Conferences, seminars; relevant to industry's products, processes and trends
- ✓ Supplier's sales people; representatives or potential representatives
- ✓ Supplier's literature; documentation from suppliers or potential suppliers (incl. Web sites)
- ✓ Customers; Representative or potential customers
- ✓ Customer's literature: documentation from customer or potential customers (incl. Web sites)
- ✓ Other external sources; paid or unpaid consultants or outside contractors
- ✓ Catalogues, directories
- ✓ Industry Web sites
- ✓ Purchase and analysis of competitor's products
- ✓ Formal market research: questionnaires and focus groups
- ✓ Technical staff; engineers and scientist who are not assigned directly to the project considered
- ✓ Company research; another previously held research

- ✓ Personal experience; previously used ideas of the engineer that are 100% tacit knowledge.
- ✓ Do you have easy access to the sources you use?

9. Collaboration

- ✓ Are you involved in any form of collaboration with:
 - ✓ Suppliers, customers, distributors
 - ✓ Competitors
 - ✓ Non-competing companies operating in another business
 - ✓ Knowledge institutions like Technikons or Universities
- ✓ Are you collaboration with any party on R&D and why (not)?
- ✓ Who, do you think would be a best partner, for you to collaborate with on R&D and why?
 - ✓ Competitor(s)
 - ✓ Supplier(s)
 - ✓ Customer(s)
 - ✓ Non-competing companies in other businesses
 - ✓ Knowledge institutions
- ✓ What characteristics should this/these partner(s) have, relevant to R&D?
 - ✓ Financial resources
 - ✓ Capital resources (e.g. equipment, machines, factories)
 - ✓ Marketing skills
 - ✓ Incremental Knowledge skills
 - ✓ Fundamental knowledge skills
 - ✓ Radical knowledge skills
- ✓ And what can you, in your turn, offer this/these partner(s)
 - ✓ Financial resources
 - ✓ Capital resources (e.g. equipment, machines, factories)
 - ✓ Marketing skills
 - ✓ Incremental Knowledge skills
 - ✓ Fundamental knowledge skills
 - ✓ Radical knowledge skills

Appendix 2: Interview Questionnaire Protocol

A semi-structured interviews follow a loose format has been utilised in this questionnaire. Depending on the participants' answers and the company's situation, more time was spent on certain aspects of the questionnaire.

The purpose of the interview is to

The questionnaire concerns the following key aspects that link to the new product development practices (NPDP) model was developed in this research:

- Fundamental knowledge
- Strategy
- Organisational structure
- Customer requirements
- R&D activities
- Innovative engine
- Quality
- Innovative climate
- Products
- People Management

Thank you for your participation, your response is highly appreciated. For further information, please contact Mr. K Jacobs at +27 21 9596666 or send an email to jacobsk@cput.ac.za.

Questions

Questions	
1.	Fundamental Knowledge
1.1	How does fundamental knowledge affect innovation?
1.2	How is fundamental knowledge developed in your company?
2.	Strategy
2.1	Describe your company's NPD strategy?
2.2	How does strategy affect innovation?
3.	Organisational structure
3.1	What organizational structure is needed for a company to be innovative?
3.2	What kind of staff is required for innovation to take place?
3.3	How does an organisational structure and strategy influence new product development?
4.	Customer Requirements & External Environment
4.1	Are you collaborating with your customers?
4.2	What factors are driving meeting customer requirements in your company?
4.3	How does quality affect meeting customer requirements?
4.4	How does communication affect collaborating with customers
5.	R&D activities
5.1	How important is quality in your R&D activities?
5.2	How does your company generate collaborative knowledge in R&D?
5.3	How does R&D influence strategy?
5.4	What are the most important factors for successful R&D?
5.5	Where do you get ideas for new product or production process innovations?
5.6	What is required for effective collaboration?
5.7	Who do you think would be a best partner for you to collaborate with on R&D projects and why?
5.8	What characteristics should this/these partner(s) has, relevant to

R&D?	
6.	Innovative engine
6.1	How does communication influence your company?
6.2	How does collaboration take place in your company?
6.3	How does the innovative engine affect innovation?
6.4	How does information sharing affect new products?
6.5	How does shared responsibility influence the innovative engine?
7.	Quality
7.1	What quality systems does your company have in place?
7.2	How does quality affect innovation and NPD?
8.	Innovative Climate
8.1	How does one create an innovative climate?
8.2	What are the elements of an innovative climate?
8.3	How does innovation take place in your company?
8.4	What is the role of your staff in innovation?
8.5	How does strategy influence an innovative climate?
8.6	What kind of people do you need to create an innovative climate?
8.7	Why do you think that innovations are not often optimised?
8.8	How does quality affect an innovative climate?
9.	Products
9.1	What product(s) do you manufacture?
9.2	What product(s) do you intend producing in the future?
10.	People Management
10.1	What People Management is required to manufacture innovative products?
10.2	What are the biggest People Management challenges with NPD?